

SEPTEMBER 2012

PETROLEUM

IN WESTERN AUSTRALIA

WESTERN AUSTRALIA'S DIGEST OF PETROLEUM EXPLORATION, DEVELOPMENT AND PRODUCTION



Contents



Mobilising equipment and materials to the Nicolay 1 well site
(Photo courtesy of New Standard Energy)

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Cover photo: Early morning at Arrowsmith 2
in the northern Perth Basin
(Photo courtesy of Norwest Energy)

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WESTERN AUSTRALIA

Opportunities to Explore

BIDS INVITED FOR ACREAGE



Courtesy Empire Oil and Gas

- There are four release areas in the southern Canning Basin. This region is considered prospective for Ordovician-sourced (mostly the Goldwyer Formation) hydrocarbons, of both conventional type and shale gas. There may be potential for salt-related plays.

Perth Basin

There are three release areas in the onshore Perth Basin. Area size ranges from 75 km² to 717 km².

- There is one release area in the onshore southern Perth Basin, which has a Permian section with likely mature source rocks and sandstone reservoir intervals. Infrastructure is nearby including the port city of Bunbury.
- There are two release areas in the northern Perth Basin, a region noted for its Permian and Jurassic oil and gas production, and infrastructure.

Northern Carnarvon Basin

There are two release areas in the highly prospective offshore Northern Carnarvon Basin. A combined release area is 1742 km² in size. The other area is 1441 km² in size. Targets may include Cretaceous, Jurassic and Triassic sandstones.

Bids close for the two Dampier Peninsula areas on 6 December 2012.

Bids for the remaining release areas close on 18 April 2013.

Acreage release DVD packages are available from DMP and a web version is also available:

www.dmp.wa.gov.au/acreage_release

Acreage release packages contain relevant information about the release areas, land access and how to make a valid application for an Exploration Permit.



GEOHERMAL ACREAGE

Acreage is available for the whole of the State not covered by permits or applications. Application is by a Geothermal Special Prospecting Authority (GSPA) with Acreage Option (AO).

Companies are invited to apply for areas each with size up to 160 5'x5' graticular blocks.

Companies interested in geothermal acreage are allowed to bid for multiple areas.

Geothermal acreage information is available from DMP on the web at:
www.dmp.wa.gov.au/acreage_release

FURTHER INFORMATION

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PETROLEUM ACREAGE

Canning Basin

There are eight onshore release areas in the Canning Basin with size ranging from 1849 km² to 4153 km².

- The two release areas on the Dampier Peninsula have an earlier closing date. These areas are situated in or adjacent to the Fitzroy Trough which is noted for the Carboniferous Yulleroo gas-condensate accumulation and the recent exciting Ungani oil discovery.
- The two release areas in the southwest Canning Basin may have targets in Permian and pre-Permian sequences.



Hon. Norman Moore MLC
Minister for Mines and Petroleum

Minister's Message

This will be my last Minister's Message for Petroleum in WA before I retire from politics next year.

It has been an absolute pleasure to serve the people of Western Australia, particularly as the Minister for such a vital sector.

If Western Australia is the economic engine of Australia, then the resources industry is providing the fuel.

In my previous message, I reflected on the changes I have seen in the petroleum industry since I first entered parliament in 1977. For my final message I would like to look to the future.

In the coming years there will be a number of internationally significant LNG projects developed in Western Australia.

In order to aid the delivery of these projects, the State Government is developing multi-user infrastructure in two strategic areas – Ashburton North and James Price Point.

These two developments will promote the efficient use of infrastructure, and reduce costs and risks for proponents. They will also minimise environmental and social impacts.

The Ashburton North facility will aid the development of gas discoveries on the Exmouth Plateau, which are largely undeveloped.

Chevron's \$23 billion Wheatstone project will be located here, alongside BHP Billiton and Apache Energy's Macedon domestic gas facility. This project is expected to start producing in 2013.

The Wheatstone project has approval to expand to 25 million tonnes per year of LNG, with first LNG expected in 2016. The project will create an estimated 5000 jobs during peak construction and a further 400 during operation.

The proposed LNG precinct at James Price Point will be capable of hosting LNG facilities for at least two proponents, producing up to 50 million tonnes of LNG per year, starting in 2015–16.

James Price Point was selected from 43 sites, taking into account a number of factors including technical, environmental, and indigenous heritage issues; proximity to gasfields and existing infrastructure; and impacts on local communities.

Western Australia is also at the forefront of technological innovation. This State will host the world's first floating LNG (FLNG) project, the Prelude FLNG development. This project has the potential to open up a number of previously uneconomic gas reserves for development and will be a remarkable leap forward for the industry.

The Gorgon project also puts Western Australia at the forefront of carbon dioxide geological storage, being the largest proposed commercial CCS project in the world.

The department is developing Greenhouse Gas legislation to be introduced in 2013, which will enable other projects, such as the South West Hub flagship CCS project to progress.

These developments, and more, will see Western Australia's production capacity increase to more than 50 million tonnes by 2018. This has the potential to make Australia the world's second largest producer of LNG.

Developments in other areas look set to add to this potential. As I have previously mentioned WA's onshore shale gas resources have been estimated at more than double the amount of currently known offshore natural gas reserves in WA adjacent offshore areas.

Exploration for shale gas resources in Western Australia is still in its infancy. However, international companies are becoming increasingly interested in Western Australian shale.

Investment in the emerging unconventional gas sector, is welcome, but it is vital the Department of Mines and Petroleum (DMP) provides the level of regulatory transparency expected by the Western Australian community.

The department has recognised this need and is working to ensure public concerns are addressed. As a part of this process, DMP has participated in a number of community engagement sessions in regional WA. In addition, environment regulations have been created and resource management and administration regulations and their respective guidelines are being developed.

Industry has already seen significant reforms to improve safety across the sector. Last year the *Petroleum and Geothermal Energy Safety Levies Act 2011* was introduced. This ensures safety regulatory services are adequately funded, now and into the future, and used to enhance leading industry practice through continuous improvement processes.

I am extremely proud of the department's achievements since I became Minister in this Government.

It will be the job of the next Government to make the most of the potential this sector offers the great State of Western Australia. ■



Bill Tinapple

Executive Director
Petroleum Division

Executive Director's Message – Proof of Concept for Shale Gas for Western Australia

Although there have been encouraging indications, there have been very few shale gas wells drilled and no likely commercial flows in Australia. Beach Energy has operated the best flow of 56,634 m³/d (2 MMscf/d) post fracture stimulation from the Encounter 1 well in the Cooper Basin Nappamerri Trough.

However, as this publication goes to press, two proof of concept flows, from Arrowsmith 2 and Woodada Deep 1, post fracture stimulation have occurred and gas to surface has been reported. Preparations for fracture stimulation at the third well, Senecio 2, are currently underway. These are the only shale gas fracture stimulation activities projected for the State this year.

The time required to achieve the tests also are an indication of the time required for exploration. The wells were drilled two and a half years ago, cores taken and analysed, which indicated the prospectivity for fracture stimulation. Two of the fracture

stimulation activities, Arrowsmith and Woodada Deep, were referred to the Environmental Protection Authority (EPA) and then its decision was appealed to the Minister for Environment. Equipment that had been contracted was demobilised and had to be again contracted and mobilised.

Hopefully, the fracture stimulation will demonstrate the potential for commercial production. However, other steps will have to be undertaken prior to decisions for development. It is expected that horizontal drilling and stimulation will be utilised to increase gas flows. Seismic will likely be required, as well as further appraisal drilling in order to determine the extent of the resources.

Nevertheless, given good flows and the nearness to pipeline infrastructure, these proof of concept tests will be a turning point for Western Australia's gas supply outlook, similar to the discovery of the Dongara gasfield and commitment to gas supply in the early 1970s and the commitment to

North West Shelf gas supply and the building of the DBNG Pipeline in the early 1980s.

As indicated in the previous issue, the US Energy Information Administration (EIA) estimate of risked recoverable shale gas for WA was 8155 Gm³ (288 Tcf), including Perth Basin shale gas of 1671 Gm³ (59 Tcf).

Of course, growth of unconventional gas and oil will depend on getting the regulatory framework right, which DMP is continuing to do. Following an independent review, environment regulations have been written and resource management and administration regulations are being drafted. Closer collaboration with other government agencies have also been established. Getting the regulatory framework right will need to be a continuous improvement process. DMP is also developing publicly available information to assure Western Australians that activities will be appropriately regulated to minimise any risks to groundwater resources, the environment and public health. ■



Arrowsmith 2 flare
(Photo courtesy of Norwest Energy)



Jeffrey Haworth

Director Technology, Petroleum and Geothermal Petroleum Division

Director's Message – Well Integrity

With the current public debate about unconventional gas development, there have been some misleading statements surrounding well integrity that need to be addressed, especially around the regulation of the petroleum industry in Western Australia.

All petroleum and geothermal wells drilled under the onshore and offshore State legislation are regulated by the Department of Mines and Petroleum (DMP) for safety, environment and well integrity. Operators are required, before commencing any well activities, to submit an application, Environment Plan and Safety Case for approval. The Environment Plan is assessed by the Environment Division of DMP, the Safety Case by the Resource Safety Division and the application by the Petroleum Division. These are not assessed in isolation; rather there is collaboration between the divisions and the operator during the assessment process.

The main principle criteria behind the assessments being made are that the operations meet "good oilfield practice" and risks are as low as reasonably possible (ALARP). The general public, after the Macondo and other incidents, may question "good oilfield practice"; however, investigations into these incidents have shown good oilfield practice was not adhered to.

It is the regulator's role to ensure operators are adhering to good oilfield practice and actually doing what they said they would do in their approved documentation. For the subsurface, this is performed in several ways as described below. Environment and Safety divisions also have audit procedures, however, my main focus is on the subsurface.

Well Integrity

Well integrity is designed to ensure the well and any activities within it are confined to the well and producing interval. Primary of all DMP's concerns in the subsurface are the protection of aquifers and the protection of resources. Design of casing and cementing programs is reviewed to ensure they are fit for purpose and meet recognised, international industry standards. In the onshore the following casing design is recommended:

Conductor casing. This casing is set from surface to approximately 50 m depth and is designed to prevent unconsolidated surface sediment from collapsing into the well and also protect shallow surficial aquifers. It is cemented to surface as standard procedure.

Surface casing. This casing is designed to be set below the potable aquifers and in Western Australia is usually set at approximately 800 m depth. Again it is cemented to surface as standard practice. It is also the casing point where the blowout preventer is installed on the well.

Intermediate casing (optional). This may be used for deeper wells to reduce the amount of open hole to manage when drilling to the target. Cementing procedures are to meet international standards.

Production casing or liner. This is the final casing set for a production well. If it is casing, it will run up to surface; if it is a liner, it will be set inside the previous casing at a sufficient height above the casing shoe. Cementing procedures are to meet international standards.

DMP reviews casing programs to ensure the casing proposed meets the requirements and tolerances expected. It also requires samples of the cement used to be kept and that when cementing is complete, the casing is pressure tested and five metres of new formation is drilled and a leak off test is conducted to test the integrity of the casing seat.

In some circumstances, DMP requires a cement bond log be run to ensure the cement has bonded to the casing and formation along the full extent of the casing.

Monitoring

DMP monitors all subsurface operations through several mechanisms.

- The application must cite recognised, international standards applicable to the particular operations, material and equipment used on the well. DMP then monitors the operator's adherence to those standards.
- DMP staff attend pre-spud meetings and HAZID and HAZOP meetings prior to operations commencing.
- Operators are required to submit detailed daily reports during the operation.
- DMP inspectors may visit the site to witness and report on operations.
- Any variation to the well design or major change to operations must be approved by DMP before proceeding.
- Final reports and data are to be submitted to DMP which can then be compared to the original application.

The Future

DMP, as part of a national process, is moving its regulations from the current Schedules to an objective based set of regulations. As part of this process, the *Resource Management and Administration Regulations*, which cover well operations, field management and production, field abandonment and data submission, are being developed along with guidelines and checklists.

