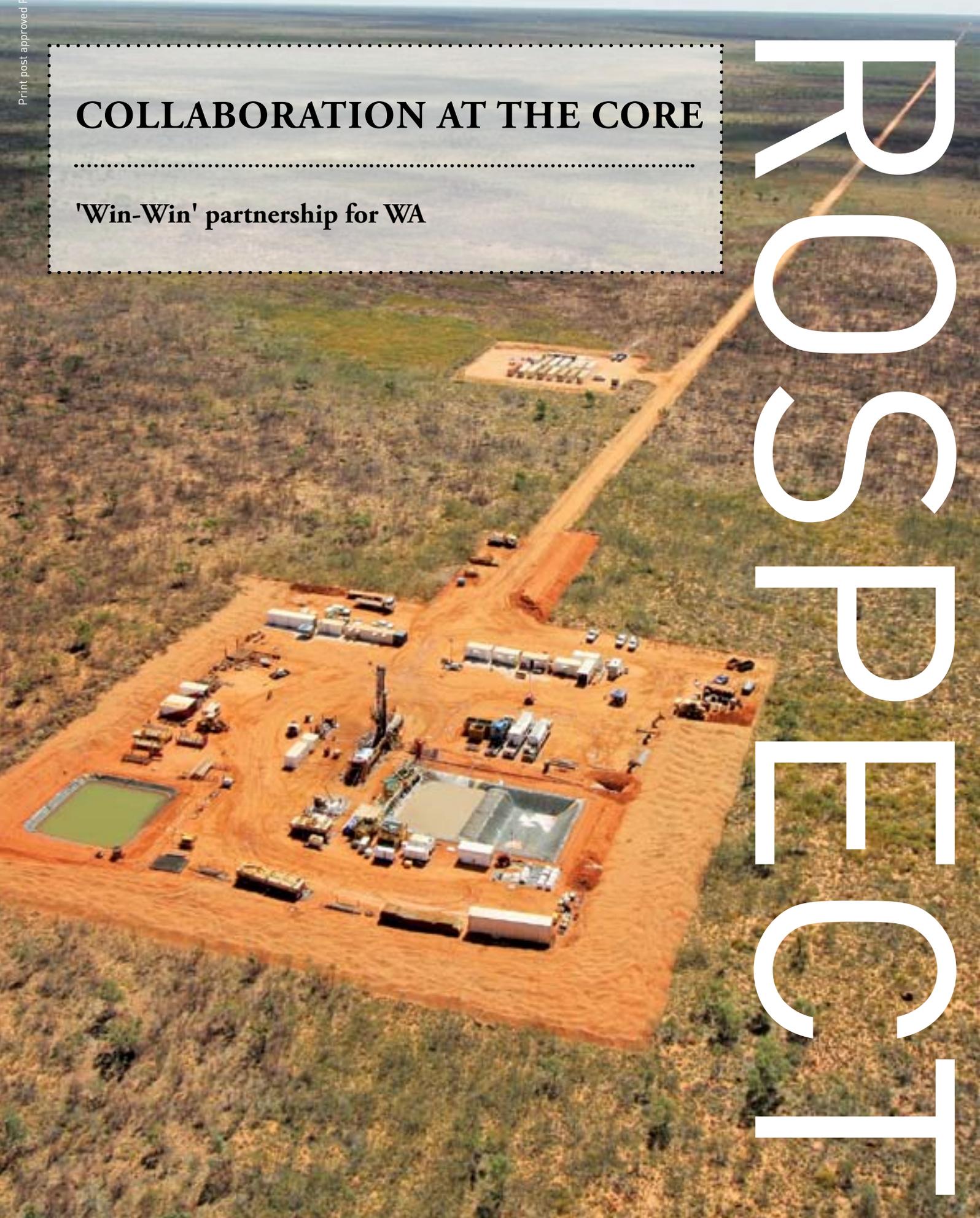


PROSPECT

COLLABORATION AT THE CORE

'Win-Win' partnership for WA





Western Australia's history of responsible resources development was again on show at the 13th annual Africa Down Under resources conference last month.

The conference, hosted by the Departments of State Development and Mines and Petroleum, provided an opportunity to share in resources and agriculture knowledge between Western Australia and visiting African ministers and senior delegates (story page 13).

The State accounts for two-thirds of Australian mining companies operating in Africa, with more than 429 projects in 30 African countries.

The African market offers new trade prospects for Western Australia, and with our reputation for responsible, sustainable resources development, the State is well placed to assist African countries to develop transparent, stable and mutually beneficial regulations for their resources sector.

Partnering with industry has proved highly successful for WA resources projects, with Department of Mines and Petroleum geologists recently collaborating in a 'win-win' project with a WA-based petroleum exploration company that has set a precedent for future partnerships between government and industry (story page 8).

Western Australia benefits from a number of regional partnerships, and in this edition of Prospect, the State's 'Sister-State' relationships with key trading partners Japan, Indonesia and China are explored (page 14).

The State is also gearing up to host the liquefied natural gas (LNG) industry's biggest global event – LNG 18 – in April next year.

Set to attract around 5000 industry experts from 60 countries, Western Australia will be front and centre on the world stage in celebration of our position as a leader in the industry (story page 4).

In fact, Perth is the only city to host the triennial event more than once.

The State's well established, sophisticated resources industry and strategic partnerships with key trading partners have seen us weather recently challenging economic conditions and continue to place Western Australia as a power-house State nationally and on the world stage.

Colin Barnett

PREMIER OF WESTERN AUSTRALIA & MINISTER FOR STATE DEVELOPMENT

Bill Marmion

MINISTER FOR MINES AND PETROLEUM

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Cover photo: The Theia-1 exploration well targeting shale in Western Australia's Canning Basin.
Photo: Finder Shale Pty Ltd. Story page 8.

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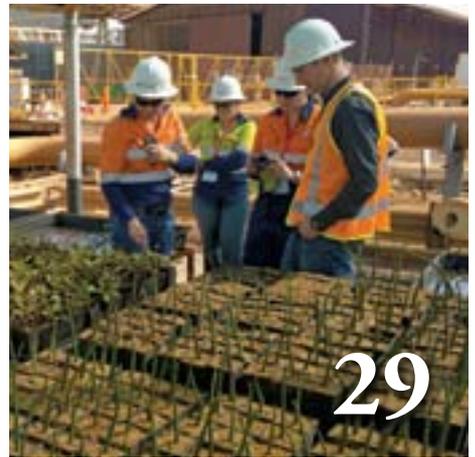
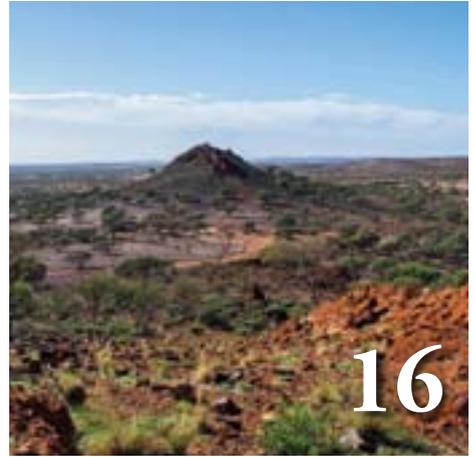
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In this issue



05 Gas grads praise program

Western Australia passes on LNG industry know-how through training partnership with China.

08 Winning partnerships

WA geologists and private industry rewarded through successful collaboration.

16 Golden days

Gold deposit discovery backed by seismic surveys confirming “trapped continent” theory.

19 Rock stars

New technique pioneered in Western Australia accurately dates minerals and aids exploration in the Gascoyne region.

23 Lithium testing success

Processing trial produces high purity lithium carbonate, demonstrating potential to fill supply gap for battery-grade lithium carbonate.

29 Golden Gecko Awards

Western Australian resources companies go for gold in environmental excellence.



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L–R: Masashi Shiraish; Japan Australia (MIMI); Claire Fitzpatrick, BP Developments Australia; Mines and Petroleum Minister Bill Marmion; Federal Industry and Science Minister Ian Macfarlane; Robert Edwardes, Woodside; Steve Phimister, Shell Australia; and Matlaizhen, PetroChina International Investment Australia at the apportionment signing. Photo: Woodside.

BROWSE DEVELOPMENT MARKS SERIES OF MILESTONES

The proposed Browse floating liquefied natural gas (FLNG) development marked a series of milestones over a two-month period earlier this year, the culmination of extensive cooperation between the proponents and the Western Australian and Commonwealth Governments.

On 23 June 2015, the State Government announced it had signed a Key Principles Agreement with the Browse Joint Venture (BJV) for the provision of domestic gas and to anchor a supply chain in Western Australia for the development.

Under the Agreement, the BJV committed to reserve gas equivalent to 15 per cent of production from the State's share of the Torosa field, one of three gas fields (Brecknock, Calliance and Torosa) that make up the project. This is expected to be around 60 terajoules per day, or 800 petajoules over the life of the project.

The BJV has also committed to the development of an integrated supply chain in WA to provide port, marine, aviation, storage and transport services over the life of the Browse development, which is located off the Kimberley coast.

Premier and State Development Minister Colin Barnett said news that the project was progressing well was excellent for the resources sector in Western Australia and for WA as a whole.

"While the State Government would still prefer this project to be developed onshore, this agreement ensures that the project will deliver benefits to the State in terms of domestic gas and opportunities for local businesses and workers," the Premier said.

The agreement helped to provide sufficient certainty for the BJV to enter the front-end engineering and design (FEED) phase of

TOROSA CLOSER

A deed of agreement has been executed that sets out the proportion of petroleum in the Torosa petroleum pool which straddles Commonwealth and Western Australian retention lease areas.

Torosa is the biggest of three fields being developed as part of the Browse floating

"The economic benefits of the proposed Browse project to WA and Australia are enormous and we are committed to seeing our offshore petroleum resources developed."

liquefied natural gas (FLNG) project in the north of Western Australia.

Under the agreement, Western Australia's share of Torosa will be 65.4 per cent while the Federal Government will hold a 34.6 per cent interest.

The deed of agreement, executed on 22 July by Western Australian Mines and Petroleum Minister Bill Marmion and then Federal Industry and Science Minister Ian Macfarlane, was also signed by senior representatives of the Browse Joint Venture.

Mr Marmion and Mr Macfarlane have both praised the close collaboration between parties.

"Minister Macfarlane, the Browse Joint Venture partners and I have been able to achieve an outcome that provides

certainty for the Joint Venture to move into the front-end engineering and design phase," Mr Marmion said.

"Our efforts maintain security of tenure for the titleholders and ensure a fair return to the WA economy if and when the proposed Browse project proceeds.

"The economic benefits of the proposed Browse project to WA and Australia are enormous and we are committed to seeing our offshore petroleum resources developed."

The deed of agreement allocates the proportion of gas and condensate in Commonwealth retention lease WA-30-R and State retention leases TR/5 and R2 and will continue to apply if production licences are granted over these areas. ■

the project, which was announced on 1 July by Woodside Chief Executive Peter Coleman.

"We are excited to be moving into the next phase of the Browse FLNG Development," Mr Coleman said.

"In particular, we acknowledge the support of key government stakeholders and especially commend the current and previous Ministers responsible for resources for their consistent, clear and long-term approach to oil and gas development."

Mr Barnett welcomed the announcement as a positive step in the development of the project.

The Agreement also cleared the way for the renewal of the retention leases covering the Browse FLNG development gas fields. On 7 July, the State and Commonwealth Governments jointly announced the renewal of a total of seven retention leases, providing further certainty to the BJV.

Mines and Petroleum Minister Bill Marmion said: "WA is committed to working closely with the Commonwealth to ensure the timely and efficient development of this resource which will deliver enduring benefits for all Western Australians."

On 22 July, the State, Commonwealth and BJV participants signed an agreement over the apportionment of the Torosa petroleum pool, following a change to maritime boundaries.

The agreement confirms Western Australia holds a 65 per cent share in Torosa, with State royalties from the Browse project estimated at more than A\$1 billion over the lifetime of the project.

Finally, on 17 August the Australian Department of Environment announced that the development had been granted Commonwealth environmental approval under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*, marking another significant milestone. ■

What happens next?

- The State Government and Browse Joint Venture will develop a State Development Agreement, based on the Key Principles Agreement.
- Further work is being undertaken during the FEED phase to determine details related to the commercialisation, timing and sequencing of FLNG deployment including costs and technical definition.
- Woodside Petroleum is targeting a final investment decision in the second half of 2016.



SPECTACULAR WORLD OF GAS COMING TO WA

Forget LOL, there's three other letters currently making a bigger impact globally – LNG.

Liquefied natural gas (LNG) is big news around the world and Australia, particularly Western Australia, is at the centre: developing the fastest growing LNG projects in the world and on track to become the largest LNG exporter worldwide by 2018.

Globally, LNG trade in 2014 was around 240 million tonnes per annum (mtpa), with Asia accounting for 75 per cent of global LNG imports.

With its abundance of gas reserves and ideal location, major resource companies have invested heavily in Western Australia to increase production of LNG for Asian markets.

There are currently two operating LNG export projects in Western Australia, the North West Shelf and Pluto, providing a total capacity of 20.6 mtpa.

Three Western Australian LNG projects are currently under construction: Gorgon, Wheatstone and Prelude.

By the end of 2017, the State will have five operating LNG export projects with a total capacity of 48.7 mtpa.

The value of Western Australia's LNG sales last year was A\$15.6 billion.

LNG is making a big impact worldwide. New and existing markets, especially in Asia, are increasingly turning to LNG to meet their growing energy needs.

As the centre of the world's developing LNG story, Western Australia will play

host in April 2016 to the world's largest global LNG event – LNG 18.

LNG 18 is set to reveal the next chapter in the booming world of LNG.

The event will feature LNG industry leaders from around the world as guest speakers, including the chief executive officers of Petronas, ExxonMobil, INPEX, ConocoPhillips, Chevron, RasGas, TOTAL, Woodside, Shell and others.

Western Australian Premier and State Development Minister Colin Barnett will speak at the opening ceremony and, for the first time, the CEOs of Shell, Chevron and Woodside will jointly open the conference program, which is focussed on the theme, "Redrawing the Global Map of Gas".

The event exhibition will showcase more than 250 key players of the LNG industry from over 60 countries.

It will be the largest dedicated LNG gathering in the world with companies ranging from major global producers through engineering, procurement, construction services, to specialist suppliers showcasing the newest technical solutions in the industry.

LNG 18 Executive Director Barbara Jinks said the event was shaping up to be "spectacular".

"The sharing of ideas and information on latest developments, along with opportunities to speak with key players of the industry, offers delegates the chance to enhance their understanding

of the booming LNG industry and expand their network," Ms Jinks said.

"The program will be spectacular."

The program commences with technical tours, including a Woodside Karratha tour of the North West Shelf and Pluto LNG plants; a Chevron Wheatstone site tour and Gorgon Project fly-over; and other facility and laboratory tours, as well as Perth city tours.

The conference plenary session topics include:

- the globalisation of gas
- the changing LNG supply and demand landscape
- technical solutions for challenging projects
- shipping and bunkering
- project development, capital formation and finance
- Australian industry trends and opportunities
- markets and trends
- environment and safety
- technical innovation for the future of LNG
- floating LNG
- the expansion of Asia Pacific markets and new growth
- Australia – the "new LNG powerhouse".

Pre-conference tours, networking events, evening social functions and post-conference tours will also be available.

Registrations for LNG 18 are currently open with early bird registration available until 4 November 2015. ■

2015 LNG FUND EXECUTIVE GAS TRAINING PROGRAM

The first cohort of 2015 Executive Gas Training Program participants recently celebrated their graduation – and a second group of students has commenced their studies, aiming to complete the program in October.