These regulations will be submitted for public comment as part of the process and the current timetable aims to have the regulations ready for government approval by the end of 2012.

The regulations will assist the government in its goals to make regulation transparent and consistent and allow for continuous improvement as part of DMP's leading practice philosophy.

In conclusion, the main message I wish to impart is that well integrity is currently strongly regulated in Western Australia to ensure safety and the environment is protected and that subsurface resources, including potable aquifers are also protected. The move to regulations for the subsurface will reinforce transparent and consistent regulation into the future. ■

Petroleum Exploration, Development and Production Activity in Western Australia in 2012

Mike Middleton

General Manager
Assessment and Compliance
Resources Branch



Setting dog collar
(Photo courtesy of Norwest Energy)

Highlights from January to June 2012

This article highlights petroleum exploration, production and development activities for the second half of the 2011–2012 fiscal year. Production, reserves, drilling, and seismic survey statistical summary tables for the Western Australian onshore and territorial waters covering this period can be found in the back of the magazine. A summary of activities carried out in the 2011 calendar year can be found in the April 2012 edition of *Petroleum in Western Australia*.

It should be noted that from 1 January 2012, the Minister for Mines and Petroleum ceased to be the Designated Authority for the administration of offshore Commonwealth waters. The Joint Authority which comprises both Western Australian and Commonwealth delegates still regulates petroleum resource management of the offshore Commonwealth waters. However, the Department of Mines and Petroleum (DMP) no longer carries out its administrative role as part of the Designated Authority. As this is the case, only brief mention will be made of activities in the Commonwealth areas in this article.

Commonwealth regulations pertaining to the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGSA06) with regard to

resource management regulation were developed over the previous 12 months, and are available at an appropriate Commonwealth Government website (links are available at the DMP website).

Wells drilling during the period 1 January to 30 June 2012 consisted of three exploration wells, two appraisal wells and one development well, for a total of six wells (Figure 1 and Table 3 on p. 34). Of these, one well was drilled in territorial waters, and the remaining five wells were drilled onshore. Development activity in territorial waters was declining over the six month period, however, appraisal activity is increasing onshore, as will be explained later in the article. A total of 273 km² of 3D seismic data were acquired in the reporting period.

Drilling was confined to the Canning, Perth and Carnarvon basins. The most active companies in the Perth Basin were AWE and Origin Energy, while in the Canning Basin the most active were Buru Energy and New Standard Onshore. Apache was the most active in the territorial waters.

EXPLORATION ACTIVITY BY BASIN

Bonaparte Basin

Little exploration activity has taken place in the onshore Bonaparte Basin in the first half of 2012. No drilling or seismic activity occurred in this basin over the past six months.

Browse Basin

The Torosa gasfield, which lies partially within Western Australian territorial waters, continued to be evaluated by Woodside with the processing of the Tridacna 3D ocean-bottom-cable seismic survey. Development of this field is planned to be part of the larger Browse Basin development of Woodside's currently discovered fields in this basin.

Canning Basin

Activities were carried out by Buru Energy and New Standard Energy, and will be discussed under company activity below.

Buru Energy

Buru Energy had previously announced petroleum discoveries with the Valhalla 2 and the Ungani 1 wells. The Ungani 2 appraisal well was drilling at the beginning of the reporting period, and confirmed the Ungani oil discovery. Clean up flows commenced on the Ungani 1 and 2 wells. A Location was awarded to Buru over the Ungani field. A preliminary field development plan was also submitted to DMP for the Ungani field, and is currently being reviewed.

Paradise 1 Deepening in EP 428, and near the boundary of EP 371, is the second well in the Buru-Mitsubishi Corporation Joint Venture program. Paradise 1 Deepening was drilled in late 2010 and an interpreted oil zone was reported in Lower Grant Formation

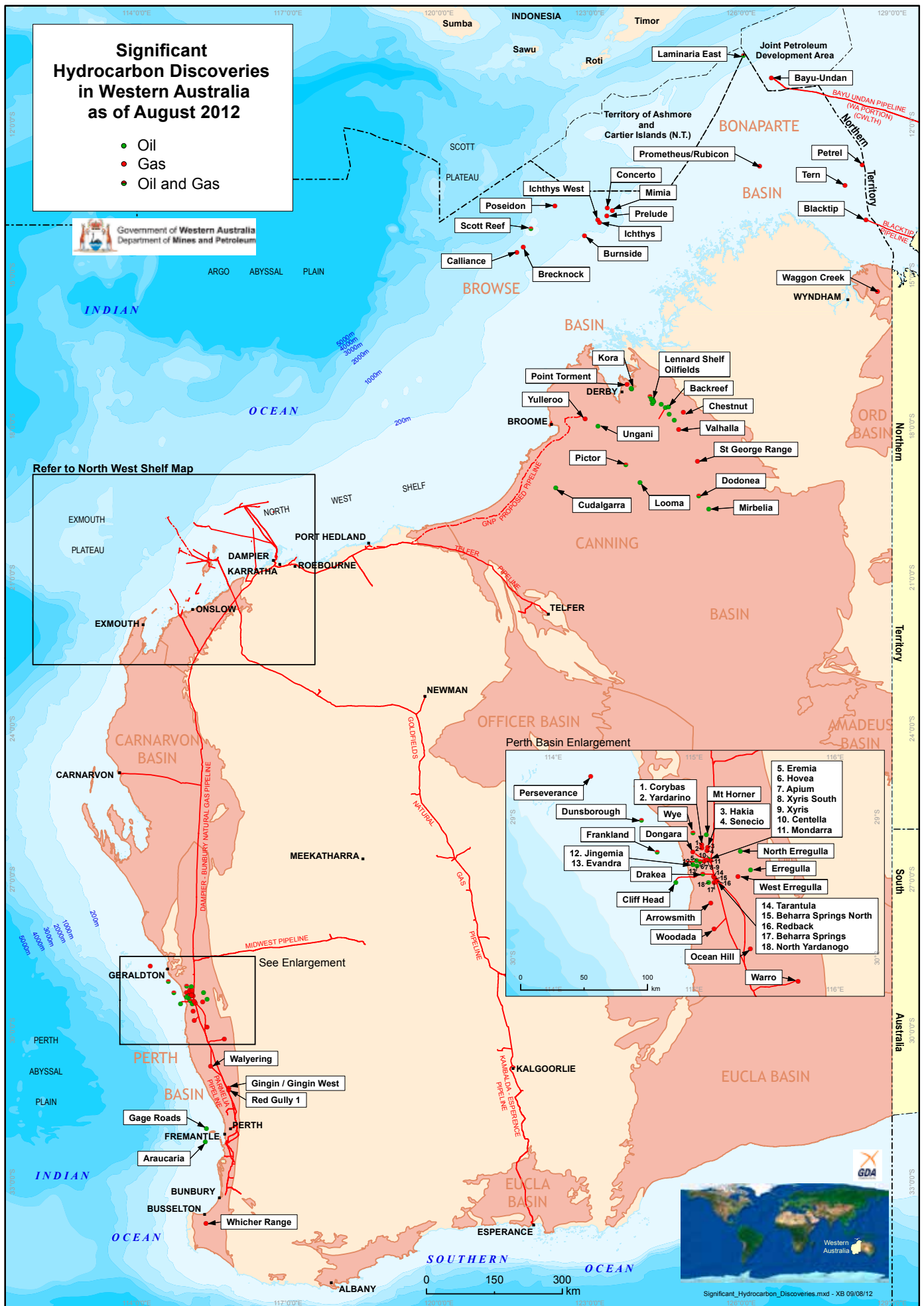


Figure 1 | Significant hydrocarbon discoveries in Western Australia

or Anderson Formation at 904 m, but no definitive test could be carried out at the time. Despite an initial decision to plug and abandon Paradise 1 Deepening, live oil was recovered to the surface during preparations for the abandonment procedure. Paradise 1 Deepening was commenced on 20 May 2012, and the well was suspended 22 June 2012.

Yulleroo 3 was spudded on 25 May 2012, and was still being drilled at the end of the reporting period. Gas sands in the Laurel Formation were reported in the Yulleroo 3 well at approximately 3200 m with porosities and permeabilities in the conventional, rather than unconventional (tight) range. Yulleroo 3 will be suspended.

Buru plan to drill the Cyrene 1 well later this year to evaluate the Goldwyer shale oil and gas potential. Also either later this year or early in 2013, Buru will test the unconventional play of the Gogo Formation with the Emanuel 1 well in EP 129, close to the current Buru production permits.

New Standard Energy

New Standard Energy continued its search for shale gas within the Goldwyer Formation in the Kidson Trough and Broome Platform. The MB Century #14 rig was mobilised to the Nicolay 1 drill site, with spud planned mid August. The Nicolay 1 well is one of three wells planned to target the potentially gas-rich shales of the Goldwyer Formation.

Oil Basins

Oil Basins Limited drilled Backreef 1 in October 2010. The hole was re-entered on 18 May 2012 to conduct a drill stem test of the Gumhole and Yellow Drum Formations. The company reported trace oil recovered to the surface upon reverse circulation, and samples were collected.

Carnarvon Basin

In territorial waters, Apache kicked off Bambra 10 in April 2012. Planning for decommissioning the Sinbad Platform was carried out by Apache.

On Barrow Island, Chevron was planning for drilling associated with their Gorgon Project.

No drilling or seismic activity was carried out in the onshore portion of the Carnarvon Basin.

Perth Basin

AWE

The Evandra 2 well was drilled by AWE in April 2012. The well reached TD at a measured depth of 2324 m. The primary target, the Dongara Sandstone, was not encountered in the well. Strong oil shows were observed in a 14 m interval in the Wagina Sandstone, which stratigraphically underlies the Dongara Sandstone. The company considered these shows to be uneconomic. The well was plugged and abandoned. Both Evandra 1 and 2 were drilled in order to establish the existence of the Dongara Sandstone reservoir on the mapped Evandra structure; however, neither well intersected the objective unit.

The Woodada Deep and Senecio discoveries will continue to undergo evaluation through hydraulic stimulation in the following quarter, and planning is continuing with these activities.

The Irwin 3D seismic survey was commenced on 16 February and suspended on 10 April being 84 per cent completed. The suspension was due to the commencement of the agricultural activities in the survey area, and the survey will be completed next year. This survey covered parts of L1, L2, L7, EP 320 and EP 368, which are held by Origin, AWE and Empire, and was contracted to Schlumberger for completion.

The Redback Terrace development is progressing and is with government authorities for review at the moment. The Trapdoor 1 well is planned, on the availability of drilling rigs, to target additional gas resources on the Redback Terrace.

Empire Oil and Gas

Empire holds, as operator, a large number of onshore petroleum Exploration Permits: EP 289, Gingin West 1 discovery 2010, Red Gully discovery 2011, and Wannamal prospects; EP 426, where 400 line km of airborne gravity was recorded over the North Erregulla prospect and reprocessing of seismic data occurred; EP 368, wherein the before mentioned airborne gravity was also carried out; EP 432, wherein the Black Arrow 1 wild cat well is planned; EP 454, where the Garibaldi 2D seismic survey was recently funded by the 50 per cent partner ERM as part of a farmin agreement; EP 416, where

planning is continuing for 80 km of 2D seismic acquisition to evaluate the Leschenault Prospect, and is near the recently drilled GSWA Harvey 1 stratigraphic well; EP 430, wherein a new 2D seismic survey is planned for 2013; EP 440 with office studies being undertaken; and EP 437, wherein a well, Waugh 1, is being planned for 2013.

Latent Petroleum

Latent Petroleum continued to evaluate the Warro 3 and Warro 4 wells, which intersected gas in the deep Yarragadee Formation. Hydraulic stimulation was carried out on the Warro 3 well in 2009, and on Warro 4 in 2011. The results of these stimulations are the basis of ongoing studies into the Warro field.