The program was established as part of the Australia-China Natural Gas Technology Partnership Fund, which has been running since 2002 as part of a historic agreement for Western Australia to supply gas to China for 25 years.

The Executive Gas Training Program offers senior managers and officers from major Chinese oil and gas companies, and from the Chinese Government, the opportunity to study in Australia to further their knowledge of the liquefied natural gas (LNG) industry.

There are two groups each year, with students pursuing a three-month 'MBA style' short course in Australia in conjunction with the University of Western Australia and the Australian Institute of Management, Western Australia.

Graduates have overwhelmingly praised the program, which has seen many participants go on to further their careers in the sector.

"We all have a sense of accomplishment and self-improvement after three months of training in Perth," course participants summarised in their student newsletter.

"The LNG industry is still in the early stages in China, but it is already very mature in Australia, so it's a very important opportunity for every student to be trained in Australia.

"This training program has been the start of a deeper understanding of the LNG industry and has provided us with the skills to learn more and progress in the field."

Teaching staff and course presenters are senior industry experts, including experienced professors, government representatives and company leaders.

Students study a varied curriculum relevant to the natural gas sector, including legal risk management, procurement contracts, market analysis, economic model analysis, project planning and network communication.

Their studies culminate in a final group presentation, for which students undertake extensive research. This year's recent graduates presented on issues currently pertinent to the LNG sector, including: "An examination of the likely impact on the LNG industry of the current drop in oil price"; "The creation of an Asia-Pacific natural gas trading market"; and "A detailed review of the current status of natural gas globally".

Part of the course structure sees students undertake site visits, both in Perth and regionally. The recent graduates' site visits included the

Economic Regulation Authority and the North West Shelf project liquefaction plant in Karratha.

"Whether in the industrial zone of Karratha liquefied natural gas (LNG) plant, or in the salt pool or mining area... it has been an impressive experience to be in Perth for three months," students reported.

"It was the first time for most of us to come to Australia. We were full of anticipation and eagerness to start the training. We also looked forward to seeing the clay brown rock, blue sky and blue sea in Western Australia.

"When we return to our positions in gas receiving stations, shipyards, or power plants, we will use the knowledge we learnt on the program and work harder.

"We will strive to apply what we have learned to our work and to the development of the LNG industry. We will also make our contribution to the friendship and trading relationship between China and Australia."

To date, 297 participants have graduated from the program, with 17 in the current participant group.

For more information on the training program or the Australia-China Natural Gas Technology Partnership Fund, of which the Department of State Development is one of three funders, visit forum.gasfund.com.au/site/index.html ■

2015 Executive Gas Training Program – part of the Australia-China Natural Gas Technology Partnership Fund – participants on tour in Karratha.



Onslow Airport



Premier and State Development Minister Colin Barnett opened the redeveloped Onslow Airport in August. Photo: Shire of Ashburton.

ONSLOW TAKES FLIGHT

The town of Onslow, located between Exmouth and Karratha on Western Australia's Pilbara coast, has recently undergone a series of transformations and now boasts even better connections to the world by air.

In 2008, the Western Australian Government resolved that a new hydrocarbon processing precinct should be developed to derive maximum benefit from substantial gas discoveries off the Pilbara coast near Onslow.

The Ashburton North Strategic Industrial Area, located 12 kilometres south-west of Onslow, is a multi-use precinct with scope for a major gas processing proponent as well as secondary processing sites, areas for general support industries and supply base operations, a port with common user facilities and common user access and infrastructure corridors.

The two major gas projects in the area are the Chevron-led Wheatstone liquefied natural gas project, which is more than 65 per cent complete, and BHP Billiton's Macedon domestic gas project, which became operational in September 2013.

The development of the region's gas industry has brought more people and industry to Onslow, along with government and industry commitments for the town's development.

In August, Premier and State Development Minister Colin Barnett opened the redeveloped Onslow Airport, which now offers regular passenger services.

"This A\$49 million project was an immense undertaking for the Shire of Ashburton, and its completion is a significant breakthrough for Onslow residents who have, until recently, had to drive three hours to Karratha to access air travel," Mr Barnett said.

"The airport is now a state-of-the-art facility with a new terminal equipped with security screening, a runway capable of landing large jets, and community access to direct flights to Perth."

The project received A\$30 million in funding from the Chevron-operated Wheatstone project.

The State Government and Chevron provided an additional A\$13 million from the Onslow Community Development Fund to be used to complete the airport project. The rest of the project was funded through the Shire of Ashburton.

The fund was established in 2011 through Wheatstone's State Development Agreement, with A\$10 million through the State Government's Royalties for Regions program and A\$5 million from Chevron.

"This investment recognises that a high-quality airport is important both for the Wheatstone project and for the overall

amenity of a remote town like Onslow," the Premier said.

The airport redevelopment project included a new 1900-metre runway to support larger commercial aircraft, as well as a new terminal building and associated facilities to accommodate passenger and charter travel.

Regional Development Minister Terry Redman said the new facility was an important part of Onslow's economic infrastructure, and its completion opened up new opportunities for tourism and business in and around Onslow, as well as boosting recreational opportunities for the local community.

The Chevron-operated Wheatstone project has committed more than A\$250 million to social and critical infrastructure projects in Onslow including health, recreation and utilities. The Western Australian Government has also committed about A\$70 million.

"Together, the Wheatstone Joint Venture and the State Government are making an unprecedented investment in Onslow, funding new critical and social infrastructure, and ensuring the town can meet the challenges of population growth," Mr Barnett said.

The Department of State Development is the lead agency for the Ashburton North project. For more information, visit www.dsd.wa.gov.au ■

INDUSTRY FIRST TO INCREASE OIL AND GAS TRAINEES

The Australian petroleum industry's first collaborative training partnership between Woodside and Chevron Australia has been established by the Chamber of Commerce and Industry of Western Australia (CCI).

Under the agreement, Chevron's operator trainees work at the North West Shelf Project's Karratha Gas Plant.

The North West Shelf Project is operated by Woodside and Chevron Australia holds a one-sixth interest.

CCI Chief Executive Officer Deidre Willmott said the agreement between the two companies would help address the increasing demand for highly trained liquefied natural gas (LNG) plant operators.

"Under the innovative agreement, CCI's Energy Apprenticeships Group hosts trainees for Western Australian oil and gas companies," Ms Willmott said.

"CCI is proud to be working with both companies to provide opportunities for workers to establish a career in the oil and gas sector."

The number of LNG trains, or processing plants, operating in Australia is expected to increase from eight to at least 21 by the end of 2018.

Chevron Australia Human Resources General Manager Kaye Butler said with the Chevron-led Gorgon and Wheatstone natural gas projects now taking shape in WA, the initiative gave Chevron trainees important onsite operational experience.

"This new wave of trainees joins more than 400 people who have already participated in training programs specifically aimed at developing skills and creating job opportunities with the Gorgon and Wheatstone projects," she said.

"Chevron is committed to investing in people, partnerships and technology for the long-term benefit of the Australian economy while helping to position Perth as a global energy hub."

The Chevron trainees complement their theoretical learning with on-the-job experience working alongside Woodside's trainees at the Karratha Gas Plant.

Woodside Karratha Gas Plant Manager Steve Trench said the company recognised that with Australian LNG supplies increasing over the coming years, it was important the industry invested now in training the next wave of LNG workers.

"With several major LNG projects under construction in Australia, it is important for

industry to find ways to collaborate and address the growing need for skilled and experienced workers," he said.

"We are proud of our 25-year history as a safe and reliable LNG operator and pleased to be able to share knowledge and expertise.

"Supporting Chevron, by providing their trainees access to the Karratha Gas Plant, is evidence of Woodside's ongoing commitment to industry collaboration towards establishing an LNG hub in Western Australia."

The Karratha Gas Plant is one of the world's premier LNG facilities and the only place in Western Australia where operator trainees can gain hands-on LNG and pipeline gas experience.

The first group of trainees started onsite training last September and worked alongside Woodside trainees for a number of shifts leading up to the completion of their traineeship with Energy Apprenticeships Group.

Following this experience, these trainees have now gone on to work directly for Chevron at their Gorgon and Wheatstone facilities.

For more details on apprentice or trainee programs in the oil and gas sector visit www.eag.com.au ■



Left to right: Pat Tierney, Michael Hinwood, Bryan Miller, Caitlin Simcock, Dave Hilliard (rear), Daniel Kitts, Scott McLean, Moira Vice, Reece Jennings and Arlyn Masinading. Photo: CCIWA



CORE VALUE

Finder Exploration's Theia-1 rig. Photo: Finder Exploration.

DMP IN 'WIN-WIN' PARTNERSHIP WITH EXPLORATION COMPANY

The drilling of the Theia-1 exploration well targeting the Middle Ordovician Goldwyer III shale in Western Australia's Canning Basin is being viewed as a model for future partnering between the Department of Mines and Petroleum (DMP) and industry.

DMP geologists participated in the highly successful collaborative exercise which rewarded DMP with immediate access to fresh drill core through working with privately-owned Finder Shale Pty Ltd – a wholly owned affiliate of Finder Exploration Pty Ltd.

"It really is a classic win-win situation," DMP Geological Survey of Western Australia (GSWA) Assistant Director Don Flint said.

"If we hadn't been able to work with Finder, under our protocols governing storage of drill core at DMP's Core Library, we would have had to wait two years to look at the core when it became 'open file'," he said.

Mr Flint said that DMP would release the results of the Theia-1 drilling to industry

when data for the well became public after the two-year waiting period.

"We want to be able to analyse core to integrate into our regional understanding as soon as possible, but even utilising a cost effective rig where drilling costs can be in excess of A\$5 million makes it cost prohibitive for GSWA in its own right," he said.

"So, being able to leverage our industry collaboration and acquire significant core means that we can maximise the benefit from funding through DMP's Exploration Incentive Scheme."

Mr Flint said that Finder had been pleased to have DMP geologists Leon Normore, Charmaine Thomas, Louisa Dent and Sarah Martin assist in the Theia-1 drilling programme in July and August this year.

"It's fantastic for our geologists to be able to view core that is so fresh that they're looking at it before it is even wrapped with the cling film or foil used to preserve it," he said.

"It's better science because with the immediate access we're accelerating geological knowledge that improves our understanding of the Canning Basin's stratigraphy and petroleum systems.

"At the same time, Finder is getting the benefit of GSWA geologists looking at the core and that adds value for them. They regard us as the technical specialists and our skills place their core in a regional context in real time – and this is useful for ongoing exploration."

Mr Flint said that DMP was talking to other companies about similar partnership projects.

"We would follow the same model of collaboration at the drilling and coring phase to generate fresh data, while respecting confidentiality provisions under the *Petroleum Act*," he said.

For more information on collaborative projects of this nature, contact GSWA Assistant Director Don Flint at Don.FLINT@dmp.wa.gov.au ■

JOURNEY STARTS WITH DMP DATA

Finder Shale Pty Ltd Chief Operating Officer Ryan Taylor-Walshe said that the company was delighted to be able to work with the Geological Survey of Western Australia (GSWA).

“As with all journeys, Finder had to start somewhere and we leveraged the data and interpretations made available through the acreage release notes and the DMP website, particularly some of the studies completed by the GSWA,” he said.

“As well as our significant internal work to develop the geological model, Finder leveraged available historical studies by GSWA and DMP, notably the geothermal gradient work completed by GSWA senior geologist Dr Ameer Ghori, plus the work on Canning Basin shale gas volumetrics by DMP petroleum specialists Nina Triche and Mohammad Bahar.

“GSWA geologists then worked alongside the Finder geologists during the coring operations and assisted in post-well sampling of the core.”

Mr Taylor-Walshe said that before being awarded Exploration Permit EP 493, Finder Shale had completed a large regional study of the Canning Basin which ultimately resulted in the drilling of its first operated well, the Theia-1 exploration well.



L–R: DMP geologists Leon Normore, Charmaine Thomas and Louisa Dent working onsite.

“The well was designed to test the Middle Ordovician Goldwyer III liquids-rich resource play and the early assessment of well results appears to validate the Finder geological model and de-risk the play,” he said.

“However, with no previous wells in the Exploration Permit, Finder planned to continuously core a section of nearly 800 metres of the middle to upper Ordovician section.”

“On hearing of our plans to acquire such a large amount of continuous core, GSWA contacted Finder to discuss the opportunity of accessing the core and associated data to further the understanding of the stratigraphy and petroleum systems of the middle to upper Ordovician of the Canning Basin.”

Theia-1 was drilled between 15 July and 28 August 2015 to a total depth of 1645 metres. Over 22 days, 146 cores were recovered, totalling 778 metres and weighing 6.5 tonnes.

“Normally, onshore petroleum operations would have only one wellsite geologist present for a 12-hour shift, but the collaboration between Finder and GSWA meant that during any one shift there were up to three geologists working together to mark up, describe, sample the core and to interpret the intersected stratigraphy,” Mr Taylor-Walshe said.

“The regional experience of the GSWA geologists in regard to Ordovician stratigraphy, detailed knowledge of fossils, carbonate sedimentation, etc., combined with Finder’s wellsite operation and core handling experience made for a formidable onsite scientific team.

“The initial phase of this collaboration between government and industry has delivered excellent results and Finder looks forward to continuing the team effort through the analyses and continued interpretation of the core results.” ■



DMP geologists view fresh drill core at the Theia-1 rig site.

FUNDING IMPROVES CORE LIBRARY

The success of the Department of Mines and Petroleum's (DMP) Exploration Incentive Scheme has created the need for more storage space for drill core samples at DMP's Core Library in the Perth suburb of Carlisle.

Plans to upgrade the facility will also include enclosing the library's external viewing area, which will ensure confidentiality for clients examining and analysing core.

"At the moment, it's a multi-user facility restricted to a common viewing area," DMP's Geological Survey of Western Australia Assistant Director Don Flint said.

"Enclosing the external viewing area gives us the opportunity to overcome one of the fundamental problems we've had with the Core Library up until now and that is having different layout areas for public and confidential core."

The viewing improvements are part of the A\$7.3 million package created by the addition of an extra A\$2.5 million in joint State and Federal funding announced earlier this year by Mines and Petroleum Minister Bill Marmion and Federal Industry and Science Minister Ian Macfarlane.

The new funding comes on top of A\$4.8 million committed in last year's State Budget to enlarge the library's warehouse for drill core samples by about 50 per cent, or 3500 square metres.

The A\$2.5 million boost will also be used to create a conference room, and expand the area housing a sophisticated rapid spectroscopic logging and imaging system known as a HyLogger core scanner.

The Core Library will continue to store two thirds of all Commonwealth-managed petroleum core derived from offshore drilling from around Australia.

"The improvements allow us to operate the Core Library more efficiently," Mr Flint said.

Assistant Director Don Flint said the Core Library holdings were now included in the new online version of DMP's Western Australian Petroleum and Geothermal Information Management System (WAPIMS) database which was launched at the department's 2015 Petroleum Open Day on 4 September in Fremantle.

"Not only is WAPIMS a good system for textual and spatial querying and retrieval of petroleum wells, surveys and associated documents but now, for the first time, it includes the core library physical assets and they are now searchable online," he said.

"So now everything we have at the DMP core libraries (Carlisle and Kalgoorlie) – mineral core, petroleum core, stratigraphic core, water bores, petroleum onshore and offshore – is searchable online.

"The system is integrated in a totally new way. It's just as easy to access a petroleum sample as a mineral sample. They're not separate in the way they were before when most of the data were maintained on spreadsheets or in a local database.

"We've always had a good system to handle the petroleum samples and now we can handle the mineral samples in the same way."

"There will be less double handling of the core, and that saves time and money. Also when core was laid out externally, it was subject to the weather. You can't leave core out in wet weather, and it's exceedingly hot to be working outside in the summertime."

Mr Flint said that the Core Library was a dual facility for minerals and petroleum operating under a formal service level agreement with Geoscience Australia and the National Offshore Petroleum Titles Administrator (NOPTA) to manage offshore petroleum samples.

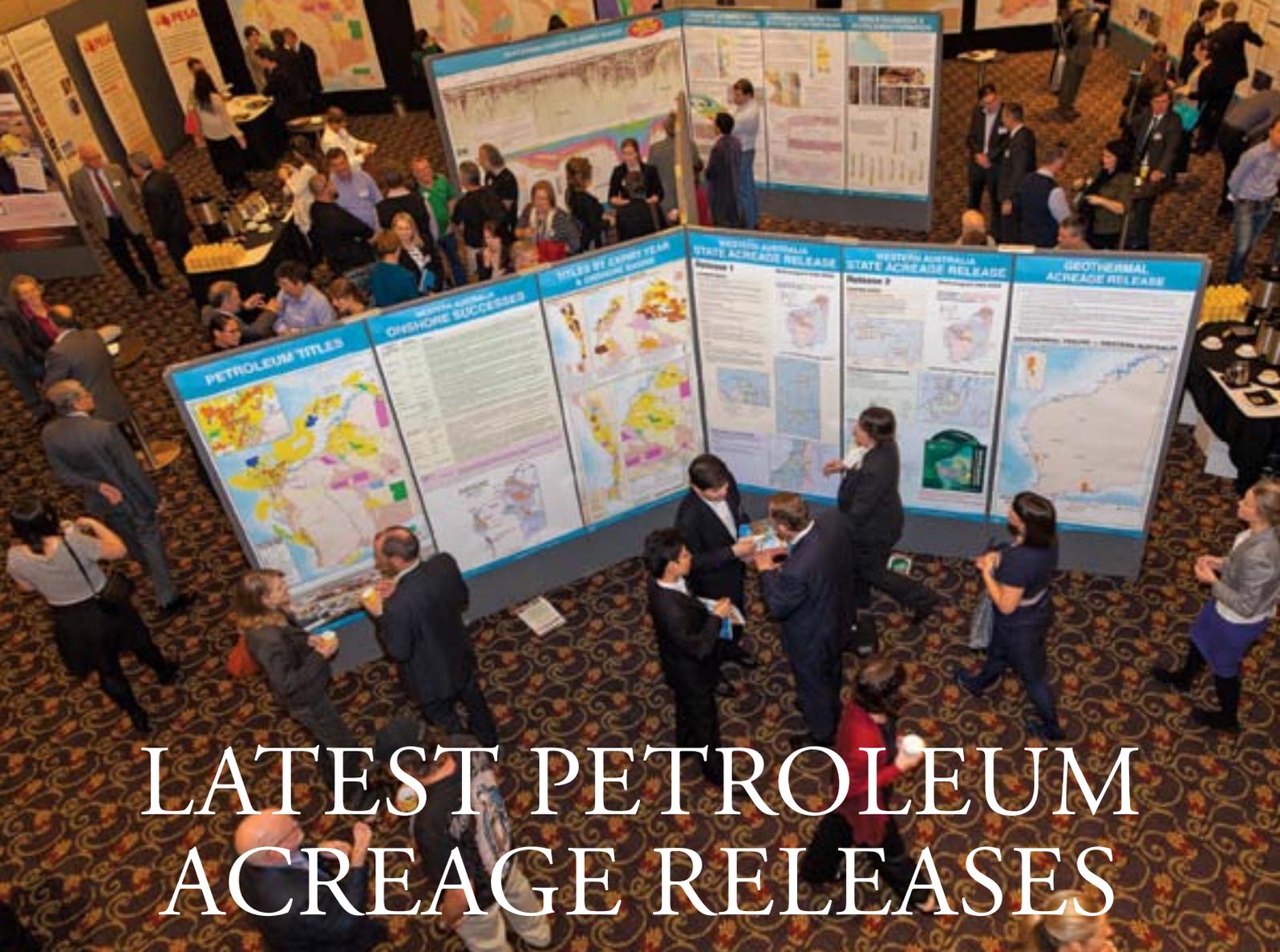
"It is because of that agreement, and the high-quality service that we have provided since January 2012 in managing offshore petroleum samples, that we received financial assistance from the Commonwealth to enclose the external viewing area," he said.

Concept plans for the Core Library improvements have been prepared and the work is expected to start early in 2016 and be finished by the end of that year.

When the work is finished, the Core Library should satisfy the combined needs of the State and Commonwealth for the next 20 years. ■



DMP's Core Library in Carlisle.



LATEST PETROLEUM ACREAGE RELEASES

The latest petroleum acreage releases for Western Australia were announced in September at the annual Department of Mines and Petroleum (DMP) Petroleum Open Day.

Mines and Petroleum Minister Bill Marmion announced the release for areas within the onshore Carnarvon Basin and State Waters in the Northern Carnarvon Basin during his opening address.

Five blocks, one in the Canning Basin and four in the Carnarvon Basin, are available for work program bidding with a closing date of 28 April 2016. This and future releases of petroleum acreage will be entirely web-based.

The DMP website includes information specific to the release areas, including acreage applications, royalties, online petroleum systems, and environment and Native Title.

The department will also include detailed maps of the release areas, the gazette notice, release area prospectivity summaries, data listings and land access planning considerations.

DMP assesses applications before any future drilling programs are approved to ensure they comply with State legislation that protects public health, the environment and water resources.

New regulations for the petroleum and geothermal industries came into effect on 1 July, giving Western Australia one of the most stringent well integrity and resource management regimes in the nation.

The regulations stipulate mandatory well and field management plans, including baseline water quality monitoring before drilling, and continued monitoring during and after completion to minimise any risk of aquifer contamination.

The annual open day attracted more than 280 oil and gas industry professionals and provided a forum for DMP's Petroleum Division and Geological Survey of Western Australia (GSWA) to engage with government, industry and community stakeholders.

"This event provides DMP with an opportunity to update industry on the latest developments, provide feedback to stakeholders and discuss future trends,"

DMP Director General Richard Sellers said.

Transparency in petroleum regulation and the future of onshore petroleum in Western Australia came under the spotlight at the event, along with an industry perspective by the Australian Petroleum Production and Exploration Association (APPEA).

"Many of the presentations reflected the importance of transparency, not just for the department and the Commonwealth, but also proponents, especially in the early stages of projects," Mr Sellers said.

"A social licence means a community has confidence in the industry and DMP as the regulator to do the right thing," he said.

A resource management workshop was also held and workstations were made available for attendees to try the department's new online systems and provide feedback. Further information on the acreage release is available from the department's website www.dmp.wa.gov.au/21807.aspx ■

NEW WA OVERSEAS APPOINTMENTS

The Western Australian Government has recently appointed new representatives in three of the State's overseas offices.

Experienced international business executive Christopher Barnes was appointed in June as new Regional Director, Indonesia.

Premier and State Development Minister Colin Barnett said Mr Barnes was highly qualified for the position, having worked in senior roles across government and the private sector with a focus on strategic engagement with Indonesia.

Western Australia has maintained a trade and investment office in Indonesia since 1992. The country is Western Australia's largest export market for wheat and live cattle and total trade between WA and Indonesia was valued at more than A\$3 billion in 2014-15.

In January this year, the Western Australian Government adopted a new office model, seeking to grow and diversify the State's relationship with Indonesia.

"The new office model will focus efforts and resources where there is real potential for growth with our nearest trading partner," the Premier said.

"Indonesia's proximity to WA and its emerging middle class provide many opportunities for the State's primary producers and tourism operators," he said.

Mr Barnes has advised a number of Australian and international companies on doing business in Asia, held senior roles with the Commonwealth Bank and is a former national president of the Australia Indonesia Business Council.

He will lead an expanded trade and investment office in Jakarta that will include dedicated tourism and agriculture officers.

The appointment of a new Agent General for Western Australia based in London, John Atkins, was announced in June, with Mr Atkins to begin his two-year term in September.

Mr Atkins, a chairman of the Lotterywest board, holds directorships in several commercial and not-for-profit boards and was previously the chairman of ANZ in Western Australia and had a highly successful legal career.

"Mr Atkins has had a distinguished career in law and banking and, combined with his



Christopher Barnes



John Atkins



John Catlin

board level experience and acumen, he is extremely well suited to this position," Mr Barnett said.

"He was head of Freehills' Perth office and has had a long and respected career in WA's business and law communities. As a founding Director of the Committee for Perth, Mr Atkins has demonstrated a strong interest in the capital city and the State, making him an ideally suited advocate for WA in this key trade and investment role.

"The European market remains a major source of investment attraction for the State and Mr Atkins's links with the business world will be of great benefit in promoting the State and its strong economic position."

Mr Barnett thanked outgoing Agent General Kevin Skipworth CVO for his outstanding work both in London and the public sector over many years.

"Mr Skipworth has worked hard at developing the State's links with African nations and forged new trade and investment links with this emerging market," he said.

A new Regional Director, Singapore – John Catlin – will take up his position in October.

Mr Catlin is currently Deputy Director General Community and Human Services at the Department of the Premier and Cabinet (DPC).

He has extensive experience in Indigenous issues and resource management policy and has previously been a member of the National Native Title Tribunal, was employed in the Victorian Government's Native Title Unit and in Queensland's mining industry.

Prior to his recent employment, Mr Catlin worked at DPC in the 1990s, as well as the Western Australian Departments of Indigenous Affairs and Mines and Petroleum.

Mr Catlin will head a team servicing the main island of Singapore as well as the surrounding region.

Singapore is currently Western Australia's fourth largest trading partner with total trade valued at A\$8.5 billion in 2014-15.

For more information on Western Australia's overseas trade and investment, visit www.dsd.wa.gov.au ■

MINING EXPERTISE AT AFRICA DOWN UNDER

The 13th annual Africa Down Under resources conference held in Perth in September was marked by a series of high-level briefings by the Departments of Mines and Petroleum (DMP) and State Development for representatives of the Common Market for Eastern and Southern Africa (COMESA).

"The key objective was for COMESA members to tap Western Australia's

expertise," DMP Director General Richard Sellers said.

"I hope that our contribution has helped African countries to develop their mining laws, tenement systems, and environmental and safety standards to levels similar to those in Australia."

The Africa Down Under conference followed the two-day East Africa Oil and Gas Conference opened by Mines and Petroleum Minister Bill Marmion. ■

WESTERN AUSTRALIA BUILDS ON AFRICA TIES



Premier and State Development Minister Colin Barnett (pictured above, seated centre left) held an official "Premier's Breakfast" event for African mining ministers and delegates as part of the 2015 Africa Down Under Conference. African ministers from six countries, which are members of the Common Market for Eastern and Southern Africa (COMESA), as well as ministers from eight other African countries in which Western Australian companies are active, attended the breakfast (they are pictured above). They were joined by Mines and Petroleum Minister Bill Marmion (standing third from left), Department of State Development Director General Steve Wood (standing first left) and Department of Mines and Petroleum Director General Richard Sellers (standing fourth from right).

The world's second largest continent and the second most populous (after Asia), Africa includes 54 individual countries and Western Australian mining companies currently operate in over half of them.

WA accounts for two-thirds of Australian mining companies operating in Africa (as of August this year), with more than 429 projects in 30 African countries.

In 2014-15, the State exported goods valued at A\$1.4 billion to Africa.

In September, Western Australia put a spotlight on Africa, welcoming government ministers and senior delegates from across Africa as part of an ongoing strategy to share knowledge and skills across the agriculture and resource sectors.

The visit coincided with the 13th annual Africa Down Under resources conference, which has proved a popular event with last year's conference attracting more than 1500 delegates to Perth.

Opening the three-day conference, Western Australian Premier and State Development Minister Colin Barnett said Africa represented an exciting new market for Western Australian goods and services.

"With our long history of responsible resources development, WA is well placed to assist African countries to develop transparent, stable and mutually beneficial regulations for their resources sector," he said.

To coincide with the conference, senior staff from the Departments of State Development and Mines and Petroleum briefed several groups of African ministerial delegates, including representatives of Common Market for Eastern and Southern Africa (COMESA) member countries.

COMESA is a 19-member regional trading bloc with which Western Australia signed a Memorandum of Understanding (MoU) in January 2014 with the aim of promoting co-operation in the fields of agriculture, mineral and petroleum resources, vocational education and capacity building.

COMESA members are Burundi, Comoros, Democratic Republic of the Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Uganda, Zambia and Zimbabwe.

Total trade between COMESA member countries and Western Australia totalled almost A\$890 million last financial year.

Mines and Petroleum Minister Bill Marmion said Western Australia would provide assistance in developing regulations and legislation under the MoU.

"This will help ensure the benefits from resources development in COMESA countries flow through to their communities, and also help provide opportunities for the Western Australian resources sector and service providers," Mr Marmion said.

The Department of Agriculture and Food also supported COMESA by hosting delegates for a two-day visit program, with opportunities for COMESA delegates to discuss biosecurity and food security issues with local experts.

The Western Australian Government maintains an overseas office in Nairobi, Kenya, which looks after COMESA and other select African countries. For more information, visit www.dsd.wa.gov.au ■

BUILDING CONNECTIONS – WA

Geographically isolated by distance and with a small population relative to the national total, Western Australia has long been an outward-looking, export-oriented state.

It's a mindset that, despite being born out of necessity, has proved a boon for the State and its people.

With just over 10 per cent of the national population, Western Australia produces almost half of Australia's exports (the State contributed 47 per cent of national merchandise exports in 2014 – totalling A\$124.6 billion).

International trade is the lifeblood of the State's economy; supporting Western Australian industry, creating jobs and bringing in billions of dollars in export earnings.

Central to this success is the recognition that international trade relies on a range of inter-relationships. The Western Australian Government has strategically sought closer relationships with neighbouring countries which are not only key economic partners but also share a willingness to connect with one another.

Western Australia's economic success has been based in part on the pursuit and continued support of shared cultural, political and social connections between the State and its key trading partners.

This forms the basis of the 'Sister State relationships' shared by Western Australia and its key trading regions. Currently, Western Australia has three active Sister State relationships:

- Hyogo Prefecture in Japan
- East Java in Indonesia; and
- Zhejiang Province in the People's Republic of China.

The Sister State relationships, managed in Western Australia by the Department of State Development, are guided by Memoranda of Understanding (MOUs) that outline areas of cooperation between the parties involved.

Western Australia's first Sister State relationship was signed with Hyogo in 1981 and was founded on the connections between Hyogo-based Kobe Steel and Nippon Steel, and the Western Australian iron ore sector.

Western Australia has supplied iron ore to the Japanese steel industry for more than 50 years and liquefied natural gas (LNG) to Japanese energy producers for the past 25 years.

Trade with Japan supported the development of the State's iron ore and oil and gas industries and saw Western Australia expand its export focus to Asia.

In 2014, Western Australia contributed over half (51 per cent) of Australian exports to Japan, with iron ore and LNG accounting for 93.5 per cent of WA's total exports to Japan.

In turn, the State buys semi-processed and finished goods from Japan, most notably passenger and commercial vehicles (passenger vehicles were Western Australia's main import from Japan in 2014, totalling A\$646 million).

The Western Australian Government maintains a trade and investment office in Hyogo, as well as a main office in Tokyo.

The State's Sister State relationship with Hyogo continues to produce a range of collaborative projects and programs including staff, student and sporting exchange programs; culture, arts and

WESTERN AUSTRALIA-KOREA ENERGY AND RESOURCES (WAKER) FORUM

Feedback from delegates at this year's Western Australia-Korea Energy and Resources (WAKER) forum declared the event – the third of its kind – a resounding success.

Held in Seoul, South Korea in May, the focus of the forum was to highlight Western Australia as a long term trade and investment partner and promote investment opportunities in the State's infrastructure, agriculture, and resources and energy sectors.