Origin Energy

Origin Energy reported that the Hovea oilfield remained shut-in on care and maintenance over the latter four months of the reporting period. It also reported that its gas production for the Perth Basin was approximately 1 PJ. It indicated that the North Erregulla 2D seismic survey in EP 368 and EP 426 has been deferred to the latter part of 2013.

Southern Sky Resources

An Electron Spin Resonance (ESR) survey was completed by Southern Sky Energy in SPA 1 AO (Special Prospecting Authority with Acreage Option) during March 2012. The ERS technique was originated by internal Southern Sky Resources technologists and researchers, and is purported to be a direct hydrocarbon indicator based on tuning electromagnetic signatures. It has been used previously in the Eucla Basin in Western Australia.

PRODUCTION

Reported production for the 2011 calendar year can be found in Table 1 at the back of the magazine. There were no new fields brought online in the first half of 2012.

DEVELOPMENT ACTIVITY ONSHORE

Warro

Appraisal of the Warro field continued to be carried out by Latent Petroleum after fracture stimulation of the Warro 4 well. Gas was reported flowing after the stimulation.

Arrowsmith

Norwest Energy and its partners reported on 31 July 2012 that Arrowsmith 2 began flowing gas from the High Cliff Sandstone. The well was undergoing clean-up at this time. Accurate rates of gas flow are expected to be reported after the clean-up is completed. Planning was carried out and approvals sought for the fracture stimulation for Arrowsmith 2 during this reporting period.

Red Gully

Planning and approvals for the Red Gully field development, within EP 389 in the Perth Basin, were pursued by Empire Oil and Gas. The company has entered into a contract to acquire an area of approximately 200 hectares for the site of the Red Gully Processing Facility.

Blina and Sundown

Buru Energy reported that the Blina and Sundown fields averaged about 11.3 kL/d (71 bbl/d) in the reporting

period. The company reports that it will continue to assess possible options to improve production levels from the two fields.

Yulleroo

Buru Energy reported that the Yulleroo 2 well continued to flow gas and condensate in a test during the final quarter of 2011. The reservoir at Yulleroo is in the Upper and Lower Laurel Formation gas sands.

Ungani

Buru Energy reported that Ungani 1 made a significant oil discovery in the final quarter of 2011. Preparations for production testing of the Ungani field, due to commence on 1 July 2012, were carried out over this period. The Ungani 1 and 2 wells are undergoing clean-up flow.

Gorgon Project

As the construction progresses on Barrow Island, Chevron has achieved some significant milestones. The

recent completion of the breakwater for the island's new materials offloading facility (MOF) followed successful dredging operations, which was completed with no significant environmental incidents. The facility is expected to be finished by the end of 2012. Construction of two LNG tanks is progressing well. In addition, the first pre-assembled rack modules are now in place, following offloading at the MOF in June, marking the start of the next major phase of construction.

JOINT AUTHORITY ACTIVITIES

Assessment and advice was provided for decisions by the Western Australian Delegate of the Joint Authority for fifty four variations to work programs, three Retention Lease applications, five Declarations of Location and one preliminary Field Development Plan in the Commonwealth areas offshore of Western Australia during the reporting period. ■



Inside one of the LNG Storage Tanks which will hold 180,000 cubic metres of LNG
(Photo courtesy of Chevron)

Company Focus – New Standard Energy

New Standard Energy (NSE) is an emerging oil and gas explorer, with a core focus on Western Australian, onshore, unconventional hydrocarbon projects.

With a gross net acreage of 59,400 km² (13.82 million acres) across Western Australia, New Standard is strategically positioned within the rapidly expanding shale gas industry in Australia. In September 2011 New Standard secured top tier partner ConocoPhillips to fund and progress the company's flagship Goldwyer Project, located in the onshore Canning Basin.

New Standard retains 100 per cent ownership of its emerging Merlinleigh Project (onshore Carnarvon Basin) which is focussed on exploration for shale and conventional gas, and operated interests of between 50 and 60 per cent in its Laurel Project within the Canning Basin.

The company's early position in this rapidly emerging sector has positioned it to assess and participate in strategic exploration and corporate activity. Its large project equities (25–100 per cent) provides New Standard and its shareholders with both significant exposure to value creation and corporate/project flexibility.

New Standard's board and senior management has been expanded to reflect the growth and development of its exploration program so it possesses significant technical skills, expertise and success in hydrocarbon exploration, project development and corporate strategy, providing New Standard with a skillset to achieve the company's corporate objectives.



Setting up MB Century 14 drilling rig – mast pinning
(Photo courtesy of New Standard Energy)



Setting up MB Century 14 drilling rig – working on flooring around draw-works
(Photo courtesy of New Standard Energy)

Areas of Activities

New Standard's Australian acreage

| Australian Oil & Gas Exploration | Type | Interest | Operator | Joint Venture Partners |
|---|-------------------------------|----------|------------------------------|--|
| Goldwyer Project, Canning Basin | | | | |
| EP 443 | Exploration Permit | 25% | New Standard Onshore Pty Ltd | ConocoPhillips |
| EP 450 | Exploration Permit | 25% | New Standard Onshore Pty Ltd | ConocoPhillips |
| EP 451 | Exploration Permit | 25% | New Standard Onshore Pty Ltd | ConocoPhillips |
| EP 456 | Exploration Permit | 25% | New Standard Onshore Pty Ltd | ConocoPhillips |
| Application Area 1/09-0 | Application area | 25% | New Standard Onshore Pty Ltd | ConocoPhillips |
| Application Area 2/09-0 | Application area | 25% | New Standard Onshore Pty Ltd | ConocoPhillips |
| Application Area 5/09-0 | Application area | 25% | New Standard Onshore Pty Ltd | ConocoPhillips |
| Laurel Project, Canning Basin | | | | |
| EP 417 | Exploration Permit | 50% | New Standard Onshore Pty Ltd | Buru Energy Ltd Green Rock Energy Ltd |
| STP-SPA-0017 | Special Prospecting Authority | 60% | New Standard Onshore Pty Ltd | Green Rock Energy Ltd |
| Merlinleigh Project, Carnarvon Basin | | | | |
| STP-EPA-0014 | Application area | 100% | New Standard Onshore Pty Ltd | – |
| STP-EPA-0015 | Application area | 100% | New Standard Onshore Pty Ltd | – |

Each Australian project provides exposure to a different geological environment, stage of project development, and path to commercialisation creating a diverse mix of projects and risk. Although all projects are currently early in the exploration cycle, the portfolio hosts the potential for liquids rich gas and comprises large acreage positions, and as a result New Standard is well placed in an emerging sector where the onset of future drilling programs can accelerate the maturation of the project portfolio.

New Standard's portfolio is split between direct equity interests in large and dominant acreage positions in discrete geological environments and an indirect exposure to the broader Canning Basin and associated petroleum systems via a 6.4 per cent equity stake in fellow ASX-listed explorer Buru Energy Ltd (ASX:BRU). This balance provides exposure to a unique blend of direct project and corporate wealth creation in a rapidly emerging sector in the oil and gas industry in Australia.

New Standard has amassed one of the largest shale and tight gas portfolios in Australia via its 100 per cent (reducing to 25 per cent) operated equity interests in

its flagship Goldwyer Project in the Canning Basin, the emerging Laurel Project in the Canning Basin and the Merlinleigh Project in the Carnarvon Basin. All projects, whilst at early stage, are highly prospective for large, strategic onshore hydrocarbon resources in Western Australia.

Goldwyer Project

The Goldwyer Project is a very large asset extending over some 48,000 km² (11 million gross acres) of exploration permits and application areas in the southern Canning Basin – covering approximately 2 per cent of Western Australia's land mass. The project was named after the Goldwyer Formation which incorporates a regional marine shale that blankets New Standard's acreage and forms the primary target within the project.

New Standard's exploration acreage includes a potential wet gas (liquids rich) window identified by New Standard's technical team where the Goldwyer Formation has the potential to be present at attractive depths and over significant thicknesses such that it could host a substantial hydrocarbon resource. Given the Goldwyer Formation comprises a

blanket marine shale present at varying depths and across differing maturity windows; it is potentially prone to liquids generation within parts of New Standard's exploration permits. As a result the Goldwyer has some attributes that are analogous to attractive resource plays in the United States such as the liquids-rich Eagle Ford and Bakken shales.

After an extensive partnership assessment process, New Standard teamed up with ConocoPhillips in 2011 to jointly explore and evaluate the Goldwyer Project. ConocoPhillips brings a wealth of expertise and experience to evaluate the Goldwyer Project by virtue of their substantial experience and existing operations in the Eagle Ford and Bakken shale plays. As part of the farm-out arrangement, ConocoPhillips has agreed to a US\$119 million, four year exploration, evaluation and pilot development program.

Phase 1 of the program involves the drilling, logging, coring and suspension of three vertical wells; complete detailed core lab analysis of the cores from each well; and if warranted, subsequent formation evaluation tests of discrete zones of interest within each well.

The Phase 1 exploration program is heavily focused on data acquisition to provide proof of concept for the Goldwyer Project. Data will be acquired through a combination of full coring throughout the Goldwyer Formation, sophisticated mud-logging and a comprehensive suite of electric wireline logs. Following data acquisition, a detailed set of scientific studies and analyses will be undertaken in specialised laboratories to more fully assess the Goldwyer Formation prospectivity.

The information being acquired through the Phase 1 drilling program and subsequent scientific analysis and reservoir evaluation is aimed at obtaining a comprehensive, modern data set (it is the first well to be drilled in the area for more than 30 years) in order to more fully appraise the potential for presence of a regional hydrocarbon resource of significant scale and prospectivity. In particular, the data being sought is aiming to establish the following attributes that are important for successful shale plays, including:

- Quality of the source rock (TOC, Kerogen type, Maturity, Gas to Condensate Ratio, Rock Evaluation)
- Quality of the reservoir (Facies, GRI Porosity, Saturation, Permeability)
- Containment (Seal, Faults, Burial History, Residence Time)
- Brittle and breakable rock (Mineralogy, Contiguous Thickness, Depth, Pressure, Stress Regime).

Establishment of encouraging results for each of these aspects during Phase 1 will help provide the basis for making a decision to proceed to Phase 2 of the farm-in program.

The Nicolay 1 prospect (Figure 1), located in EP 456, has been selected as the first location for the Phase 1 drilling program. Well design and engineering have been completed and specifically tailored for the early stages of unconventional exploration. Nicolay 1 will be drilled to approximately 3400 m and is aimed at gathering a comprehensive understanding of the Goldwyer play through the intended acquisition and analysis of a substantial

section of full core over the entire thickness of the Goldwyer Formation.

Following months of planning and preparation, Phase 1 of the Goldwyer Project has reached a major execution phase as New Standard expects to spud Nicolay 1 in mid-August, with an estimated time to complete of approximately 50 days.

A significant milestone achieved in the execution of Phase 1 during mid-2012 was the successful mobilisation of the MB Century Rig #14 (MBC #14) to site at Nicolay 1, following the completion of civil works associated with access tracks and the Nicolay 1 well site. Over 300 km of the Kidson track has been upgraded and maintained to facilitate the successful mobilisation of MBC #14 which has been further aided by the completion of a new site airstrip and the establishment of site camp and facilities including reliable water sources.

As operator of the Goldwyer Project, New Standard has been undertaking regular consultation with government

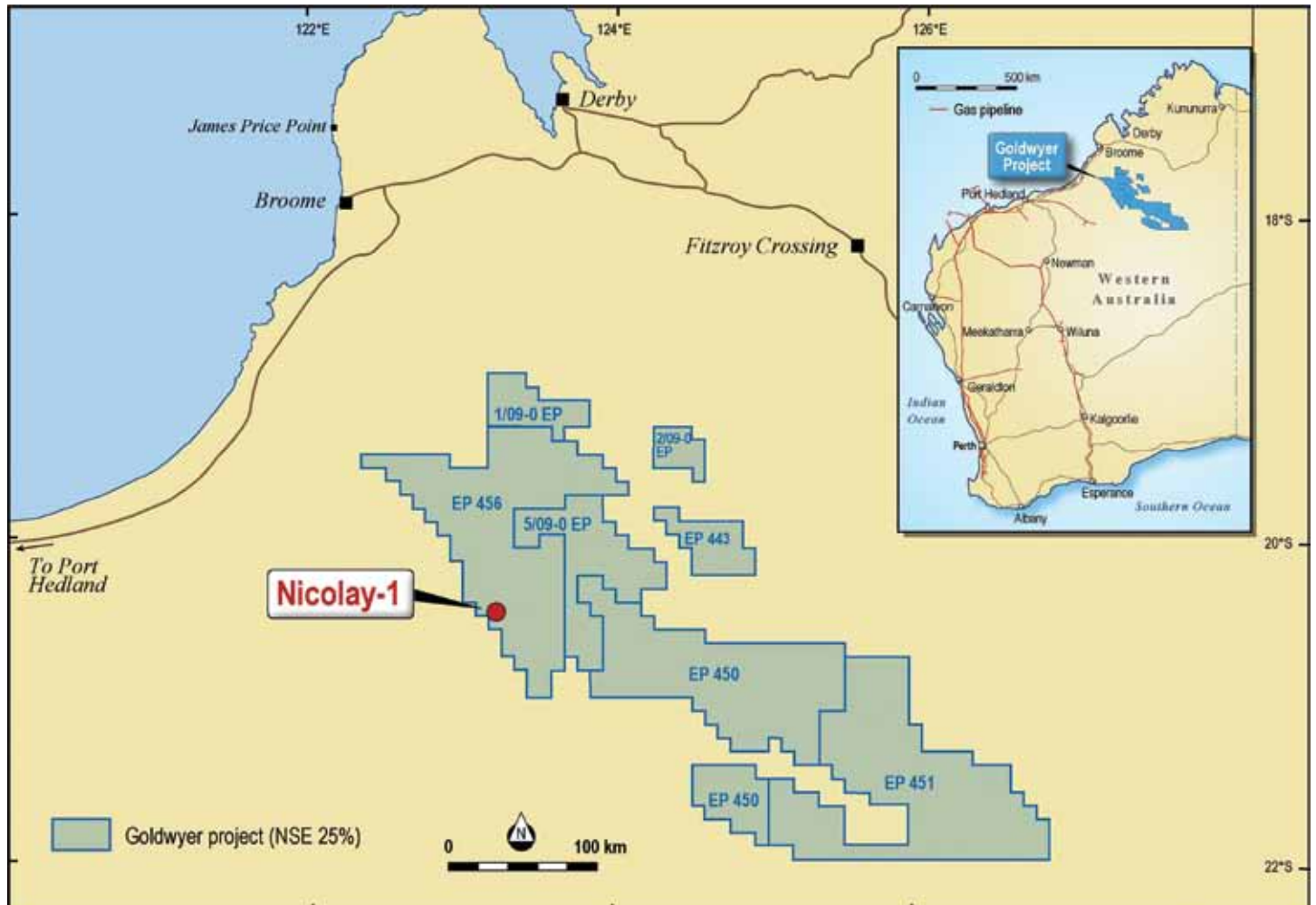


Figure 1 | Location of the Nicolay 1 prospect in the Canning Basin

regulators and Indigenous traditional owners to build awareness of the drilling program and communicate its commitment to responsible and safe exploration practices.

Similar preparatory work is also underway for the second and third well locations (Gibb Maitland 1 and Blatchford 1, respectively) to ensure these locations are prepared ahead of intended inter-well moves which will occur following the completion of Nicolay 1 drilling operations.

The Merlinleigh Project

The Merlinleigh gas/condensate project is based around the 5500 km² (1.4 million acres) held by the company in the

onshore Carnarvon Basin. New Standard owns a 100 per cent operated interest in the project which is presently comprised of two permit applications being STP-EPA-0014 and STP-EPA-0015. These applications will convert to granted Exploration Permits once agreement is finalised with the Traditional Owners. The application areas are strategically located adjacent to the Dampier to Bunbury Natural Gas Pipeline (DBNGP) which supplies gas to a large number of industrial, mining and domestic customers in Western Australia.

The conventional prospectivity of the Merlinleigh is also attractive with the Kennedy Range 1 well exhibiting good gas shows over significant intervals within reservoir sands with average porosities of

12%. Although these conventional traps have been structurally defined by relatively sparse 2D seismic data in conjunction with comprehensive surface geology and anticlinal mapping, they are sufficiently robust to warrant drilling in conjunction with testing the unconventional potential at the same time.

In particular, New Standard is targeting locations within the acreage where the Byro Group and Wooramel Group source rocks have reached the wet gas generation window. Those shales are somewhat analogous to producing shales in the northern Perth Basin.

In May New Standard announced that a technical analysis of the Merlinleigh Project had found:

- Proven hydrocarbon generating basin with good quality source rocks
- Good gas shows in the Kennedy Range 1 well with gas bleeding from cores

As a result New Standard provided a significant unconventional and conventional resource potential of:

- Unconventional: 934 Gm³ (33 Tcf) potential GIP in mature shales across 1100 km² zone
- Conventional: up to 340 Gm³ (1.2 Tcf) GIP across four key prospects

The company's strategy to progress the Merlinleigh Project is to:

- Complete ongoing technical assessments to enhance the database and understanding of the petroleum system and various hydrocarbon targets;
- Leverage the company's current resources, including secured drilling slots, to develop an exploration program and lock in a near term drilling program in H1, 2013;
- Assess the opportunity to secure suitable potential joint venture partners during H2, 2012 to consider divesting a portion of the project whilst maintaining a controlling equity stake, substantial leverage to exploration success and operatorship; and
- Move quickly to establish the presence of attractive hydrocarbon resources for potential production and supply to the domestic market.



New Standard Energy's upgraded road to the Nicolay 1 well in the Canning Basin
(Photo courtesy of New Standard Energy)

Forward Work Program and Project Milestones

To execute the above strategy, the following commercial, technical and field work is planned:

- Conclude current negotiations with Traditional Owners with respect to land access and associated heritage matters;
- Convert the current applications (STP-EPA-0014 and STP-EPA-0015) to active Exploration Permits;
- Conduct technical studies and well planning activities during 2012 in preparation for drilling;
- Obtain all necessary land access and other required approvals in time for exploration drilling in 2013;
- Assess partnering alternatives and opportunities in H2, 2012 and if warranted, lock in associated agreements; and
- Ensure the company is well placed to be able to drill multiple exploration wells on combined conventional/unconventional prospects during 2013.

Figure 2 shows the location of the top four conventional prospects that have been identified based on the current database — all of which have both unconventional and conventional potential. These prospects have been chosen and ranked on the basis that they exhibit the best opportunity of understanding the unconventional resources in the region as well as exploiting any migrated hydrocarbons that may be present within the structural traps at each location (such as those present in Kennedy Range 1).

The orange shaded area illustrated opposite, highlights the major zone of focus for potential shale resources covering acreage of approximately 1100 km². This area is a more focused area (within the greater envelope of mature source rocks shaded in grey) that in New Standard's opinion, contains gas-mature source rocks in the early Permian that are prospective for hosting an attractive regional resource play.

Laurel Project

New Standard's other project in the Canning Basin lies in the northern Fitzroy Trough and Gregory Sub-basin and is called the Laurel Project. New Standard has successfully farmed this project out to Buru Energy and

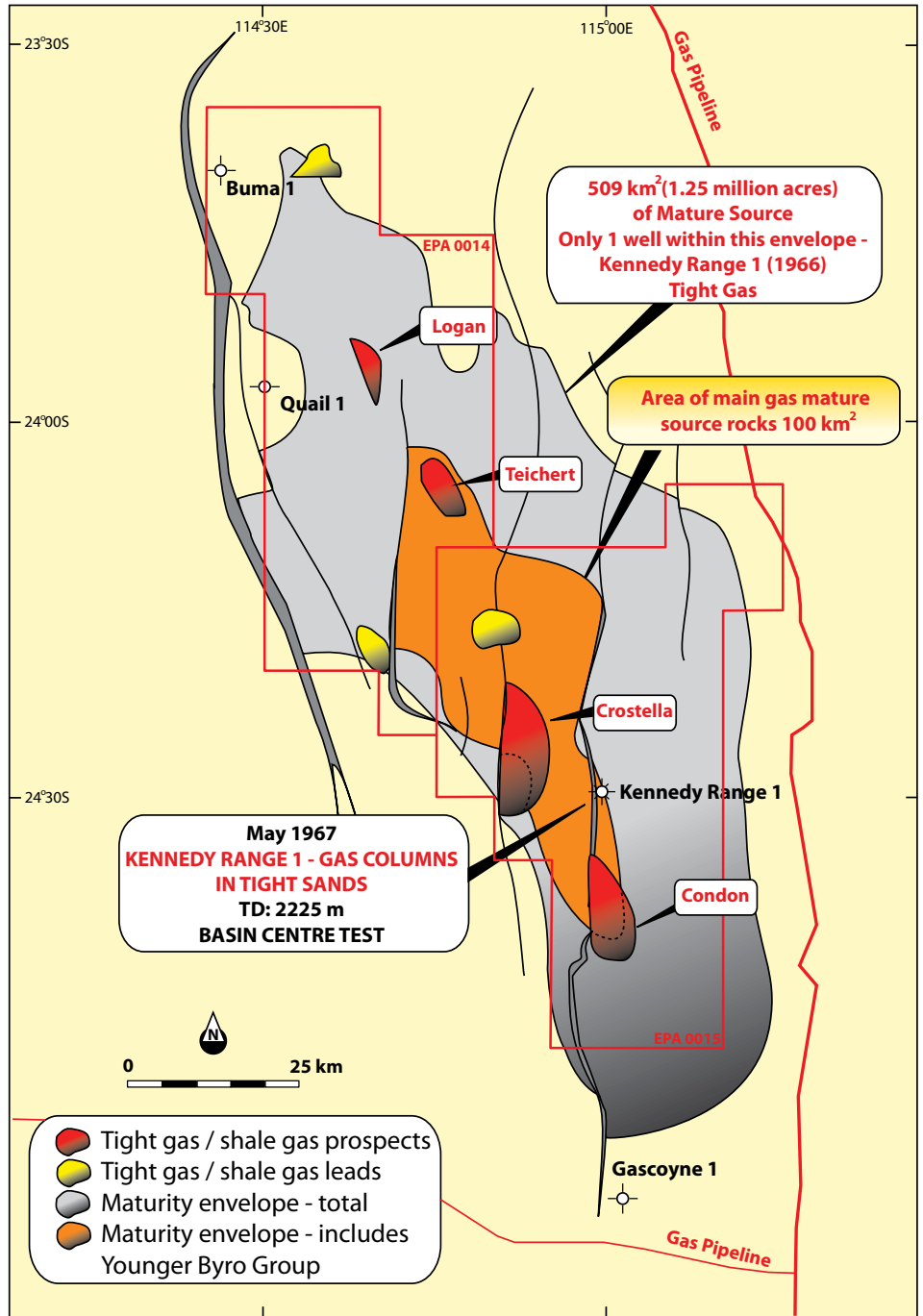


Figure 2 | Merlinleigh Project area highlighting the major zone of focus for potential hydrocarbon resources

Green Rock Energy over time to de-risk its exposure and it has secured additional acreage to increase its footprint in the emerging play. Recent exploration success through Buru and its farm-in partner Mitsubishi Corporation has provided valuable momentum in the Canning and as the Laurel play emerges more fully New Standard will continue to undertake regional studies and technical assessment of its acreage.