South Korea is Western Australia's third largest trading partner and third largest export market, valued at A\$9.8 billion in 2014. The State contributes almost

half (49 per cent in 2014) of Australia's exports to South Korea, including wheat, iron ore, crude petroleum, liquefied natural gas (LNG), and copper. Imports to Western Australia from South Korea were valued at A\$2.3 billion last year.

A Korea-Australia Free Trade Agreement entered into force in December 2014, eliminating tariffs on 84 per cent of Korea's imports (by value) from Australia, rising to 99.8 per cent when the agreement is fully implemented.

During the WAKER forum, Western Australian delegates networked

with senior representatives of major Korean companies and government agencies. The event was attended by 110 senior Korean business leaders, government officials and academics, with the WA delegation including Mines and Petroleum Minister Bill Marmion, Department of Mines and Petroleum Director General Richard Sellers and Department of State Development International Trade and Investment Director Stuart Crockett.

The Western Australian International Trade Office in Korea organised private business matching meetings for WA delegates to meet with major Korean companies to promote their products

SISTER-STATE RELATIONSHIPS

performing arts exchanges; collaborative university research; business delegations and forums; and knowledge sharing on government administration and essential services.

Western Australia and Hyogo will celebrate the 35th anniversary of their Sister State relationship in 2016.

August this year marked the 25th anniversary of the Sister State relationship between Western Australian and East Java, which was signed in 1990.

The relationship has produced various programs and exchanges between the two regions in agriculture, education, governance, health and welfare, and culture and sport.

Indonesia has been among Western Australia's top ten trading partners for several years – in 2013-14, it ranked seventh with total trade of nearly A\$3.9 billion.

The State's top imports from Indonesia include petroleum oils, iron and steel structures, and maritime vessels and the country is Western Australia's largest export market for wheat and cattle.

For the past ten years, Western Australia's largest export market has been China, which accounted for 51 per cent (A\$63.5 billion) of the State's exports in 2014, mainly in iron ore (76 per cent) and gold (64 per cent).

The Sister State relationship with Zhejiang was signed in 1987 and provided access to China at a time when Western Australia's relationship with the country was undeveloped.

At the time of the signing, doing business with China depended on "guanxi".

Meaning "connections", guanxi is still considered important today – and is at the core of the Sister State concept: as formal relationships that provide an official platform for broader engagement across culture, business and political spheres; and an avenue for diplomacy.

The WA-Zhejiang relationship has seen the regional partners cooperate in the resources, work safety and cultural and education/training sectors, and look to expand cooperation and develop exchanges in other areas, including media, tourism, agriculture and agribusiness, environmental services, information

technology, biotechnology, scientific research, health care, sports and recreation, land administration, and regional development.

Zhejiang investors have invested in Western Australia's resources, hotel, real estate, building supplies, services and agribusiness sectors.

In the education sector, Western Australian universities share strong collaborative relationships with Zhejiang universities in research and development, in areas such as health, grains, water resource management and ocean science. There are 12 Western Australian schools that have formed 'Sister School' relationships with the Chinese province.

Built on a mutual desire to cultivate long-term trust, understanding and good will, and to encourage cooperation between trading partners, Western Australia's Sister State relationships are evidence of successful and ongoing regional connections.

For more information on Western Australian international trade and investment and global trade offices, visit: www.dsd.wa.gov.au ■

and services. The delegation also attended a site visit at the Samsung Heavy Industries shipyard on Geoje Island where the Shell floating LNG ship "Prelude" is being constructed.

Perth delegate Gordon Flake, CEO of the Perth USAsia Centre, said the WAKER forum was successful in exposing opportunities for collaboration between Western Australia and South Korea.

"The forum in Seoul effectively highlighted the many and growing opportunities for collaboration between individuals, investors and institutions in Korea and Western Australia," Mr Flake said.

"The forum was attended by a diverse cross section of interested Koreans (and was) packed full of information about the relative advantages of

doing business in Korea and the comparative strengths of both parties.

"In particular, Korea's growing need for reliable energy supplies from a stable partner... plays well to Western Australia's strengths."

WAKER forum participants were invited to attend LNG 18, to be held in Perth in April 2016, as well as the fourth WAKER Forum, which is planned for the end of 2016, also in Perth.

The Department of State Development supports a trade and investment office in Seoul and publishes biannual statistics on trade and investment between South Korea and Western Australia, visit www.dsd.wa.gov.au for more information. ■



*Department of State Development
International Trade and Investment
Director Stuart Crockett at the forum.*

FINDING GOLD IN



Glenburgh terrane.

The concept that a “trapped continent” the size of Japan embedded in the Gascoyne region of Western Australia could hold buried treasure has been proven.

Seismic surveys by the Department of Mines and Petroleum’s Geological Survey of Western Australia (GSWA), funded through the Exploration Incentive Scheme, have confirmed the theory of a micro-continent trapped two billion years ago between tectonic plates.

The Glenburgh Project gold deposit about 250 kilometres east of Carnarvon was originally discovered in 1994 but not developed, and now project owner Gascoyne Resources has identified a resource of more than one million ounces of gold¹.

And there may be more Gascoyne gold waiting to be discovered, according to DMP Geoscience Mapping Assistant Director Ian Tyler – who in the 1990s was involved in mapping of the Gascoyne Province which first identified the Glenburgh micro-

continent – and Geoscience Mapping Project Manager Dr Simon Johnson.

Dr Tyler said that the original exploration that discovered the Glenburgh deposit in the Gascoyne was based on the assumption that the rocks in which it occurred were originally part of Yilgarn Craton, well known for an endowment of world-class gold and nickel deposits.

“The realisation that this part of the Gascoyne Province collided with the Yilgarn Craton two billion years ago changed the perception of the prospectivity of the area, and there was a hiatus between discovery and Gascoyne Resources’ renewed interest 15 years later,” he said.

GSWA geologist Lisa Roche has come to the conclusion that the gold deposit was actually formed before the collision and had been metamorphosed.

Ms Roche logged drill core from the Glenburgh Project, spent several weeks field mapping, and was involved in thin-section petrography of samples, and analysis of the microstructure of gold grains.



GSWA geologist Lisa Roche.

“The internal structure of the gold suggested it had been through post-depositional processes including metamorphism and deformation” she said.

Dr Tyler and Dr Johnson are pleased by the evidence and say that it is the culmination of years of research, field work and analysis.

“Lisa’s work shows that gold was deposited during the early stages of accretion of the Glenburgh Terrane to the

¹ <http://www.gascoyneresources.com.au/>

N THE GASCOYNE



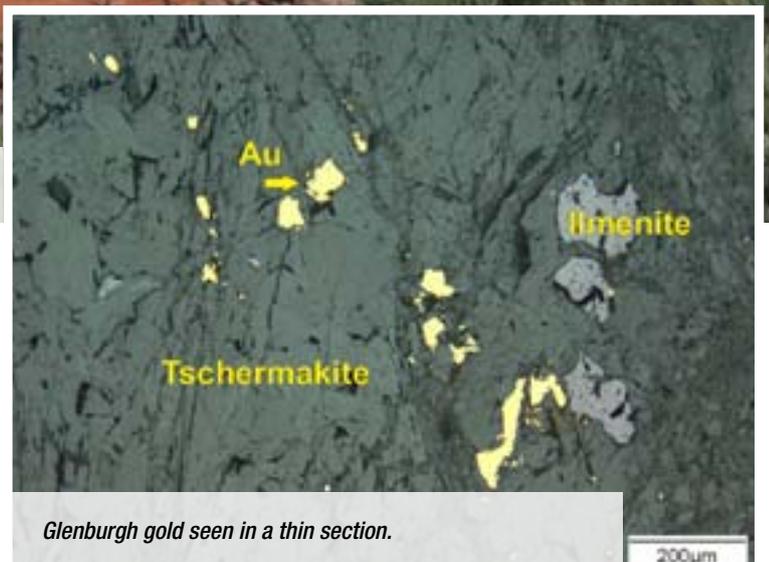
northern margin of the Yilgarn Craton about two billion years ago,” Dr Tyler said, “rather than during later stage orogenic deformation and metamorphism, and this knowledge will influence exploration models in the region.”

Dr Johnson, who is GSWA’s Capricorn Orogen Project Manager, said that seismic studies funded by DMP’s Exploration Incentive Scheme had contributed strongly to confirmation of a “trapped continent”.

Until recently, he said, geologists had relied mainly on data from mining exploration companies and aerial surveys to try to understand the Capricorn Orogen’s complex crustal architecture.

“These methods were cheaper, but did little in telling us about the deeper structures so important to understanding the regional geology,” he said. “Now we have detailed knowledge up to 60 km down into the crust.”

Dr Johnson said that seismology had discovered several major fault lines in the Capricorn Orogen.



Glenburgh gold seen in a thin section.

“Faults which go from the surface of the earth all the way down to the mantle play a significant role in mineralisation, because these can become pathways for fluids containing metals such as gold,” he said. “These major fault lines are promising places to explore.”

Ms Roche, who has been studying the Glenburgh Terrane as part of the GSWA’s Masters Program in association with the University of Western Australia, described Glenburgh as a “cheeky deposit” because it was so unlikely that it would exist.

“Gold deposits are rare in high metamorphic grade rocks and are rare in the Gascoyne, which makes Glenburgh unusual, and that’s

why it is important to try and understand when and how it got there,” she said.

Dr Tyler said that GSWA’s work on the Glenburgh Terrane had involved a wide range of scientific activity including drill core analysis, geochronology and isotope geochemistry in partnership with the Australian Research Council Centre of Excellence for Core to Crust Fluid Systems, the Centre for Exploration Targeting, and Curtin University.

“We have greatly increased our knowledge of the crust in the Gascoyne and that also reduces the financial risk for further exploration because it can be more accurately targeted,” he said. ■



NEW ORD LAND RELEASE TO INCREASE IRRIGATION SIZE

The expansion of the Ord River region in Western Australia's north has taken a major step forward with the release of a further two parcels of land for agricultural development.

The Western Australian Government announced the release of about 5000 hectares of the Ord West Bank and Mantinea land in July, as part of the State Government's Ord-East Kimberley Expansion Project, one of northern Australia's most significant projects.

Premier and State Development Minister Colin Barnett announced the new land release jointly with Regional Development Minister Terry Redman.

"This land release builds on the increasing interest in agriculture in the State's north and allows the private sector to take part in

building the Ord into a larger, world-class agricultural precinct," the Premier said.

The Ord-East Kimberley Expansion Project is a A\$517 million project, with A\$322.5 million invested from the State Government's Royalties for Regions program.

Mr Redman said the successful development of the land would further contribute to building the long term performance of the Ord region and would increase the size of the Ord irrigation scheme area to 35,000 hectares.

The Ord West Bank and Mantinea Land is considered to be potentially arable and suitable for irrigated agriculture.

"This is an opportunity for the State Government to engage with the private sector and develop the partnerships

needed to fully realise the potential of the Ord scheme both in Western Australia and in the Northern Territory," Mr Redman said.

The Minister acknowledged the continuing support of the Miriuwung Gajerrong people, whose consent to surrender native title of these lands under the Ord Final Agreement made the land release possible.

The release of Ord West Bank and Mantinea lands is consistent with the intent of the Ord Final (native title) Agreement and follows previous successful land releases of Packsaddle, Goomig and Knox Plain lands (Ord Stage 2 cropping and irrigation is pictured above).

Request for proposals for the land opened in July and closed on 2 October 2015. Further information is available at www.drd.wa.gov.au/ordrfp ■

DIRECTOR GENERAL CORRECTS MEDIA REPORT

Claims that the grant of exploration licences in Australia was taking more than two-and-a-half years have been refuted by the Department of Mines and Petroleum (DMP).

Director General Richard Sellers said the department's statistics showed it took an average of 364 days for exploration licences to be granted in Western Australia over the past year.

"More than half of Australia's exploration expenditure is spent in Western Australia. This is why it is critical to have a system that is robust, rigorous and timely," Mr Sellers said.

The average of 364 days includes assessment by DMP and other processes including native title for land access, and requests for information from proponents.

The department regularly publishes its assessment performance in quarterly performance reports and is recognised by the Australian Government's Productivity Commission as employing "leading practice in Australia".

Mr Sellers said DMP was always looking at ways to make further improvements to ensure Western Australia remains a globally recognised destination for investment in the resources industry. ■

INNOVATIVE DATING TECHNIQUE AIDS EXPLORATION

A new technique pioneered in Western Australia is being used to target exploration of the Capricorn Orogen in the State's Gascoyne region.

The Department of Mines and Petroleum's Geological Survey of Western Australia (GSWA) is using the special technique, developed by Curtin University Professor Birger Rasmussen, to analyse ultra-thin rock slices to accurately date minerals and give a clearer picture of the geological history of the region.

"We hope to be able to understand why and where mineralisation has occurred, and this should help exploration companies focus their resources and time on critical areas, rather than spreading their efforts thinly across the entire region," GSWA Geoscience Mapping Project Manager Dr Simon Johnson said.

"Being able to accurately date samples provided by Abra Mining Pty Ltd is critical to understanding the region's tectonic history, and that leads to a holistic understanding of the mineralisation itself.

"GSWA's collaboration with Professor Rasmussen and his team at Curtin University has been critical in unravelling the detailed story we have been working on for about 10 years with Abra on their lead-copper-zinc deposit in the middle of the Capricorn Orogen."

Dr Johnson said that it was impossible to date when the various minerals present

had first crystallised using the usual method of analysis – crushing rock samples.

"However, Professor Rasmussen's technique, which involves mounting extremely thin slices of rock from Abra's diamond drill core on a slide, means small mineral crystals can be identified and individually dated in situ," he said.

Dr Johnson said that the next step in the project was sending two Curtin University PhD students – Imogen Fielding and Nishka Piechoka – to work in the region, using the Curtin dating technique in an attempt to locate more prospective areas for mineral explorers.

Dr Johnson said a deep crustal seismic survey funded by the Department of Mines

and Petroleum's Exploration Incentive Scheme (EIS) indicated that the northern part of the Orogen should be highly prospective.

"Even though there aren't many mines up there, there is a successful operation currently at the Paulsens Gold Mine and at the Mt Olympus gold mine in the past, and there are hundreds of gold and base metal occurrences throughout the region," he said.

GSWA's collaboration with Professor Rasmussen and his team at Curtin's School of Applied Geology is supported through the EIS, and has attracted funding in the form of a linkage grant from the Australian Research Centre. ■



Above: Drill core from AB61 showing red zone mineralisation from the Abra Deposit. The Red Zone is characterised by banded jaspilite, hematite, galena, pyrite, barite, siderite, and quartz. Top: On location in the Gascoyne. Photos: Abra Mining.



Dr Huaiyu Yuan and Dr Klaus Gessner discuss a sample of Meeberrie Gneiss formed deep in the Earth's crust about 3.73 billion years ago.

DMP'S EARTHQUAKE MAN

Solving the Capricorn Orogen jigsaw

Your mission, should you choose to accept it, is to harness the power of earthquakes to see into the depths of the earth's crust and help explorers discover hidden ore deposits.

No, it is not an impossible mission; it is a scientific marvel being achieved by Dr Huaiyu Yuan, a seismologist working closely with the Department of

Mines and Petroleum (DMP) in Western Australia's Mid-West, Gascoyne and Pilbara regions.

Dr Yuan's work collecting and interpreting earthquake seismic data is a vital part of the mammoth A\$16 million Capricorn Distal Footprints project.

Collaboration in the project involves the CSIRO (Commonwealth Scientific

and Industrial Research Organisation) with funding from the Science and Industry Endowment Fund, DMP's Geological Survey of Western Australia, the Minerals Research Institute of Western Australia, the University of Western Australia, Curtin University, and industry.