Conclusion

New Standard has established a large and technically prospective portfolio of projects that provide shareholders with

a diverse exposure to various potential hydrocarbon resource plays across differing geological settings with differing potential commercialisation and development pathways. The projects are each advancing at different rates and the potential exists for maturation of each of these projects to occur as exploration activity accelerates within the specific project and region. In addition to the existing portfolio of projects, New Standard is continually assessing opportunities that fit the rigorous investment criteria in order to introduce additional growth opportunities to the project pipeline. ■

Unconventional Gas Meetings Well Received in the Midwest

Mark Gabrielson

General Manager
Business Development



Jason Medd (left) and Mark Gabrielson were among DMP staff who met with local community stakeholders in Dongara, Eneabba and Gingin recently

The Department of Mines and Petroleum (DMP) recognises the need to cultivate relationships with key stakeholders and has commenced what is anticipated to be ongoing and targeted community engagement strategy.

DMP is actively speaking with a number of stakeholder groups including local government representatives, as well as the West Australian Farmers Federation and the Pastoralists and Graziers Association of Western Australia.

Recent community information sessions organised by the National Party, in Dongara, Eneabba and Gingin provided DMP with the opportunity and a forum to:

- give a clear, honest and transparent overview of how the industry is regulated;
- listen to community concerns; and
- answer questions with factual and evidence based responses.

The Hon Grant Woodhams MLA chaired the meetings with assistance from the Hon Philip Gardiner MLC. The following extract from Hansard noted the success of the engagement with local communities:

“Most significantly, we were very pleased to have public servants from the Departments of Mines and Petroleum and Water, and from the Commonwealth Scientific and Industrial Research Organisation, addressing these meetings

and providing factual information about what the State is doing as far as regulation, and some of the risks concerning water and the miscibility of gas and water. We were also able to outline and try to ameliorate some of the concerns of landowners. I think the most interesting thing out of it all was that in Dongara, where commercial companies are actually engaging with the community, there appeared to be less concern than at Eneabba”.

The engagement strategy compliments the work DMP is doing to strengthen enforceability, improve transparency and provide the community with confidence in the ability to regulate the emerging sector.

All of which, these reforms will help to further strengthen our regulatory framework to allow for the responsible development of onshore gas, for the benefit of the Western Australian community.

Since exploration for unconventional gas is in its infancy; Western Australia has the luxury and opportunity to work with the community and industry to develop a robust and responsible regulatory framework; before commercial production is considered.

Historically, DMP has an impressive record of accomplishment in terms of regulating the petroleum industry in Western Australia. Regardless of this fact, DMP is actively engaged in continuous regulatory improvement for the petroleum and geothermal energy sector, including

unconventional oil and gas. A significant part of this process draws on the lessons learned nationally and internationally through company and regulator engagement.

Current early-stage ‘proof of concept’ exploration activities will help inform the DMP’s regulation of the sector in Western Australia. The exploration phase will allow us to make informed decisions about the regulatory framework we will need for future full-scale commercial development.

However, we need to remember that if industry proceeds to commercial development, proposals of this kind may still be several years away.

DMP is committed to best practice standards for responsible exploration and development and a transparent regulatory regime to encourage investment in the State; whilst protecting the environment, water resources and public health, to responsibly develop this resource for the benefit of the people of Western Australia. ■

Awards of Exploration Permits

Richard Bruce

Exploration Geologist
Resources Branch



Oil production in the Canning Basin
(Photo courtesy of Kimberley Oil)

Commonwealth Award of Petroleum Exploration Permits

These new permits result from the first round of the 2011 Acreage Release that closed on Thursday 13 October 2011.

Commonwealth award information was principally sourced from Western Australia's online Petroleum and Geothermal Register and from the website of Australia's Department of Resources, Energy and Tourism.

In June 2012 permits WA-468-P through WA-476-P were granted.

WA-468-P (released as W10-7) in the Beagle Sub-basin of the Northern Carnarvon Basin has been awarded to Finder No 14 Proprietary Limited. The company proposed a guaranteed work program of 200 km of new 2D seismic surveying, 1200 km² 3D seismic reprocessing, purchase of 450 km² 3D seismic data and geotechnical studies to an estimated value of A\$1.8 million. The secondary work program consists of one exploration well and geotechnical studies to an estimated value of A\$17.3 million. There was one other bid for this area.

WA-469-P (released as W10-21) in the Exmouth Plateau of the Northern Carnarvon Basin has been awarded to BHP Billiton Petroleum (Australia) Proprietary Limited. The company proposed a guaranteed work program of 923 km² of new 3D seismic surveying, 161 km² 3D seismic reprocessing and geotechnical studies to an estimated value of A\$12.25 million. The

secondary work program consists of one exploration well and geotechnical studies to an estimated value of A\$49 million. There were five other bids for this area.

WA-470-P (released as W10-22) in the Exmouth Plateau of the Northern Carnarvon Basin has been awarded to BHP Billiton Petroleum (Australia) Proprietary Limited. The company proposed a guaranteed work program of 235 km² of new 3D seismic surveying, 721 km² 3D seismic reprocessing and geotechnical studies to an estimated value of A\$8.98 million. The secondary work program consists of one exploration well and geotechnical studies to an estimated value of A\$49 million. There were five other bids for this area.

WA-471-P (released as W11-1) in the Caswell Sub-basin of the Browse Basin has been awarded to IPM Browse Proprietary Limited. The company proposed a guaranteed work program of 600 km² of new 3D seismic surveying, one exploration well and geotechnical studies to an estimated value of A\$24 million. The secondary work program consists of one exploration well and geotechnical studies to an estimated value of A\$15.6 million. There were three other bids for this area.

WA-472-P (released as W11-10) in the Beagle and Dampier sub-basins of the Northern Carnarvon Basin has been awarded to Woodside Energy Limited. The company proposed a guaranteed work program of 3023 km² of new 3D seismic surveying, two exploration

wells and geotechnical studies to an estimated value of A\$54.89 million. The secondary work program consists of one exploration well, 1000 km² 3D seismic reprocessing, and geotechnical studies to an estimated value of A\$19.38 million. There were two other bids for this area.

WA-473-P (released as W11-11) in the Dampier Sub-basin of the Northern Carnarvon Basin has been awarded to Woodside Energy Limited. The company proposed a guaranteed work program of 1541 km² of new 3D seismic surveying and geotechnical studies to an estimated value of A\$11.33 million. The secondary work program consists of one exploration well, 600 km² 3D seismic reprocessing, and geotechnical studies to an estimated value of A\$19.09 million. There were three other bids for this area.

WA-474-P (released as W11-12) in the Exmouth Plateau of the Northern Carnarvon Basin has been awarded to Hess Australia (Offshore) Proprietary Limited. The company proposed a guaranteed work program of 1045 km² 3D seismic reprocessing and geotechnical studies to an estimated value of A\$9.75 million. The secondary work program consists of one exploration well and geotechnical studies to an estimated value of A\$51 million. There was one other bid for this area.

WA-475-P (released as W11-13) in the Exmouth Plateau of the Northern Carnarvon Basin has been awarded to BHP Billiton Petroleum (Australia)

Proprietary Limited. The company proposed a guaranteed work program of 192 km² of new 3D seismic surveying, 884 km² 3D seismic reprocessing, two exploration wells and geotechnical studies to an estimated value of A\$107.58 million. The secondary work program consists of one exploration well and geotechnical studies to an estimated value of A\$51 million. There was one other bid for this area.

WA-476-P (released as W11-15) in the Exmouth Sub-basin of the Northern Carnarvon Basin has been awarded to Murphy Australia Oil Proprietary Limited. The company proposed a guaranteed work program of 641 km² 3D seismic reprocessing, 100 km of new 2D seismic surveying and geotechnical studies to an estimated value of A\$1.8 million. The secondary work program consists of one exploration well and geotechnical studies to an estimated value of A\$20.4 million. There were no other bids for this area.

STATE AWARD OF PETROLEUM EXPLORATION PERMITS

To the end of June 2012, petroleum exploration permits awarded in State areas were as follows:

In June 2012, **EP 479** in the Perth Basin was awarded to ERM Gas Proprietary Limited and Empire Oil and Gas No Liability. The firm two-year period program consists of geotechnical studies and one stratigraphic well to an estimated value of A\$1,750,000. The remaining program consists of four coal seam methane exploration wells, geotechnical and engineering studies to an estimated value of A\$6,750,000.

In June 2012, **EP 480** in the Perth Basin was awarded to ERM Gas Proprietary Limited and Empire Oil and Gas No Liability. The firm two-year period program consists of geotechnical studies and two stratigraphic wells to an estimated value of A\$3,250,000. The remaining program consists of four coal seam methane exploration wells, geotechnical and engineering studies to an estimated value of A\$6,750,000. ■



Bunda 3D seismic survey, Canning Basin
(Photo courtesy of Buru Energy)

State Areas Released for Petroleum Exploration September 2012

Richard Bruce

Exploration Geologist
Resources Branch



Drilling rig in the Canning Basin
(Photo courtesy of Paul Cartwright)

DMP continues to promote the petroleum potential of Western Australia's vast sedimentary basins using a specific area release system in our State Waters and onshore areas.

A DVD package accompanies the acreage release and contains information about the prospectivity of release areas, available data listings, land access and how to make a valid application for an Exploration Permit. A web version is also available: www.dmp.wa.gov.au/acreage_release

In September 2012, DMP released a total of 13 blocks (Figure 1). This comprised eight blocks in the onshore Canning Basin, two blocks in the offshore Northern Carnarvon Basin, and three blocks in the onshore Perth Basin.

In October 2011, Buru Energy's Ungani 1 well discovered light oil (~37 degrees API gravity) in dolomitised limestones of the likely Carboniferous Laurel Formation. The well flowed at a peak rate of 261 kL (1647 bbl) per day on a 12.7 mm (½ inch) choke. The original target was gas. This is the first significant oil discovery in the Canning Basin since the 1980s and is believed to be a new oil play in the basin. This is also the first new field onshore oil discovery in Western Australia in 10 years. This discovery has generated renewed interest in the basin and this is reflected in a higher level of bidding for Canning Basin acreage in a subsequent work program bidding round. Global

companies Mitsubishi Corporation, ConocoPhillips and Hess are now active in the Canning Basin.

The size of the Canning Basin blocks range from 1849 km² to 4153 km².

- Release areas L12-15 and L12-16 on the Dampier Peninsula have an earlier closing date. These areas are situated in or adjacent to the Fitzroy Trough which is noted for the Carboniferous Yulleroo gas-condensate accumulation and the recent exciting Ungani oil discovery.
- Release areas L12-8 and L12-9 in the southwest Canning Basin may have targets in Permian and pre-Permian sequences.
- Release areas L12-10 to L12-13 are in the southern Canning Basin. This region is considered prospective for Ordovician-sourced (mostly the Goldwyer Formation) hydrocarbons, of both conventional type and shale gas. There may be potential for salt-related plays.

There are two release areas in the highly prospective offshore Northern Carnarvon Basin. A combined release area T11-3/L11-6 is 1742 km² in size. The other area L11-7 is 1441 km² in size. Targets may include Cretaceous, Jurassic and Triassic sandstones.

The three release areas (L11-8, L11-9 and L12-14) in the onshore Perth Basin range in size from 75 km² to 717 km².