The project motto is that 'it is so big and complex that no one institution could do it all'.

The scope is breathtaking — effectively creating a 3D model of a 25,000 square kilometre area that is 250 km deep and extending from the crust into the upper mantle.

The multi-disciplinary project involves a combination of active and passive seismography, and magnetotelluric and airborne electromagnetic surveys.

Through the Exploration Incentive Scheme – which also helps fund Dr Yuan's work – DMP has already been able to provide comprehensive geophysical data using active seismography, and airborne magnetic



A temporary outback seismic site. Photo: Dr Huaiyu Yuan.

and radiometric surveys and ground gravity surveys.

However, solving the Capricorn Orogen's geological jigsaw requires the ability to look much deeper inside the earth's crust and that involves what DMP's 3D Geoscience Manager Dr Klaus Gessner calls Dr Yuan's "scary maths".

"Every quake has a unique wave form," Dr Gessner explains. "If you compare the time it travels with the distance from the earthquake and the shape of the waves, the main variable will be the structure of the medium they go through.

"It's like if you play music in the lounge room, it will sound different if you're standing in the bathroom or in the kitchen.

"These seismologists are very clever people – superb mathematicians – who can use that information as a tool to deduce crustal structure which often controls the location of large mineral deposits."

Dr Yuan, who was a key researcher in earthquake seismology at the University of California before coming to Western Australia in 2013, says his contribution to the project is providing a better understanding of the tectonics involved in the creation of the Capricorn Orogen.

"The study of surface geology here in Western Australia is really strong," he said.

"Now we're trying to integrate that data with the deeper earthquake studies to get a better understanding of how the surface deposits formed."

Dr Yuan does this through what is known as passive source seismology, using data from Western Australia's more than 120 permanent and temporary recording stations monitoring earthquakes. He conservatively estimates that each month there are about 15-20 measurable quakes of magnitude 5.6 around the world that can be used for his measurements in Western Australia.

So, how can the seismic information be of value to explorers?

"If we measure the velocity of an earthquake, then we can match it up with an appropriate mathematical table to see which rock types are indicated," Dr Yuan said.



An inside view of a permanent seismic site operated by Geoscience Australia in the Pilbara.



A fenced-off seismic site with a satellite dish and small building that houses the instruments and technology which record and transmit seismic data from earthquakes.

"But there are many rocks that have similar velocities, so we examine the ratio between the earthquake's primary and secondary wave and apply another table for a tighter correlation.

"The results can highlight different geological regions that are characterised by different rock types."

Dr Yuan explains that explorers can use the information to identify where in WA's crust are the most suitable structures that can be targeted for certain mineral deposits.

The importance of Dr Yuan's work is underscored by the fact that the

Pawsey Supercomputing Centre in Perth regards him as an "early adopter" and the merit of his research and publishing means he is able to crunch his numbers there.

Dr Yuan has just published a scientific paper on a study of how the crust of Western Australian craton evolved – Secular change in Archean crust formation recorded in Western Australia – in the prestigious journal Nature Geoscience.

Dr Gessner describes the search for ore bodies in the Capricorn Orogen as "geological reasoning".

"We take all this information and we integrate it to get a clearer picture of what's going on," he said.

Knowing how a piece of the earth's crust formed means explorers are more likely to find certain minerals.

"It removes some of the guesswork and reduces the risk for explorers," Dr Gessner says.

"Geological reasoning is like forensics. If you just measure things on a crime scene without trying to understand what happened, you won't solve the puzzle." ■

LEADING SHALE AND TIGHT GAS INDUSTRY PROFESSIONALS ATTEND WATER MANAGEMENT SEMINAR

Scientists and engineers involved in shale and tight gas exploration worked together to protect Western Australia's groundwater at a seminar earlier this year. Leading international petroleum industry professionals visited Perth in June to take part in the two-day seminar on water management.

Local, interstate and international case studies were presented and sessions were devoted to details of new and existing State Government policy on regulation of the emerging shale and tight gas industry.

Department of Mines and Petroleum (DMP) specialists and Department of Water representatives took part in the seminar organised by the WA branches of the

Association of Hydrogeologists, Society of Petroleum Engineers and the Australian Society of Exploration Geophysicists.

DMP Director General Richard Sellers said it was essential for State Government representatives to take part in the seminar to collaborate with industry professionals and scientists to strengthen shale and tight gas and hydraulic fracturing regulation in Western Australia.

"While a properly-regulated shale and tight gas industry offers significant benefits to the prosperity of Western Australia, our primary responsibility is to ensure that companies do the right thing and the environment and communities are protected," Mr Sellers said.

"I was highly impressed by the line-up of speakers and the range of topics being addressed.

"This was a real meeting of minds, particularly in the disciplines of hydrogeology, geophysics and engineering."

DMP speakers at the seminar included Petroleum Executive Director Jeff Haworth, who spoke on new regulations and guidelines along with Tadas Bagdon, Department of Water Executive Director Policy and Innovation.

The seminar was officially opened by Mines and Petroleum Minister Bill Marmion. ■

DEVELOPING AN APPETITE FOR ONLINE SYSTEMS

"Lunch and learn" networking is the way the Department of Mines and Petroleum (DMP) is helping prospectors and geologists understand its online systems.

The department is keen to keep the resources industry up to speed as it continues to step up its digital processes and reduce paper-based practices.

The first "lunch and learn" session at the department's East Perth office in June was an expansion of DMP's regular Geological Survey of Western Australia (GSWA) database training sessions for prospectors and explorers to include assistance from representatives from the Mineral Titles and Environment divisions.

Event coordinator Robin Bower said attendees appreciated the opportunity to network in an informal way with department officers.

"DMP regularly liaises with key stakeholders including industry, environmental non-government organisations and community groups," she said.

"We do this through formal consultation processes such as the Mining Industry Liaison Committee and Reforming Environmental Regulation Advisory Panel.

However, this more informal approach grew out of an approach by the Associated Prospectors and Leaseholders Association and it has proved most successful."

An online training and networking session will be run in Perth on 29 October and in Kalgoorlie on 5 November.

The free training in how to use DMP's databases and online systems involves hands-on interaction that includes navigating the Western Australian Mineral Exploration Index (WAMEX), searching mineral drill holes and geochemistry databases, and the interactive map viewers GeoVIEW.WA and GeoMap.WA.

Participants are welcome to bring their own laptops for individual instruction but desktop computers are available.

For more information, email publications@dmp.wa.gov.au ■

PERTH TEST GENERATES HIGH-PURITY LITHIUM CARBONATE

More than eight kilograms of high purity lithium carbonate has been produced by lithium developer Lithium Australia NL from the company's 10-day mini-plant processing trial completed recently at a Perth laboratory.

Lithium Australia Managing Director Adrian Griffin said the trial was conducted using processing technology licensed to the company, and had demonstrated a huge potential to fill a supply gap for battery-grade lithium carbonate.

"The test resulted in the production of a total of 8.7kg of high-purity lithium carbonate derived from lepidolite (lithium mica) sourced from the Coolgardie Rare Metals Venture in Western Australia's Eastern Goldfields," Mr Griffin said.

Lithium Australia's first two mini-plant tests are the world's first successful, continuous lithium extraction tests using hydrometallurgy on hard rock.

This unique process was developed by Strategic Metallurgy Pty Ltd, which is involved in a technical alliance with Lithium Australia.

The process is based on the recovery of lithium from micas – minerals that are not usually a source of lithium chemicals.

Lithium carbonate produced from the test achieved a high-purity level of 99.57 per cent with 94 per cent recovery from leach liquor.

Further mini-plant runs are anticipated in the near future and will include material sourced from the company's other projects.

Lithium Australia also has strategic alliances with Pilbara Minerals Limited, Focus Minerals Limited and Tungsten Mining NL to investigate lithium and rare metals in prospective locations of Western Australia close to well-developed infrastructure.

It also has lithium exploration assets near Greenbushes and Ravensthorpe in Western Australia, as well as in Cinovec in the Czech Republic, and is currently evaluating other European opportunities.

Along with extensive use in the new breed of hybrid and electric vehicles, lithium batteries are used in nearly all portable electronic and communication devices, power tools, domestic power backup and off-peak storage, and load levelling for renewable energy sources such as wind, solar, and wave power. ■



Above: Testing at the mini-plant processing trial. Top: Zinnwaldite – a silicate mineral in the mica group. Photos: Lithium Australia NL.

TORO BEGINS COMMUNITY CONSULTATION



The Wiluna landscape. Photo: Toro Energy.

Toro Energy Limited has started community consultation ahead of the public release of an environmental statement seeking government approval for an extension of the company's Wiluna uranium project in Western Australia.

The company has lodged a draft Public Environmental Review (PER) with the Western Australian Environmental Protection Authority (EPA).

The review assesses impacts of the proposed extension of the Wiluna project through development of its Millipede and Lake Maitland deposits. Approvals are already in place for Wiluna's Centipede and Lake Way deposits.

The PER is scheduled for release later this year for a 12-week public review.

Toro met local Aboriginal leaders in August to give an update on the project and further discuss the company's proposals to create local jobs over the mine's life.

"Toro has an agreement with the Wiluna people to provide training and employment with the Native Title holders of land on which the Centipede, Millipede and Lake Way deposits are located," Toro Managing Director Dr Vanessa Guthrie said.

"Our agreement involves Toro providing funding and other resources to enable local Aboriginal people, either as employees or through their own business ventures, to build capacity in environmental monitoring required by the project, including radiation and groundwater.

"We are also exploring possibilities for their involvement in land management and site rehabilitation. These programs are designed to help the local community understand how the Wiluna project is being undertaken without

adverse impacts to public health, safety and the environment."

Dr Guthrie said that Toro was also consulting with the Barwidgee people who claim an interest in the land on which the Lake Maitland deposit is located.

She said that once Toro had EPA approval to publicly release the PER for mining at Millipede and Lake Maitland, it would continue consultation with the wider community, including project information days in Kalgoorlie, Leonora and Wiluna during the public review. ■



Toro Energy consults locals. Photo: Toro Energy.

REGULATORY FRAMEWORK TO GUIDE FUTURE DEVELOPMENT OF SHALE AND TIGHT GAS

Western Australia's whole-of-government regulatory framework for shale and tight gas has been outlined in a document prepared in collaboration with, and endorsed by, those government agencies charged with assessing and regulating petroleum resources.

The framework will assist industry, other stakeholders and the public to understand the robust regulatory assessment, approval and compliance processes for shale and tight gas projects as well as other petroleum projects.

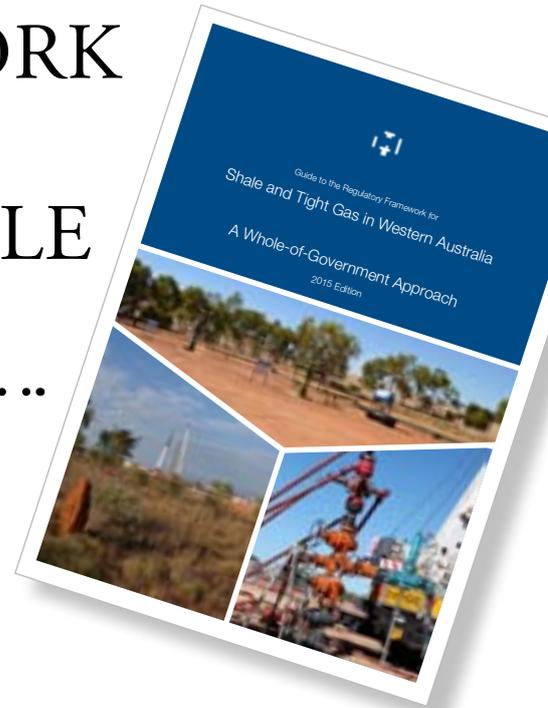
The framework document was coordinated by the Department of Mines and Petroleum (DMP), the lead agency for regulating the resources sector in Western Australia.

The 'Guide to the Regulatory Framework for Shale and Tight Gas in Western

Australia' has been endorsed by the Environmental Protection Authority, Office of the Environmental Protection Authority, and the Departments of Water, Health, Environment Regulation, Aboriginal Affairs, Parks and Wildlife and Planning.

"While WA's shale and tight gas industry is in the early stages of exploration, with any significant commercial production predicted to be about five to ten years away, it is important that there is clarity to industry and the public about the States' expectations and the legislation and regulations through which these expectations are enforced," DMP Executive Director Petroleum Jeff Haworth said.

He said the multi-agency collaborative approach was a key element in the development of the State's petroleum resources.



"Agencies are united by a common and overarching responsibility to manage risk, whether to the natural environment, human health or the amenity of communities," Mr Haworth said.

Department of Water spokesperson Executive Director Policy and Innovation Tad Bagdon said the early consideration of water related issues in the proposal process had been a significant achievement of the framework development, in line with public expectations.

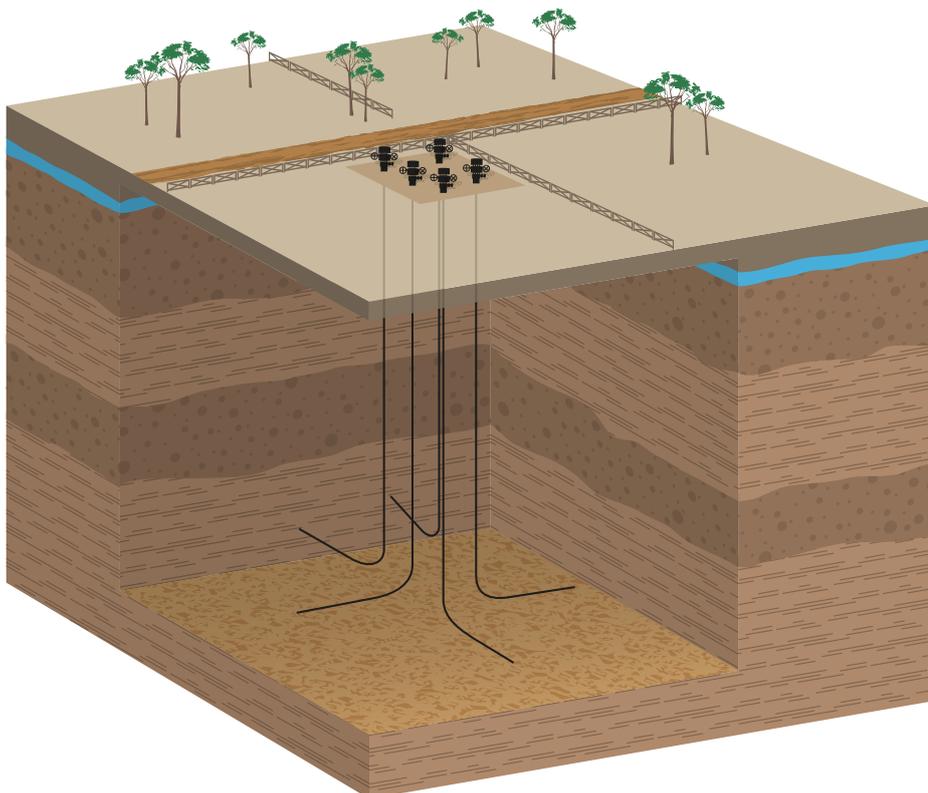
"The Department of Water's advice on water is used by DMP and the Environmental Protection Authority to work out what level of environmental assessment is needed on each proposal.

"By building in processes for early and sufficient consideration, the Department of Water makes sure that enough scientific information is available about risks to water resources before decisions are made by the agencies."

New regulations for the petroleum and geothermal industries that came into effect on 1 July 2015 are now the most stringent in Australia.

The Regulatory Framework sets out the regulatory requirements and expectations of the State Government and covers the need for industry to consult and engage with the community in a timely and ongoing manner throughout the life of a project.

The document is available on the DMP website at www.dmp.wa.gov.au ■



The framework document includes diagrams such as this one illustrating how multiple horizontal wells can be drilled in many directions below ground from a single multi-well pad.

REPORT IDENTIFIES SAFETY RISKS IN MINING

An extensive analysis of serious mining injuries has been conducted by the Department of Mines and Petroleum to improve understanding of injury risks and causes in Western Australia's mining industry.

State Mining Engineer Andrew Chaplyn said the department analysed 658 serious injuries, including three fatalities, reported by the mining industry between 1 July and 31 December, 2013.

"The analysis follows on from the department's review of 52 fatal accidents in the mining industry between 2000 and 2012," Mr Chaplyn said.

Risk profiles have been compared to establish if hazards and causation factors identified in the serious injury data are consistent with the results of the fatal accident review and this led to the independent identification of three main hazards.

"They are falling while working at height, being in the line of fire for objects or suspended loads, and being struck or crushed by machines and heavy components," Mr Chaplyn said.

Selected serious injury data was shown to be statistically consistent over a period of 10 years, and will be used to establish baseline standards for monitoring the effectiveness of fatality prevention strategies.

"The department is encouraging companies to build on the information available, and develop more comprehensive hazard and risk profiles," Mr Chaplyn said.

"In particular, job and task analysis should focus attention on critical tasks and activities where risks are heightened."



The Department of Mines and Petroleum has analysed 658 serious injuries as a part of its report on serious injuries in Western Australia's mining industry.

The department has been sharing the results of both these reports with key representative groups across Western Australia's mining industry and the most recent report was released by Mines and Petroleum Minister Bill Marmion.

Mr Marmion said the Serious Injuries Report was an extremely valuable resource for everyone involved in Western Australia's mining industry.

"The simple concept of 'golden safety rules' can reinforce critical awareness and controls, such as never start work if there is a risk of falling from height, never stand under anything that can fall on you, and never place any part of your body where it can be crushed," Mr Marmion said.

"Despite a fatality-free year in 2012 and six deaths in 2009, there have been on average

two to three deaths per year on WA mine sites. This report identifies that there are on average about 200 high consequence injuries every 12 months that have very similar causal factors to fatalities.

"Reviewing the rate of high severity injuries including amputations, fractures and crush injuries could help provide key indicators so more efforts can be focused on critical activities that may link to serious injuries or fatalities."

The report is available to download on the department's website (dmp.wa.gov.au) along with the review and analysis of fatalities that was released in 2013.

Mr Chaplyn said the department would continue analysing safety and injury data to provide information for industry.

"The recent reports highlight the importance of adopting a risk-based approach to mines safety which encourages development of site specific strategies that can be tailored to address site specific risks," Mr Chaplyn said.

"As we continue to move away from the older, more prescriptive style of regulation we need to ensure that information and education is available to industry.

"It also provides an opportunity for industry to share their collective knowledge around safety and encourage innovation by building and adapting that knowledge." ■

RESEARCH HELPS TACKLE MINE TAILINGS RISKS



Research by the University of Western Australia is making tailing dams safer and saving water. Photo: UWA.

The University of Western Australia (UWA) is addressing the persistent and serious problem of tailing storage affecting the mining industry worldwide.

UWA's Professor Andy Fourie said when mines stored tailings in large mounds that also held water, the structures occasionally failed, which can have disastrous effects for local communities and the environment if they contain contaminated slurries. Late last year, three people were killed after a tailings dam collapsed at an iron ore mine in Brazil.

Professor Fourie, who is head of UWA's School of Civil, Environmental and Mining

A PASSION FOR SAFETY

If you travel eighty-two kilometres north of the small Mid West town of Sandstone, you will come across a series of open pit mines that make up the Gidgee gold project.

Currently on care and maintenance, back in 1996 the mine employed more than 100 workers and was one of a number of mining projects found throughout Western Australia's Mid West region.

One of the members of Gidgee's 100 workers was Clinton Woosnam, working in his first job in the mining industry. The 21-year-old – who today is Western Australia's first Aboriginal Special Inspector of Mines – had recently completed his butcher's apprenticeship in Perth, but decided to change his career path.

"Working in the mining industry was something that had always interested me, so I decided to apply for a position at Gidgee," Mr Woosnam said.

He got a job as a sampler and pit technician, but it wasn't long before he sought to add further skills.

"While I was at Gidgee I completed my shotfirer's certificate and learned how to operate a blast hole drill rig," Mr Woosnam said.

Over the next decade, Mr Woosnam worked in a variety of roles at mine sites across the State – from feeding mill crushers and longhole drilling, to driving trucks and boggers, mixing shotcrete and leading charge up crews. As his career progressed, Mr Woosnam was given more responsibility and completed his underground supervisor's certificate of competency, which led to a job as an underground shift boss.



L–R: Members of the Mines Safety inspectorate Jim Boucaut, Neil Woodward, Faye Akbar, Clinton Woosnam, Jessica Crow and Waeel Ilahi, with Resources Safety Executive Director Simon Ridge.

Throughout his time in the industry, safety has always been at the forefront of Mr Woosnam's mind and it was this focus that led to his most recent job opportunity with the Department of Mines and Petroleum.

Mr Woosnam was officially sworn in as an inspector by Mines and Petroleum Minister Bill Marmion in July this year.

Mr Woosnam said he hoped to provide a career path that others could follow.

"I do hope that my appointment can encourage other Aboriginals to join the department," he said.

Mr Woosnam said working in the mining industry offered a rewarding career to anyone willing to work hard.

"The advice that I would give to anyone looking to work in the industry would be to have goals, and know what is required to achieve these goals," he said.

"Then it's a case of putting in the hard work, knowing it will pay off in the long run." ■

In July, four new mines inspectors were officially sworn in by Mines and Petroleum Minister Bill Marmion.

Clinton Woosnam, Warren Mitchell, Gary Clinch and Bradford Sheldrick completed six months of rigorous training and testing to qualify. All have extensive experience across the WA resources sector.

"Between them, these four new inspectors have spent more than 90 years working in the mining industry," Mr Marmion said.

"Not only do they have a comprehensive understanding of day-to-day operations, they also have a passion for safety.

"As inspectors they have an opportunity to use their skills and experience to make a difference to safety across Western Australia's mining industry."

Engineering, said an emerging solution involved treating tailings to thicken them or make them into a semi-paste, a process that could reduce water losses due to evaporation and help reduce operating costs.

Professor Fourie and Associate Professor Richard Jewell of the Australian Centre for Geomechanics at UWA are co-editors of *Paste and Thickened Tailings, A Guide*. The book is a collection of industry and academic articles regarded by many as the definitive reference for the new technology and is about to go into its third edition.

Professor Fourie said the School of Civil, Environmental and Mining Engineering played a key role in raising awareness of the emerging technology.

"We're certainly leading the way in terms of the technology transfer and we are conducting associated research," he said.

"We have a couple of PhD students at the school making advances in this area, but it's a worldwide initiative with some very good work also being done in Canada and elsewhere."

Professor Fourie said the use of thickened tailings had been evolving over the past 15 years and had been adopted at more

than a dozen mine sites around Australia – including the Mt Keith nickel mine in WA – and about 30 or 40 other mines around the world.

"At the Osborne mine in Queensland, they reported a 35-40 per cent saving in water with thickened tailings, and that's a heap of water," he said.

"It also has the advantage of reducing the risks of catastrophic failures."

The book is published by the Australian Centre for Geomechanics, a joint venture between UWA and the CSIRO (Commonwealth Scientific and Industrial Research Organisation). ■



*DMP Environment Executive Director
Dr Phil Gorey.*

POSITIVE RESULTS FOR MINING REHABILITATION FUND

Mining tenement holders are taking positive steps to reduce their environmental disturbance according to data collected before the closure of the second compulsory reporting period for Western Australia's Mining Rehabilitation Fund (MRF) on 30 July.

The data showed seven per cent more land was under rehabilitation in 2015 than 2014 and less disturbance was reported.

Department of Mines and Petroleum Executive Director Environment Dr Phil Gorey said these were positive indications that tenement holders were responding to the environmental incentives built into the MRF.

"One of the department's objectives when developing the MRF was to encourage good environmental practice through early and ongoing rehabilitation," Dr Gorey said.

"We did this by calculating levy payments based on the actual rehabilitation liability on a tenement at the reporting date.

"By rehabilitating early, tenement holders can reduce their future levy contributions or even be exempt from paying the levy if their rehabilitation liability falls below the A\$50,000 threshold."

The department recently developed an online calculator tool to help tenement holders calculate their MRF levy payments at different levels of disturbance.

A snapshot of the data submitted in MRF reports is made publicly available on the

DMP website once initial quality assurance processes have been completed.

"Making this data publicly available improves transparency and can assist industry to conduct research on tenements," Dr Gorey said.

"The community can access the data to gain a detailed picture of mining and exploration activities in the State.

"The data builds on information already collected by DMP during a project's approval process and ongoing monitoring."

Dr Gorey said that industry had been extremely supportive of the MRF and the move away from providing unconditional performance bonds as mining security.

During the initial non-compulsory year, companies voluntarily paid more than \$A6.7 million into the fund.

At the close of the 2014 compulsory reporting period, reports were submitted for 96.5 per cent of tenements, and the MRF team worked with tenement holders over the following months to ensure almost all outstanding reports were completed.

"At the close of the 2015 reporting period, 98 per cent of tenement holders had submitted their report," Dr Gorey said.

"The higher rate of compliance this year suggests tenement holders were not only made aware of their reporting obligations, but had the support they needed when navigating the online reporting system." ■

Draft Abandoned Mines Policy feedback

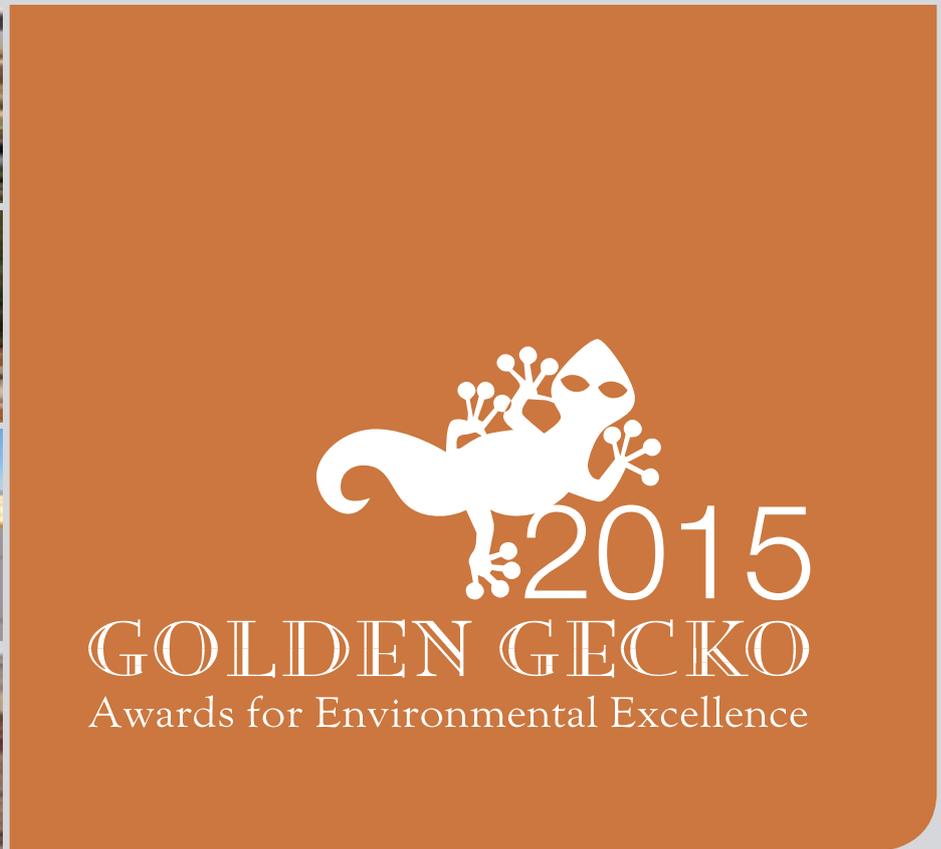
Feedback on an eight week consultation period for a draft Abandoned Mines Policy that will support decisions about prioritising, managing and rehabilitating legacy mine sites is now being reviewed by DMP staff.

Executive Director Environment Dr Phil Gorey said the introduction of the MRF meant Western Australia now had a dedicated fund to address problems posed by abandoned mines.

"It's important to have a robust framework in place to support decisions regarding the State's many legacy sites," he said.

"Feedback received through the consultation process is being reviewed and will be incorporated into the policy.

"Stakeholder engagement is an important stage in developing a robust policy to ensure MRF funds are allocated and prioritised to deliver the best outcomes for Western Australia, taking account of environmental, safety and heritage concerns." ■



WA COMPANIES VIE FOR 2015 GOLDEN GECKO AWARDS

Western Australian resources companies are continuing to push the boundaries of environmental excellence through innovative problem solving and the development of new technology.

Eight such companies are in the running for this year's prestigious Golden Gecko Awards for Environmental Excellence.

Projects vying for this year's Golden Gecko include the first use of absorption refrigeration technology on an Australian mine site, a tunnelling solution to avoid the environmental impacts of crossing a shoreline, and a project that preserves and maintains ecosystem integrity at the world's largest bulk-export port.

Department of Mines and Petroleum (DMP) Executive Director Environment Dr Phil Gorey said the quality of this year's Golden Gecko entries was outstanding and showed a strong commitment to environmentally responsible resources sector development.

"The eight projects contesting this year's Golden Gecko are all extremely different and worthy of the recognition that being a finalist in this award brings," Dr Gorey said.

"It's very pleasing that nominations were received from companies of all sizes as well as a not-for-profit organisation and a State Government authority."

The 24th annual Golden Gecko awards will be presented by Mines and

Petroleum Minister Bill Marmion at a ceremony on 29 October in East Perth.

More information on the awards and the nominated projects is available at www.dmp.wa.gov.au/goldengecko ■

THE EIGHT FINALISTS AND THEIR PROJECTS (PICTURED ABOVE) ARE:

- 1. Chevron Australia**
Wheatstone Micro-tunnel Project
- 2. Fortescue Metals Group Limited/Ziltek Pty Ltd/PT Environmental Services**
Better Environmental Outcomes from Hydrocarbon Spills using RemScanTM
- 3. Kalgoorlie Consolidated Gold Mines**
Gidji Emissions Reduction Project
- 4. Pilbara Mesquite Management Committee Inc**
Battling the Thorny Menaces through Corporate Alliances
- 5. Pilbara Ports Authority**
Mangrove Rehabilitation Program
- 6. Premier Coal Limited/Golder Associates**
Lake Kepwari Trial Flow-through
- 7. Rio Tinto Iron Ore (RTIO) Utilities Division**
West Angelas Fuel Hub
- 8. St Barbara Limited**
Gwalia Operations Absorption Chiller Upgrade

AGRICULTURE

East Kimberley – Ord – Ord/East Kimberley Expansion Project**WA STATE GOVERNMENT**

The State Government has invested \$322m to construct irrigation channels, roads and off-farm infrastructure on the Ord lands in the East Kimberley Region. A Development Agreement has been signed with Kimberley Agricultural Investment (KAI) for the lease and development of 13,400ha of irrigation land in the Goomig and Knox Plain areas. KAI, a subsidiary of China's Shanghai Zhongfu Group, proposes to establish a sugar industry in the Kununurra region and have recently begun cropping on the Goomig land. The State is also currently working towards the release of approximately 5000ha of Ord West Bank and Mantinea lands via a Request for Proposal process.

Expenditure: \$322m.