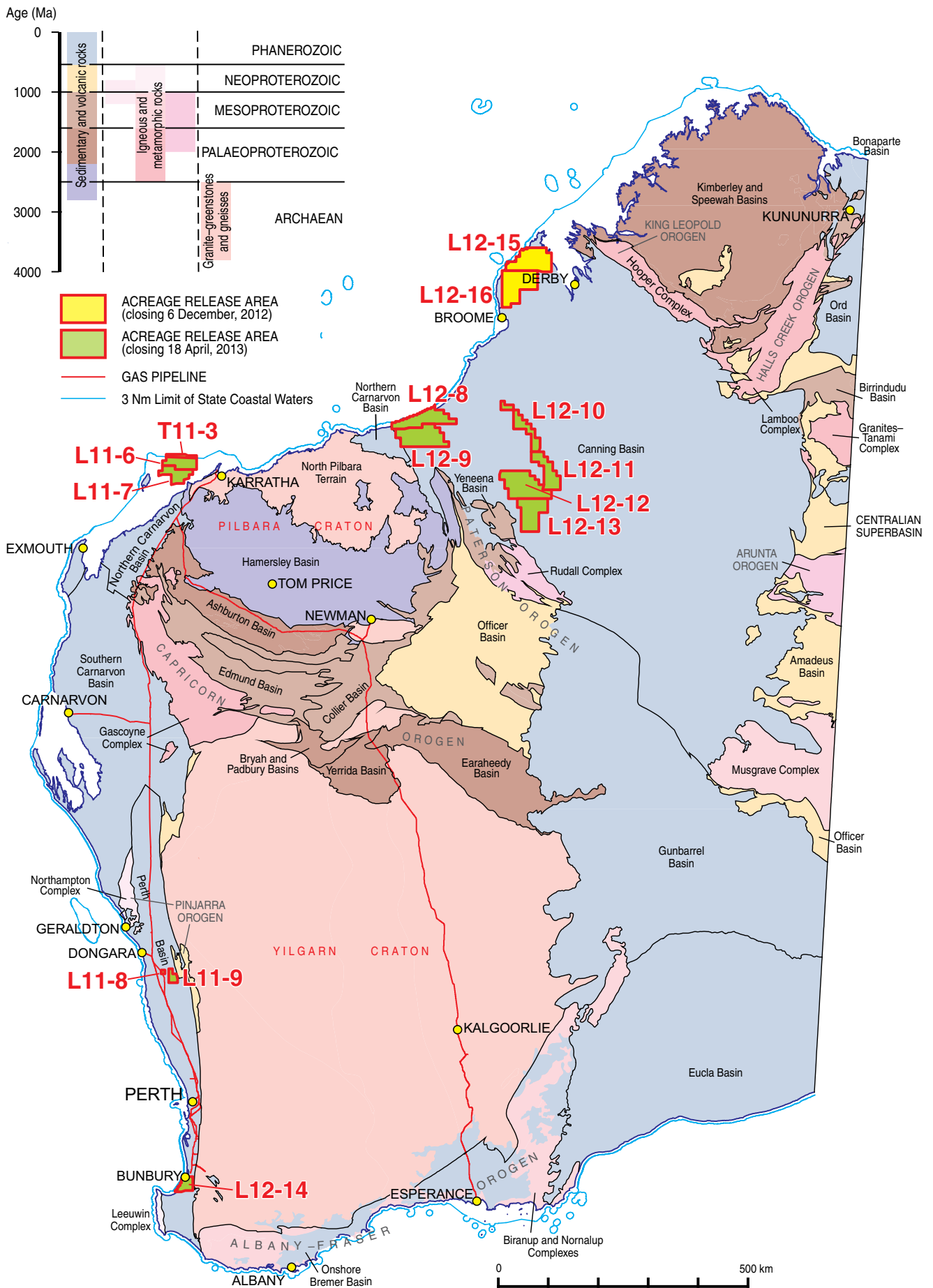
There are three release areas in the onshore Perth Basin. Area size ranges from 75 km² to 717 km².

- Release area L12-14 is in the onshore southern Perth Basin, which has a Permian section with likely mature source rocks and sandstone reservoir intervals. Infrastructure is nearby including the port city of Bunbury.
- Release areas L11-8 and L11-9 are in the northern Perth Basin, a region noted for its Permian and Jurassic oil and gas production, and infrastructure (including two gas pipelines and a sealed highway which runs south to the State capital Perth and the Kwinana oil refinery).

Work program bids close:

1. 4pm on Thursday 6 December 2012 for the Dampier Peninsula release areas.
2. 4pm on Thursday 18 April 2013 for the remaining release areas.

Should you require any further information or assistance, please contact Richard Bruce (08 9222 3314) of DMP's Petroleum Division or Alan Millar (08 9222 3841) of the Geological Survey of Western Australia. All enquiries will be dealt with in strictest confidence. ■



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Figure 1 | September 2012 State petroleum release areas

Shale Gas in Western Australia – Wave of the Future?

Nina Triche

Petroleum Geologist
Resources Branch



Shale sample from the Noonkanbah Formation, Canning Basin

The success of unconventional resources in the US energy industry has created a lot of excitement in Australia recently. The possibility of bringing new sources of natural gas to market for Western Australia would help to mitigate the foreseen shortfall in our domestic gas supply and to increase the diversity of our available gas resources. Whether or not offshore gas reserves will ever increase enough to offset future domestic demand, Western Australia would certainly benefit from an additional, onshore source of gas, especially if it adds production to the LNG hub proposed for development at James Price Point, which may be designated for domestic supply. Increasing costs associated with the petroleum industry in general could also create economic justifications for this more expensive, more technically challenging resource.

While larger international companies may benefit from the abundant resource represented by Australian shale gas, smaller local businesses could also take this opportunity to expand into alternative sources of gas and acquire new acreage with new types of gas plays. Shale gas resources could also contribute to the domestic gas supply in the near to long-term future through pipeline extensions. It is currently estimated that approximately \$600 million in exploration work commitments exist for shale gas in Australia. The question in Western Australia now is, can the

future development of the Australian shale gas play be a similar “game-changing” scenario as that seen over the past ten years in the US?

Unconventional Shale Gas

Unconventional petroleum resources, as opposed to conventional oil and gas, are those found in low permeability (tight) formations, that cannot produce economic volumes of hydrocarbon without the use of specialised recovery processes (Holditch, 2006). Shale gas is one of the main types of unconventional resources, and includes all natural gas that is found in low porosity, low permeability mud-rocks that do not allow the type of free gas flow found in typical, conventional plays. This means that producing gas from shale layers requires either the presence of natural fractures to allow the gas to flow, or enhanced engineering techniques, such as well stimulation (fracturing of the rock formation, technically known as “hydraulic fracture stimulation”).

Rocks that are mature for shale gas are often found at much greater depths than those involved in typical petroleum exploration, but also often extend over immense geographical areas. A shale gas play is also simpler in that the source of the petroleum is the same rock layer in which this gas has become trapped; shale gas consists of the biogenic or thermogenic hydrocarbon produced from high-organic-content mudstones that

has not migrated away from this source. This gas volume may be trapped in local fracture porosity or within the micropores of the shale itself, or it may be adsorbed onto the mineral or organic matter components of the shale. Typical shale gas is generally composed of light components, although some formations do produce wet gas. Shale gas is found extensively in Western Australia, as opposed to coal seam gas (CSG). WA currently has no known, potentially commercial CSG resources because of the State’s geology and character of its coal.

Shales are formed through typical sedimentary processes, usually from the consolidation of clay-sized particles (muds) in low-energy, aqueous depositional environments such as tidal flats or deep-water basins. Any algae, plant, or animal matter that may be present in these environments may settle amongst the clay particles during deposition, resulting in the formation of a mudstone with high organic content. Because shales are specific types of mudstones that form laminae, or thinly layered bedding, they possess very limited horizontal and extremely limited vertical permeability, which functions to trap some of the gas produced when their organic contents are matured. Permeability in a shale gas is generally on the order of 0.0001 to 0.1 millidarcies (mD), as opposed to the 100–10,000 mD seen in typical sandstones, which means that gas

can only migrate through a shale over geologic time (millions of years).

Shales are highly variable in terms of reservoir properties and production capabilities, but generally may be characterised in terms of their source rock potential. This characterisation uses measures such as TOC (total organic content), R_0 (thermal maturity) and kerogen type analysis. They may also be described in terms of their producibility, using measures such as their silica content, the presence of natural fractures (which increase gas flow) and the pressure gradient of the rock layer. Many shale gas plays in the US typically show relatively low TOC values (1–5%) and high R_0 values (0.5–2%), and consist of large volumes of oil that have been cracked to gas at high temperatures. This high maturity indicates the most obvious difference between shale gas and CSG resources; shales are found at significantly greater depth, usually below 2000 m, while CSG is generally found between 300 and 1000 m.

Unconventional gas resources, including shale gas, have been produced for decades, particularly in North America, where advances in

horizontal drilling and well stimulation techniques have now made unconventional commercially viable. In the US, shale gas resources have expanded from near zero to about 20 per cent of the total gas market in the past ten years; nearly all of this occurred in the past five years, as shale gas has become more economic (Figure 1). Projections by the US Energy Information Administration (EIA) (2011) estimate that shale gas will constitute 45 per cent of the US market by the year 2035. This relies on an estimated 23.4 Tm³ or 827 Tcf of technically recoverable shale gas resource.

Shale Gas Prospectivity in Western Australia

Although shale gas reserves around the world still constitute a somewhat unknown quantity, Western Australia alone is estimated to have extremely large gas-in-place resources, perhaps the sixth largest in the world. In 2011, the EIA assessed four of the potential shale gas basins of Australia (the Cooper, Maryborough, Perth and Canning basins), leading to an estimate of 11.2 Tm³ or 396 Tcf of recoverable shale gas in the country (US EIA, 2011). Nearly 75 per cent of

this potential resource is found in Western Australia, in the Perth (1670 Gm³ or 59 Tcf) and Canning basins (6484 Gm³ or 229 Tcf) (Figure 2). This resource represents twice the amount of gas known from the offshore of Western Australia and nearly three times the proven gas reserves in the entire country, enough to supply the city of Perth with energy for nearly 3000 years.

The Canning Basin, which is larger than Texas in areal extent, contains approximately 125,000 km² of prospective shale gas rock (EIA, 2011), an area that is an order of magnitude larger than any US shale play except the Marcellus shale of Pennsylvania (Figure 3; EIA, 2010). The successful plays in the Fayetteville, Barnett, and Woodford shales, for comparison, all cover significantly less than 30,000 km² (Table 1). The vast area covered by the Canning Basin has seen little exploration historically, although interest by a number of large and smaller companies is currently increasing. Much acreage in the basin is held by New Standard Energy (NSE) with ConocoPhillips and Buru Energy Ltd, mainly in partnership with Mitsubishi Corp. Problematically, most of the basin is inaccessible to current infrastructure

US dry gas Tcf/year

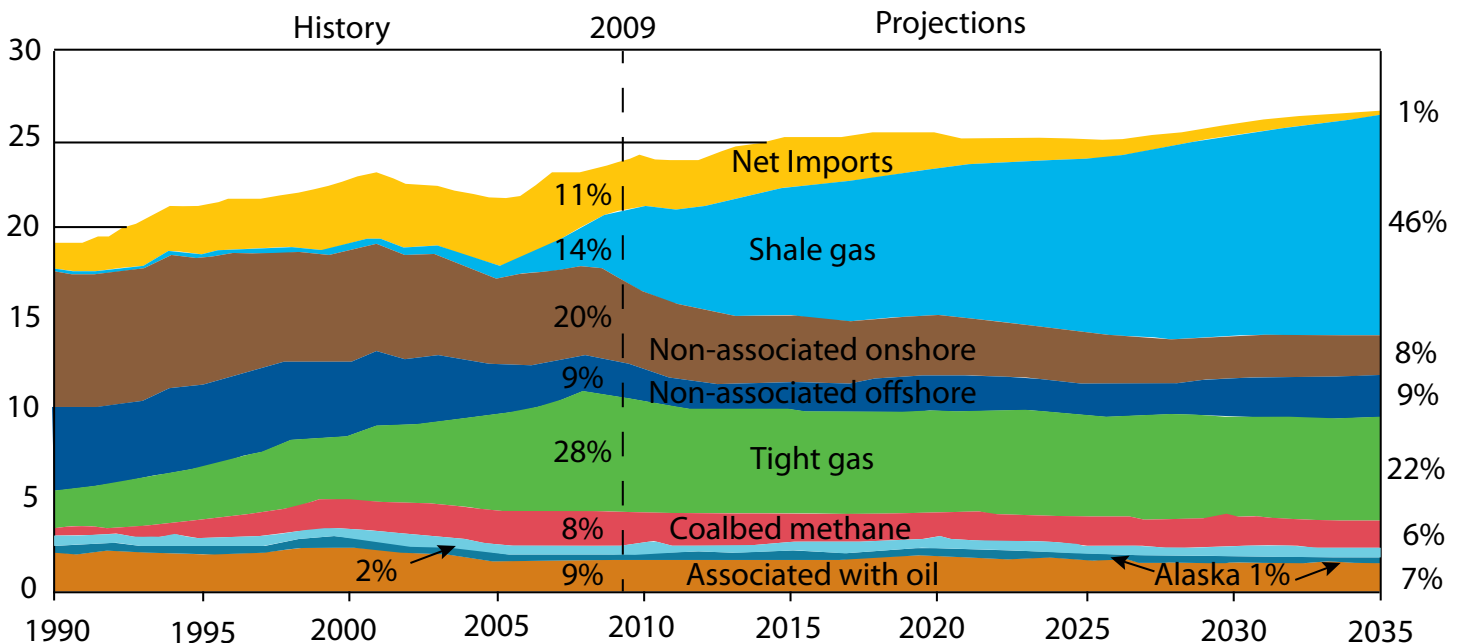


Figure 1 | Historical and Projected US Gas Production, 1990–2035
Source: EIA, 2011