IRON ORE

Pilbara – BHP Billiton Iron Ore – Shiploaders 1 and 2**BHP BILLITON IRON ORE PTY LTD**

The tie-in of shiploader 2 was successfully completed in January 2015. There are currently no major projects in execution at BHP Billiton WA Iron Ore, and further growth in supply chain capacity to 270 Mtpa (100 per cent basis) is expected to be achieved without the need for additional fixed plant investment.

Expenditure: \$407m.

Employment: Construction: 500

IRON ORE PROCESSING

Pilbara – Cape Preston – Sino Iron CITIC PACIFIC

The Sino Iron project is located at Cape Preston, 100km south west of Karratha. Construction of the largest magnetite mining and processing project in Australia is at an advanced stage, with limited production from the first and second of six lines commencing in 2013. On completion, the project will comprise in-pit crushers, six autogenous and six ball mills, concentrators, 6Mtpa pellet plant, 25km slurry pipeline, combined cycle 450MW power station, new port and trans-shipment facilities, and a 51GL desalination plant. At full production the project will export up to 21.6 Mtpa of magnetite concentrate and 6 Mtpa of high grade pellets. The first shipment of ore occurred on 2 December 2013 and, as at March 2015, 2.2 million tonnes had been shipped from Cape Preston.

Expenditure: \$11.1b.

Employment: Construction: 4000; Operation: 500

AMMONIUM NITRATE

Pilbara – Burrup Industrial Estate Site D – Yara Pilbara Nitrates**YARA INTERNATIONAL ASA**

Yara Pilbara Nitrates Pty Ltd (YPNPL) is an incorporated joint venture between Yara International ASA (Yara), Orica Limited (Orica) and Apache Corporation (Apache). YPNPL has executed an Engineering, Procurement and Construction (EPC) contract for the construction of a world class circa 350,000tpa Technical Ammonium Nitrate (TAN) plant to be located on the Burrup Peninsula. Ammonia feedstock

will be supplied from Yara Pilbara Fertilisers Pty Ltd (YFPPL), which operates its facility directly adjacent to the proposed location for the new TAN plant. Yara will be the operator of the TAN plant and Orica will manage the product sales and distribution of the TAN product. Yara and Orica each have a 45 per cent interest in the joint venture and Apache the remaining 10 per cent. It is intended that all manufactured product will be sold into the Pilbara region. Work on the project has commenced and it is expected that the new plant will be commissioned in late 2015, with nameplate capacity production rates expected by the end of 2016.

Expenditure: \$800m.

Employment: Construction: 500; Operation: 65

HEAVY MINERAL SANDS

Keysbrook – Heavy Mineral Sands Mine MZI RESOURCES LTD

Construction of the Keysbrook Mineral Sands Project, located near the township of Keysbrook approximately 70km south of Perth, is well advanced. The project comprises a new mine and wet concentration plant, and upgrades to the existing mineral separation plant owned by Doral Mineral Sands in Picton, near Bunbury. Keysbrook has a mineral resource of 78.9Mt at an average grade of 2.5 per cent total heavy mineral (THM) and an ore reserve of 670,000t THM, which underpins the first 5.5 years of operations. Based on the total mineral resource estimate, the potential mine life could be more than 15 years. Approximately 110,000tpa of heavy mineral concentrate from Keysbrook will be trucked 120km south to Doral's mineral separation plant in Picton where it will be toll treated under a processing agreement. The project is expected to produce 67,500tpa of leucoxene products and 28,700tpa of zircon concentrate, which will be exported from the Bunbury Port. Commissioning and first production is scheduled for Q4 2015.

Expenditure: \$70m.

Employment: Construction: 100; Operation: 50

IRON ORE

Pilbara – Roy Hill Iron Ore Mine & Infrastructure ROY HILL HOLDINGS PTY LTD

Roy Hill Holdings is a private company which is majority-owned by Hancock Prospecting Pty Ltd, and also has key international investment partners with strategic steel-making interests. It is developing the Roy Hill iron ore project located 115km north of Newman. This project is expected to come into production in 2015 and will produce 55Mtpa of iron ore for 20 years following ramp-up. The project includes mine development, mine processing infrastructure, a new heavy-haul railway, and significant new port facilities at Port Hedland's inner harbour. All primary environmental and other approvals have been secured. Construction of the 344km heavy haul railway is completed and construction of the mine, port infrastructure is considerably advanced with the project passing the 86 per cent completion in July 2015. Contractor and Owner/Operator mining is underway with more than 12Mt of ore stockpiled. Roy Hill secured the world's largest ever debt financing package for a mining project of US\$7.2b in March 2014.

Expenditure: \$10b.

Employment: Construction: 5300; Operation: 2000

OIL & GAS DEVELOPMENTS

Carnarvon Basin – Greater Western Flank Phase 1**WOODSIDE ENERGY**

The Greater Western Flank Phase 1 Project will develop the Goodwyn GH and Tidepole fields, via a subsea tie-back to the existing Goodwyn A Platform. The project remains on schedule for start-up expected in early 2016.

Expenditure: \$2.5b.

Carnarvon Basin – Persephone Project**WOODSIDE ENERGY**

Woodside Energy Ltd, as operator of the North West Shelf Joint Venture is developing the Persephone gas field. The development involves two subsea wells and an 8km subsea tieback to the existing North Rankin Complex. Fabrication activities and offshore brownfield work has commenced, with start-up expected in early 2018

Expenditure: \$1.2b.

Carnarvon Offshore Basin – Barrow Island – Gorgon Project**GORGON JOINT VENTURE**

The Gorgon Foundation Project on Barrow Island, now in its sixth year of construction, is a three train LNG development with a nameplate capacity of 15.6 Mtpa and includes a domestic gas plant capable of delivering at least 300TJ/d of gas to the mainland. Cost estimates for the project construction have been reassessed at \$55b (US\$54b) following a cost and schedule review conducted by Chevron in December 2013. The project involves the processing of gas from both the Gorgon and Jansz/lo gas fields and includes potentially the largest commercial CO₂ geosequestration project in the world. Train one start up and first shipments of LNG are expected toward the end of 2015 with trains two and three being commissioned in 2016.

Expenditure: \$55b.

Employment: Construction: 8000; Operation: 300

Kalgoorlie – Tropicana Gas Pipeline Project ANGLGOLD ASHANTI/APA GROUP JOINT VENTURE

APA Operations Pty Ltd, a subsidiary company within the APA Group (APA), has commenced construction of a \$140m 294km high pressure natural gas pipeline to convey gas from the Murrin Murrin gas lateral pipeline (licence PL 36) to the Sunrise Dam Gold Mine and to the Tropicana Gold Mine. Both gold mines are operated by AngloGold Ashanti Australia (AGA). The pipeline is called the Eastern Goldfields Gas Pipeline (EGP) and all licences and government approvals are in place. Construction on the pipeline commenced in May 2015 and is expected to be completed by January 2016 with first gas delivery planned for early 2016. A pipeline licence (PL 108) was granted on 29 January 2015 under the *Petroleum Pipelines Act 1969*.

Expenditure: \$140m.

Employment: Construction: 250

Pilbara – Wheatstone LNG Development CHEVRON AUSTRALIA PTY LTD

Chevron Australia Pty Ltd as Operator of the Wheatstone Project is currently working towards the construction of two LNG trains, a domestic

gas plant and port facilities at the Ashburton North Strategic Industrial Area near Onslow. The project will initially produce 8.9Mtpa of LNG and have a 200TJ per day domestic gas plant connected to the Dampier-to-Bunbury Natural Gas Pipeline. The construction schedule is approximately 60 per cent completed. The first export of LNG is scheduled for late 2016.

Expenditure: \$29b.

Employment: Construction: 6500; Operation: 400

POWER STATIONS

Boodarie Industrial Estate – South Hedland Power Station

TRANSALTA

In July 2014, TransAlta Energy (Australia) Pty Ltd announced it will build, own and operate a 150 megawatt power station in South Hedland's Boodarie Industrial Estate. The plant will consist of a combined cycle gas plant, which is a reliable, highly-efficient, low-cost and clean process of generating electricity, featuring both natural gas and steam turbines. The \$570 million investment will help meet the future energy needs of the region through a 25-year agreement with both Horizon Power and Fortescue Metals Group. The plant is being designed to allow for expansion and there is a possibility that other customers may be added in the future. Construction commenced in February 2015 and is expected to create up to 250 jobs. Full commissioning is expected to be complete mid 2017.

Expenditure: \$570m.

Employment: Construction: 250; Operation: 20

AMMONIA/UREA

Shotts Industrial Park – Collie Coal to Urea PERDAMAN CHEMICALS AND FERTILISERS PTY LTD

Perdaman Chemical and Fertilisers Pty Ltd is proposing to develop an \$3.5b coal to urea plant at the new Shotts Industrial Park, near Collie. The plant will use proven coal gasification and fertiliser production technologies. Around 2.7Mtpa of coal will be used to produce approximately 2Mtpa of urea, primarily for export. The urea will be transported to Bunbury Port by rail. The company has received all its environmental and all other approvals from both the Western Australian and Commonwealth Governments. The project is on hold as the company is still seeking to finalise a suitable domestic coal supply arrangement prior to achieving its financial investment decision.

Expenditure: \$3.9b.

Employment: Construction: 2000; Operation: 200

HEAVY MINERAL SANDS

Shark Bay – Coburn Zircon Project STRANDLINE RESOURCES LIMITED

Strandline proposes to develop the Coburn zircon project, located south of Shark Bay and approximately 250km north of Geraldton. It contains total ore reserves of 308Mt at an average grade of 1.2 per cent heavy minerals, all of which lie within the portion of the project area that has received government environmental approvals for mining. At a mining rate of 23.4Mtpa, the project is expected to produce 49,500tpa of zircon, 109,000tpa of chloride ilmenite and 23,500tpa of a mixed rutile-leucoxene over its 19 year mine

life. The company has secured all of the approvals required to commence mining and processing operations at Coburn, and is continuing to pursue discussions with parties interested in becoming a strategic partner in the project. A recent Cost Review undertaken by Strandline identified a potential saving of \$29m from the previous capital cost estimate of \$202m.

Expenditure: \$173m.

Employment: Construction: 170; Operation: 110

INFRASTRUCTURE

Dampier Peninsula – Browse LNG Precinct WA STATE GOVERNMENT

The State Government is developing the Browse Liquefied Natural Gas (LNG) Precinct approximately 60km north of Broome. By focussing development at a suitable location, the Precinct will minimise the environmental footprint of gas processing and any social impacts in the region while maximising opportunities for the local community to benefit from development of the Browse Basin gas fields. The Precinct will have the capacity to accommodate at least two LNG processing operations, with a combined capacity of up to 50Mtpa. The State Government has acquired the land for the Precinct and will secure all relevant approvals to ensure the Precinct is 'project ready'.

Pilbara – Anketell – Anketell Port and SIA (Strategic Industrial Area)

WA STATE GOVERNMENT

The Anketell project involves the establishment of a multi-user, multi-commodity deep water port and associated strategic industrial area (SIA) at Anketell, located 30km east of Karratha on the Pilbara coast. The port and associated infrastructure will be a proponent-funded but State controlled Port which will be managed and operated under the *Port Authorities Act 1999*. The strategic industrial land will fall under the jurisdiction of the Western Australian Land Authority (LandCorp). During its initial phase, it is expected that Anketell will be an iron ore export facility and that, at its peak capacity, not less than 350Mtpa will be exported to customers, mainly in Asia. A number of iron ore producers with mining assets in the Pilbara have expressed interest in using the planned facilities at Anketell. It is likely that the Port will be developed in stages to accord with the development of the various mining operations which are located throughout the Pilbara. The Anketell Port Master Plan was released in June 2014 and a downloadable copy can be obtained from the DSD website.

IRON ORE

Pilbara – West Pilbara Iron Ore Project API MANAGEMENT PTY LTD

The Australian Premium Iron Joint Venture is proposing to develop the West Pilbara Iron Ore Project. Stage 1 of the project is based on the production of 40Mtpa of direct shipping iron ore from deposits, including Red Hill and Mt Stuart deposits, located 35-80km south west of Pannawonica. The ore will be transported by a new heavy haul railway for export via the proposed multi-user 350Mtpa port at Anketell. Subject to the successful completion of feasibility and environmental studies, and receipt of government regulatory approvals, the company anticipates construction to commence following a decision

to proceed by the joint venturers and completion of funding arrangements. State and Federal environmental approvals for the mine, rail and port elements of the project are in place.

Expenditure: \$7b.

Employment: Construction: 3500; Operation: 1000

NICKEL

Mt Windarra – Windarra Nickel

POSEIDON NICKEL NL

Poseidon Nickel Ltd has submitted a project development proposal for assessment for the redevelopment of the Mt Windarra underground nickel mine and associated project infrastructure at Mt Windarra. Poseidon is forecast to commence mining in 2016.

Expenditure: \$12m.

Employment: Construction: 50; Operation: 100

OIL AND GAS DEVELOPMENT

Canning Basin – Buru Canning Basin Tight Gas BURU ENERGY

The Buru Energy/Mitsubishi joint venture (JV) is undertaking the Laurel Formation Tight Gas Pilot Exploration (TGS) Program to test the commercial potential of the Laurel Formation, a large onshore natural gas resource located in the Canning Basin. Buru Energy recently selected Condor Energy as the preferred service provider for the next phase of the program which will involve the hydraulic stimulation of up to four wells across the Canning Basin. This phase of the TGS program will determine gas flows from the target reservoir. In preparation, the JV is continuing with a baseline groundwater monitoring program to detect any effect of activities on groundwater. This is considered most unlikely. Should the resource prove to be commercially viable, gas from the Canning Basin will provide energy security to WA domestic and industrial markets. Under a State Agreement the JV, upon proving up sufficient reserves, is obligated to supply into the WA domestic market at least 1500 petajoules of gas.

Expenditure: \$40m.

Employment: Operation: 30

URANIUM

Northern Goldfields – Yeelirrie – Yeelirrie Uraniun

CAMECO AUSTRALIA PTY LTD

Cameco Australia proposes to develop the Yeelirrie project in the North-eastern Goldfields, near Wiluna. The project entails open cut mining of shallow deposits of uranium ore, treatment in a plant to be established at the site, and development of associated infrastructure. The project will process up to 2.4mtpa of uranium ore over about 17 years. The resultant uranium oxide will be transported to South Australia by road for export to overseas markets. The environmental approval process has commenced. Cameco will advance the project at a pace aligned with market conditions.

Employment: Construction: 500; Operation: 225

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Significant resource projects in Western Australia

Western Australia continues to lead the way as Australia's premier resources investment destination. There are more than A\$121 billion worth of projects either committed or under consideration for the State during the next few years. These would create more than 30,000 construction jobs and more than 4700 permanent jobs.

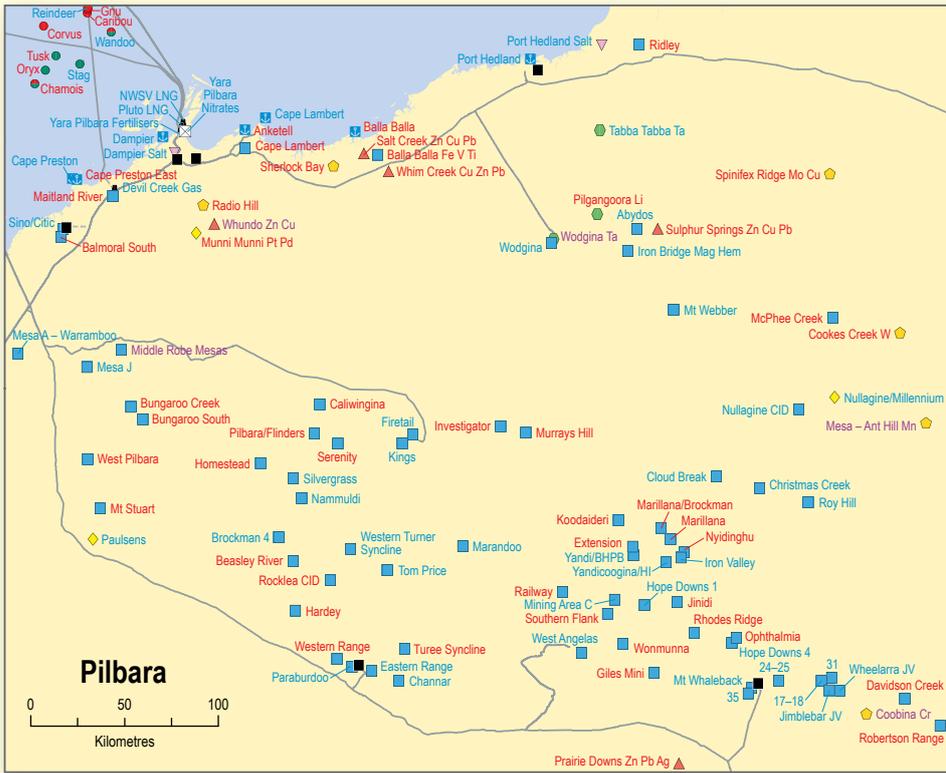
This section is intended as an overview and does not constitute an exhaustive list of projects within the Western Australian resources industry. Based on company announcements.

	Project Value (estimated A\$m)		Employment	
	Construction	Permanent		
Iron and Steel				
API Management Pty Ltd – West Pilbara Iron Ore Project	7000	3500	1000	
BHP Billiton Iron Ore – Shiploaders 1 and 2 Replacement	407	500	n/a	
CITIC Pacific – Cape Preston Mine & Processing Projects	11100	4000	500	
Roy Hill Holdings Pty Ltd – Roy Hill Iron Ore Mine & Infrastructure	10000	5300	2000	
Sub Total	28507	13300	3500	
Oil, Gas and Condensate				
Browse LNG Precinct	n/a	n/a	n/a	
Buru Energy – Buru Canning Basin Tight Gas	40	n/a	30	
Chevron – Wheatstone LNG	29000	6500	400	
Gorgon Joint Venture Gas Processing Project	55000	8000 up 1750	300	
Woodside Energy – Greater Western Flank Phase 1	2500	n/a	n/a	
Woodside Energy – Persephone	1200	n/a	n/a	
Sub Total	87740	14500	730	
Other				
Cameco Australia – Yeelirrie Uranium	n/a	500	225	
Ord East Kimberley Expansion Project	322	n/a	n/a	
Perdaman Chemicals & Fertilisers – Coal-to-Urea Plant	3900	2000	200	
TransAlta – South Hedland Power Station	570	250	20	
Yara International ASA – Yara Pilbara Nitrates	800	500	65	
Yara International ASA – Yara Pilbara Nitrates	800	500	65	
Sub Total	5592	3250	510	
TOTAL	121839	31050	4740	

All currency figures are in Australian dollars unless otherwise specified.

Abbreviations Key

b	billion	Mt	million tonnes
EPC	Engineering, Procurement and Construction	Mtpa	million tonnes per annum
GL	gigalitres	MW	megawatts
ha	hectares	t	tonnes
JV	joint venture	THM	total heavy mineral
km	kilometres	TJ	terajoules
LNG	liquefied natural gas	tpa	tonnes per annum
m	million		



Mineral symbols		Commodities	
◆	Precious metal Au (or as shown)	Ag.....Silver	Al.....Alumina
◆	Steel alloy metal Ni (or as shown)	Au.....Gold	Cr.....Chromium
●	Speciality metal Ti-Zr (or as shown)	Cu.....Copper	Fe.....Iron
▲	Base metal	Hem.....Hematite	K.....Potassium
■	Iron	Li.....Lithium	LNG.....Liquefied natural gas
■	Alumina All sites are bauxite	Mo.....Molybdenum	LPG.....Liquefied petroleum gas
●	Coal and lignite	Ni.....Nickel	Mag.....Magnetite
▽	Industrial mineral	Pb.....Lead	MgCO ₃Magnesite
⊠	Processing plant	Pd.....Palladium	Mica.....Mica
		Phos.....Phosphate	Mn.....Manganese
		Plat.....Platinum	REE.....Rare earth elements
		Sid.....Silica sand	Ta.....Tantalum
		Ti.....Titanium	Tc.....Talc
		V.....Vanadium	Ti.....Titanium
		W.....Tungsten	V.....Vanadium
		Zn.....Zinc	W.....Tungsten
		Zr.....Zirconium	Zn.....Zinc
			Zr.....Zirconium

Petroleum symbols	
●	Gas field
●	Oil field
●	Oil and gas field
○	Significant gas discovery
▲	Processing plant
—	Oil / gas pipeline, operating
- - -	Oil / gas pipeline, proposed

Infrastructure	
■	Power plant
■	Irrigation / water / desalination
■	Port

Data for offshore Commonwealth controlled waters is up-to-date as of December 2013. Enquiries for latest information for Commonwealth controlled waters is available from the National Offshore Petroleum Titles Administrator (NOPTA) at <info@noppta.gov.au>

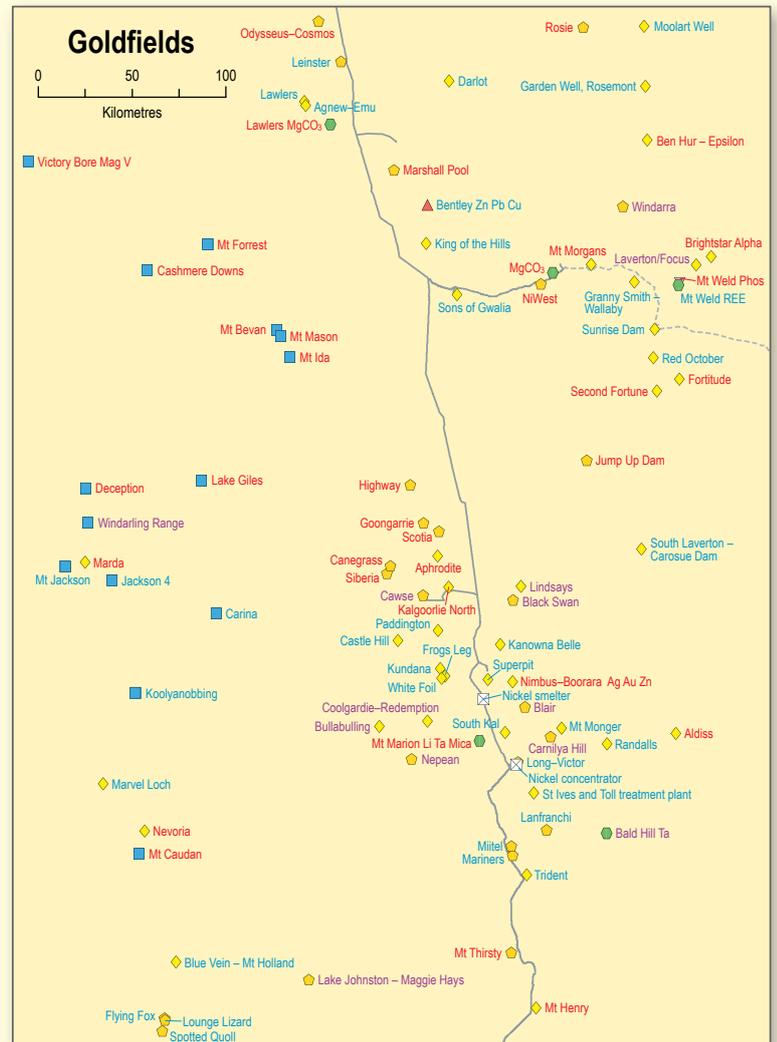


Project labels:

Projects operating or currently under development with an actual or anticipated value of production greater than A\$10 Million are shown in blue

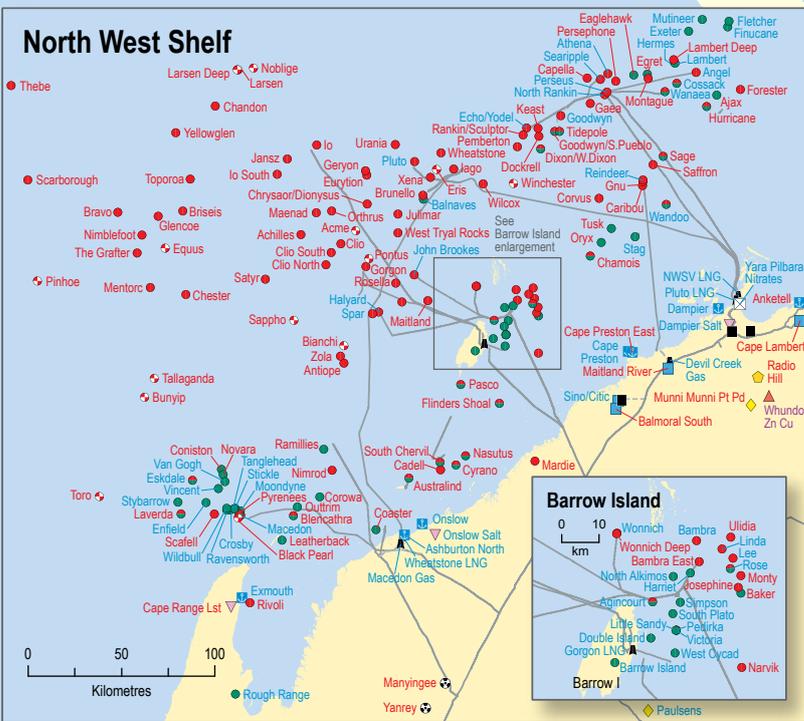
Proposed or potential projects with a capital expenditure greater than A\$20 Million are shown in red

Projects under care and maintenance are shown in purple



Kwinana-Rockingham	
⊠	Alumina refinery
⊠	Ammonium nitrate
⊠	Bulk terminal
⊠	Cement and lime
⊠	Chlor alkali
⊠	Desalination
⊠	Fused alumina
⊠	Fused zirconia
▲	LNG
▲	LPG
⊠	Nickel refinery
▲	Oil refinery
⊠	Power station
⊠	Sodium cyanide
⊠	Titanium pigment
⊠	Zirconia

North West Shelf



Major Resource Projects September 2015

Project labels:

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Proposed or potential projects with a capital expenditure greater than A\$20 Million are shown in red

Projects under care and maintenance are shown in purple



Commodities

- Ag.....Silver
- Au.....Gold
- Co.....Cobalt
- Cu.....Copper
- Dmd.....Diamond
- Fe.....Iron
- Fl.....Fluorite
- Gp.....Gypsum
- Gr.....Graphite
- Grt.....Garnet
- K.....Potassium
- Kin.....Kaolin
- Lst.....Limestone
- LNG.....Liquefied natural gas
- Mag.....Magnetite
- Mn.....Manganese
- Nb.....Niobium
- Ni.....Nickel
- Pb.....Lead
- Pd.....Palladium
- PGE.....Platinum group elements
- Pt.....Platinum
- REE.....Rare earth elements
- Ti.....Titanium
- V.....Vanadium
- W.....Tungsten
- Zn.....Zinc
- Zr.....Zirconium

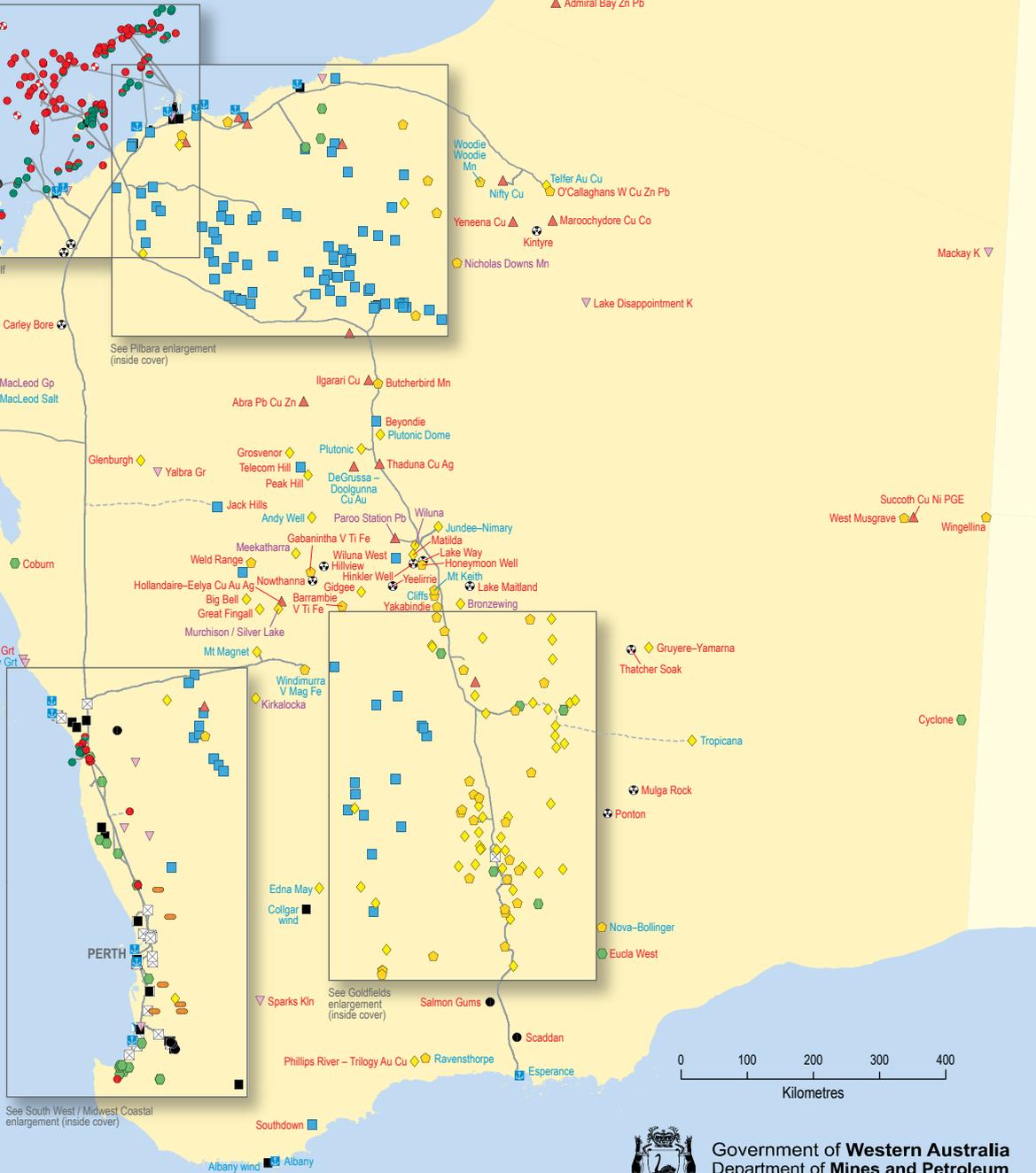
Mineral symbols

- ☆ Precious mineral
- Dmd Diamond
- ◆ Precious metal
- Au (or as shown)
- ◆ Steel alloy metal
- Ni (or as shown)
- Speciality metal
- Ti-Zr (or as shown)
- ▲ Base metal
- Iron
- Alumina
- All sites are bauxite
- Coal and lignite
- ⊛ Uranium
- ▽ Industrial mineral
- ⊠ Processing plant
- Petroleum symbols
- Gas field
- Oil field
- Oil and gas field
- Significant gas discovery
- Significant oil and gas discovery
- ▲ Processing plant
- Oil / gas pipeline, operating
- - - Oil / gas pipeline, proposed

Infrastructure

- Power plant
- ▵ Irrigation / water / desalination
- Port

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