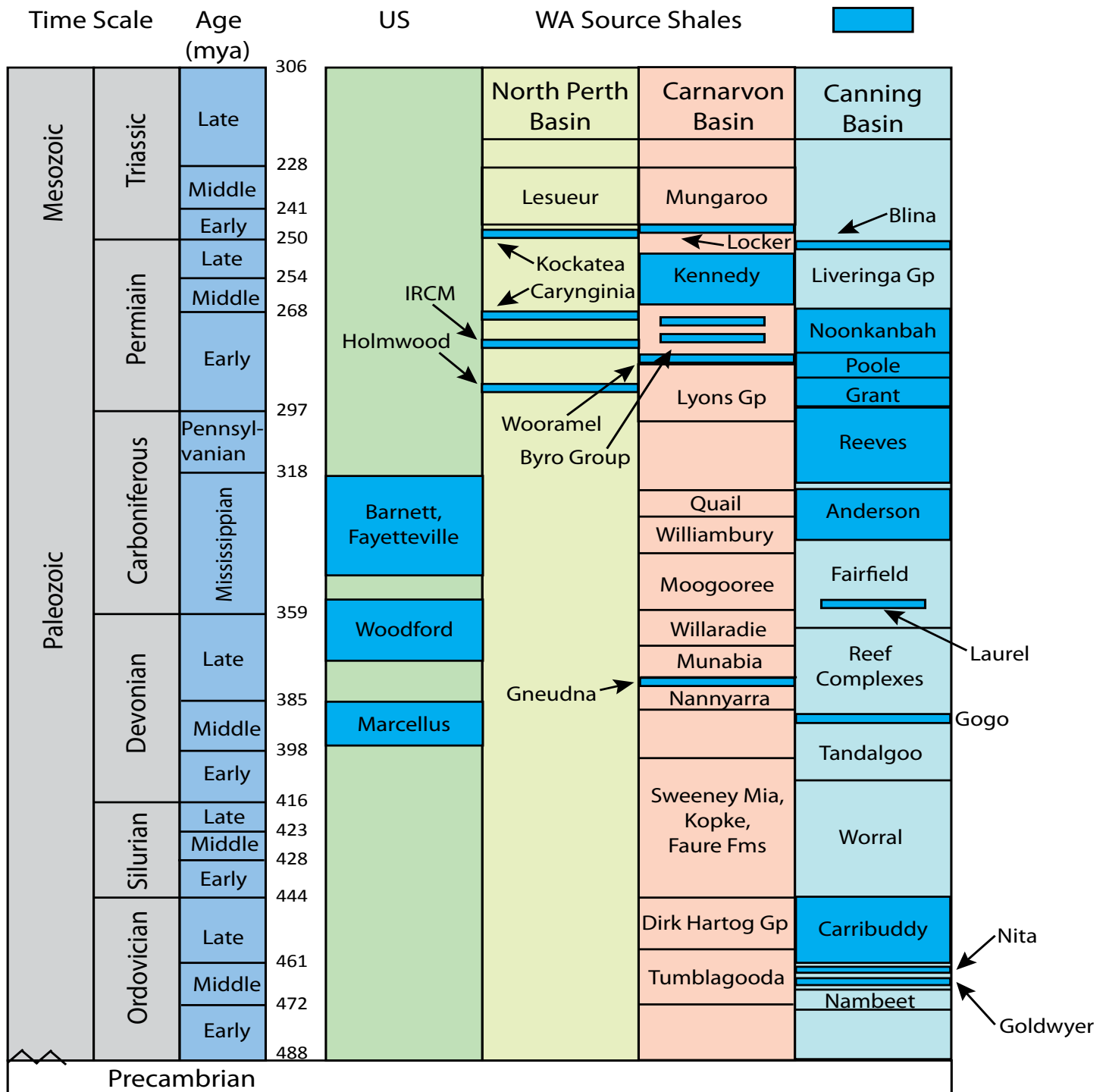


Figure 2 | Shale Gas Source Rocks in WA and the US

and would therefore need extensive development to become economic. Only 300 wells are currently drilled in the Canning, almost all of which lie in its northwest, sea-ward portions, the Fitzroy Trough and the Willara Sub-basin.

The EIA assessment of prospectivity in the Canning was based solely on a single formation, the Goldwyer Shale, using data taken from very limited acreage. The Goldwyer has been favourably compared with a number of

US plays and is quite similar geologically to the Bakken Formation in the north-central US and south-central Canada (EIA, 2011). The formation is Ordovician in age, is found between 800 and 2300 m depth and averages about 400 m thickness. What little is known of its source rock potential indicates TOC content of up to 6.4% and thermal maturity of nearly 2%. The formation remains highly underexplored, but it could contain as much as 21.6 Tm³ (764 Tcf) of gas in-place (EIA, 2011).

Prospective areas of the Canning Basin include the Fitzroy Trough and Willara Sub-basin, both of which lie nearer to the coast and potential infrastructure, although the Kidson Sub-basin, in the southeast part of the basin, appears also to contain the Goldwyer at suitable depths, thicknesses and maturity. Future exploration of the Goldwyer in the Kidson by NSE will add to the limited data available from this area.

The Carboniferous Laurel Formation and the Devonian Gogo Formation may

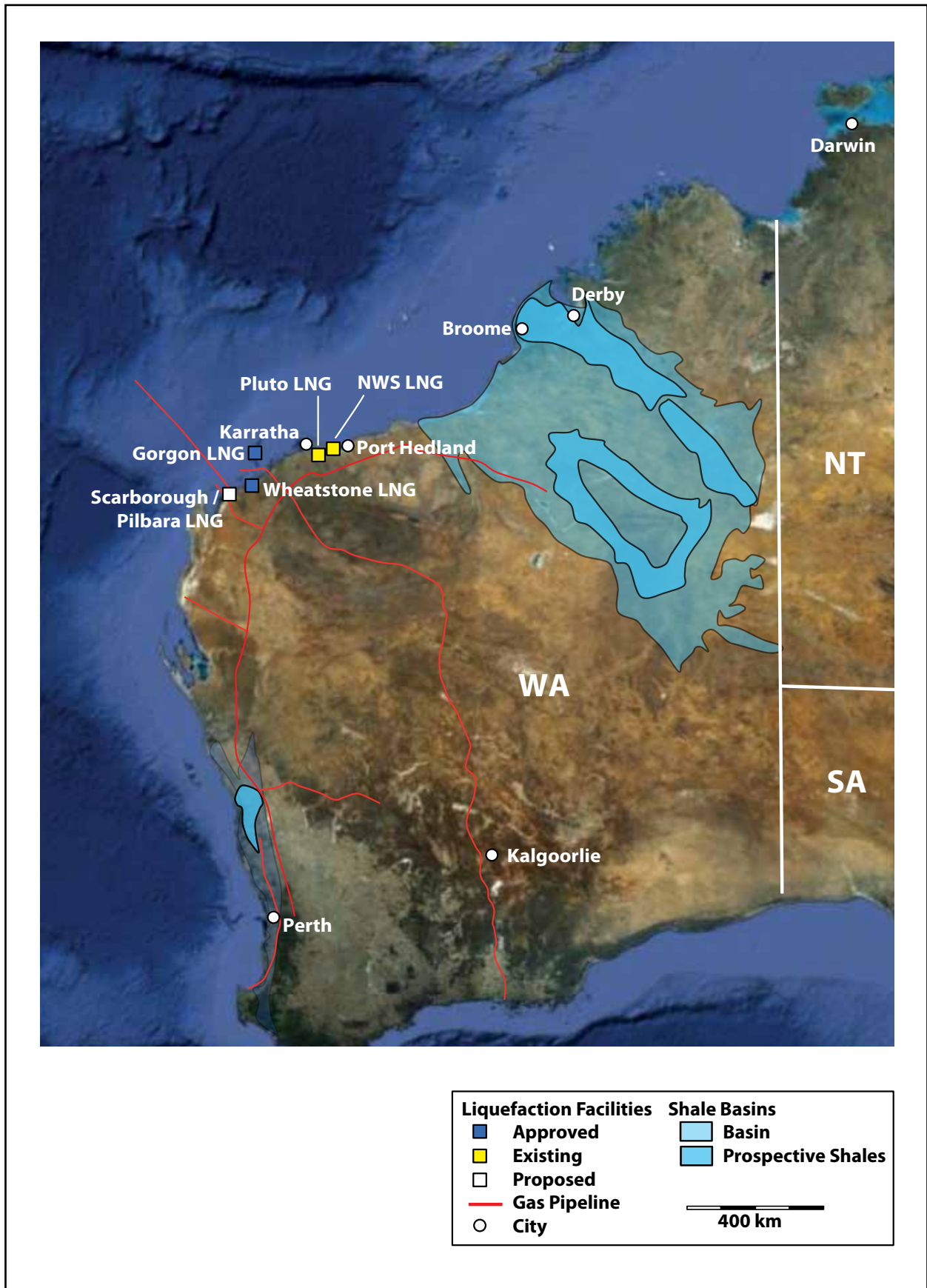


Figure 3 | Map of Western Australia showing areas perspective for shale gas

also be potential shale gas candidates in the Canning, especially in deeper parts of the basin such as the Fitzroy Trough (d'Ercole *et al.*, 2003). Both the Yulleroo and Valhalla wells showed high wet gas values in the Laurel sands in 2010, and a number of new wells are planned to investigate the Laurel in deeper parts of the basin. Current understanding of these formations indicates TOC values of up to 5% in the Laurel, which averages 550 m thick, and up to 4% in the Gogo, which averages 420 m thick. All three of these rock formations have comparable to higher source rock potential parameters than successful US plays (Table 1).

The Perth Basin, although significantly smaller than the Canning Basin, may be the first shale gas play to progress in Western Australia because of its incomparably better infrastructure, which includes direct access to pipelines and to the Perth gas market. In the Perth Basin, the Permian-age Carynginia Shale and the Triassic-age

Kockatea Formation, are estimated to hold nearly 5663 Gm³ (200 Tcf) of gas-in-place and 1670 Gm³ (59 Tcf) of recoverable resource (EIA, 2011). Additional shale gas potential may be contained in the Jurassic-age Cattamarra Coal Measures and the Permian-age Irwin River Coal Measures (IRCM) (Bahar *et al.*, 2011; Figure 2). All prospective formations are found in the Dandaragan Trough.

Shale gas exploration in the Perth Basin began in 2010, when AWE drilled Woodada Deep 1 to investigate the Carynginia Formation, the Kockatea Shale, and the IRCM. This well provided enough positive information, including extensive coring, to high-grade the Carynginia Formation for further exploration. Some of the very few fracturing jobs so far performed on shale gas targets in Australia occurred in the Perth Basin, at Arrowsmith 2 and Woodada Deep 1, with several others scheduled to follow later this year. In addition to AWE, Latent and

Origin Energy are both investigating unconventional gas in the Perth Basin.

Although the Perth Basin is probably most prospective for shale gas in the near future, and the Canning Basin clearly contains the largest potential resource, the Bonaparte and Southern Carnarvon basins may be prospective as well. The Bonaparte remains to be tested for unconventional, but could contain shale gas in the lower Milligans Formation or the Langfield Group (as seen in the Vienta 1 well). TOC values are lower than those seen in the Perth or the Canning, but do reach 2.2% in the Southern Bonaparte, which appears to be mature to 1400 m and overmature (producing dry gas) below this. The Southern Carnarvon also remains untested for unconventional, although the Permian Wooramel Group shales and the Byro Group shales of the Merlinleigh Sub-basin show high TOC levels and probably lie in the mature gas window.

Table 1. Comparison of US and WA Shale Play Parameters

Source: US DoE, 2009; DMP, 2012

| Shale Play | USA | | | Western Australia | | | | |
|---|---------------|-----------------|---------------|-------------------|---------------|----------|------------|------------|
| | Marcellus | Haynesville | Barnett | Goldwyer | Laurel | Gogo | Carynginia | Kockatea |
| Basin | Appalachian | Texas-Louisiana | Fort Worth | Canning | Canning | Canning | Perth | Perth |
| Areal Extent (km ²) | 246,050 | 23,310 | 12,950 | 48,100 | 48,100 | 48,100 | 2180 | 2180 |
| Geologic Age | Devonian | Jurassic | Mississippian | Ordovician | Carboniferous | Devonian | Permian | Triassic |
| Depth (m) | 1200-2560 | 3200-4110 | 1980-2590 | 800-2300 | 800-2880 | 330-2800 | 1220-5030 | 1000-5300 |
| Thickness (m) | 15-60 | 60-90 | 30-80 | 400-750 | 550 | 420 | 90-450 | 90-900 |
| Richness (TOC%) / Maturity (R _o %) | 12 / 3.5 | 4 / 206 | 5 / 1.4 | 6.4 / 1.6 | 4.8 / 2 | 4 / 0.8 | 4 / 1.4 | 5.6 / 1.3 |
| Original Gas-in-Place (Gm ³ /Tcf) | 42,475 / 1500 | 20,303 / 717 | 9259 / 327 | 21,634 / 764 | N/A | N/A | 2775 / 98 | 2831 / 100 |
| Recoverable Resource (Gm ³ /Tcf) | 7419 / 262 | 7107 / 251 | 1245 / 44 | 6484 / 229 | N/A | N/A | 821 / 29 | 849 / 30 |

Shale Gas Production

Shale gas production faces somewhat different obstacles as compared to conventional oil and gas resources. Most importantly, costs are higher because the low permeability of shale means that shale gas wells recover less gas per well therefore, maximising production from a shale gas reservoir necessitates much more drilling. Production in these plays also typically requires advanced techniques such as horizontal drilling and production stimulation (Figure 4). Lateral drilling is now common practice in the US, with wells commonly averaging 1500 m in lateral length and upwards of 15 to 20 stimulation stages per well for environmental protection. Additional techniques such as micro-seismic monitoring of well stimulations and the use of advanced fluids (e.g. light-sand and slick-water fracture fluids that increase the rate of fluid flow) have also come into play.

Well stimulation is a technique first used in conventional hydrocarbon wells to increase the permeability of a rock formation. It operates by pumping fluids and other materials, or 'proppants', into a well at high pressure, in order to fracture the rock and increase the flow of hydrocarbons (Figure 4). After stimulation, the well pressure is reduced and the fluid flowed back to the surface, leaving the proppant to keep the induced fractures open. The materials currently in use in fracking liquids include a high percentage of water and sand or ceramic beads (typically greater than 99 per cent) with minute quantities of other chemicals, all of which must be disclosed to regulatory agencies before stimulation is approved. The net result is acquisition of resources that would be otherwise inaccessible or unviable commercially.

Although well stimulation has been in use since the 1940s and in Australia since 1958, nearly all of the 780 stimulations performed in Western Australia were related to the production of conventional petroleum on Barrow Island; none of these specifically targeted shale gas production, although several shale gas stimulations are planned for the Perth Basin, later in the year. This compares with the US, which averages approximately 10,000 well stimulations per year and recently exceeded 35,000 per year (EPA, 2011).

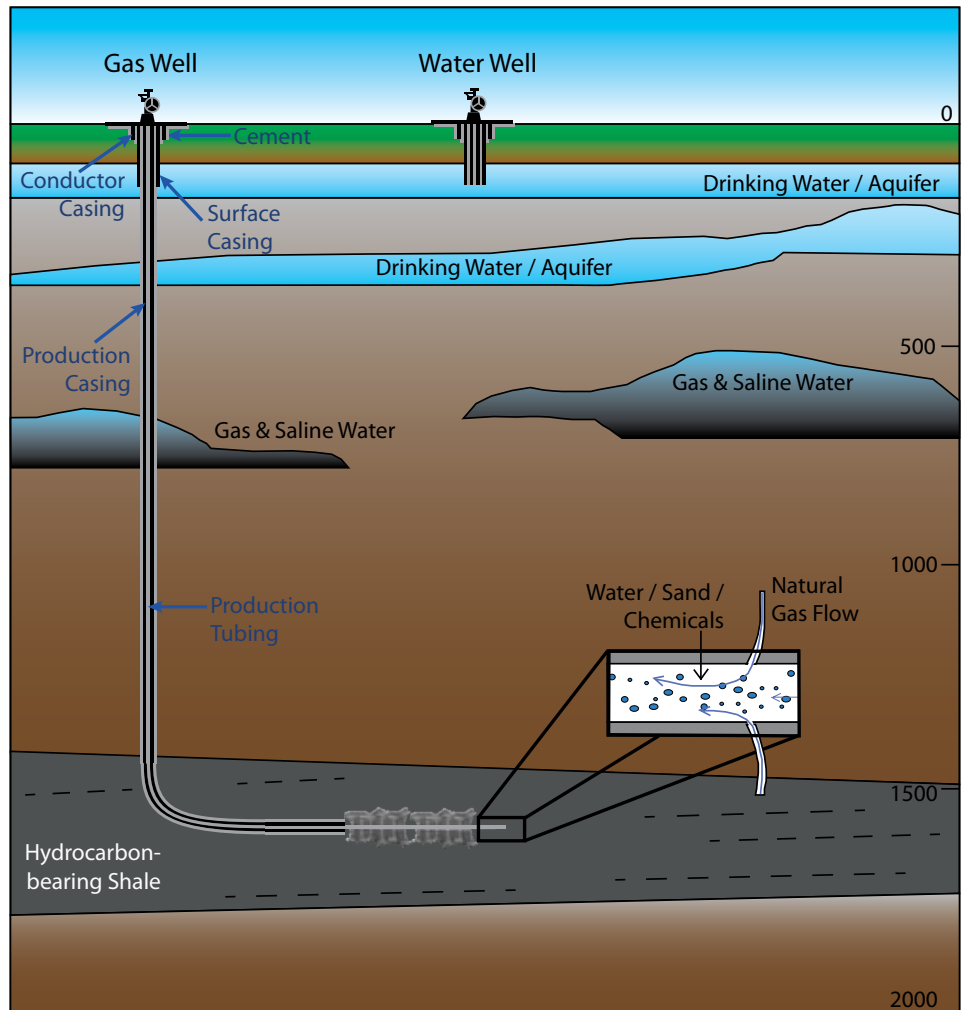


Figure 4 | **Schematic Construction of a Horizontal Well Undergoing Stimulation**
Source: After EPA, 2011

Public perception of well stimulation and its regulation in Australia remains problematic, despite the fact that fracking here is well-regulated and that no investigation, including those by the US Environmental Protection Agency and the US Ground Water Protection Council, has found any direct links between stimulation and potential ground water impacts. Shale gas is in fact almost always located at significantly greater depths than any non-saline, shallow-water aquifer, and poses no danger to potable water, which is generally found more than 1000 m above any shale gas resource. Well designed, and well regulated drilling and completion plans are key to maintaining high safety standards, just as with any conventional oil or gas well.

Factors that affect the economics of shale gas plays, such as price volatility in the gas market, the size of original volumes of gas-in-place and access to sufficient infrastructure are also shared with conventional gas plays.

Infrastructure availability is particularly important in certain areas of Western Australia, such as the Canning Basin, that are currently fairly underexplored. Water usage also becomes more important when extracting shale gas than conventional resources.

Shale gas plays therefore come with significantly higher recovery costs than typical exploration and production and will probably take much longer to become commercially viable in Australia than in the infrastructure-heavy US.

Shale gas production, while similar to that of conventional wells in terms of depth, production rate, and drilling, typically have lower ultimate recoveries (averaging 8–12%), and exhibit fairly steep production declines in their first year (~30–80%), after which production rates tend to flatten. This is again owing to the low permeabilities of the rock formation, which allow only a small fraction of the adsorbed gas to be produced. In fraced horizontal wells, initial production rates of >28,317 m³/d

(>1 MMcf/d) and Estimated Ultimate Recoveries (EUR) of >28,316,846 m³ (>1 Bcf) are typical. These wells are optimal at 1500 m to 2500 m depth, owing to appropriate reservoir pressures and drilling costs, with optimal rock thicknesses of anything greater than 100 m.

Future Shale Gas for Western Australia?

Shale gas exploration in Western Australia, though in its infancy, is poised at an exciting moment in the history of energy in this country.

As with much of the conventional oil and gas resource in the State, onshore shale gas is generally to be found in the thick sedimentation Paleozoic successions of the Perth and Canning basins. These Paleozoic successions include shales of Ordovician, Silurian, Devonian, Carboniferous, and Permian age, as well as a few potentially prospective shales in the overlying Triassic and Jurassic cover (Figure 2).

Many of the source rocks in WA correspond to similarly aged shale gas plays in the US, in addition to sharing similar characteristics (e.g. the Canning Basin's Gogo Formation with the Devonian Marcellus shale, or the early Carboniferous Laurel Formation with the Mississippian Barnett, Fayetteville and Woodford shales in the Gulf Coast of the US).

In terms of size, however, Western Australia possesses significantly larger potential shale gas plays than North America; its estimated resource of 11.2 Tm³ (396 Tcf) of technically recoverable shale gas is greater than that of all other countries except China, the United States, Argentina, Mexico, and South Africa (EIA, 2011). In terms of source rock potential, the Canning and Perth basin shales have TOC values nearly as or as high as the average US play and are mature to overmature in much of their areal extents.

An enormous untapped resource exists in Western Australia, and the recent advances in drilling and completions technologies in North America would allow the exploration and production of this shale gas. For this type of unconventional play to become a commercially viable prospect in Western Australia, however, techniques such as horizontal drilling, micro-seismic monitoring, and advanced types of environmental sensitive well stimulation need to be incorporated into current local practices, and significant increases in available infrastructure and decisions concerning water usage need to be undertaken. If this can be done, there is no reason that unconventional shale gas could not eventually match or even exceed the potential of Western Australian conventionals. ■

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Review of Small Scale and Noncommercial Geothermal Operations

Mike Middleton

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Petroleum Resources Safety inspectors at a geothermal well site in Perth

Some degree of ambiguity surrounds Part II Section 7 Sub-sections (4) and (5) of the *Petroleum and Geothermal Resources Act 1967 (PAGERA67)*.

These sub-sections state:

- (4) This Act does not apply to operations for the recovery of geothermal energy —
- that are carried out for the purposes of a small scale ground source heat pump used at or near the source of the geothermal energy; or
 - that involve small scale recovery of geothermal energy not for a commercial purpose; or
 - that are of a kind prescribed by the regulations.
- (5) Without limiting subsection (4) (b), the regulations may specify whether the small scale recovery of geothermal energy in prescribed circumstances or for a prescribed reason is or is not for a commercial purpose.

Initially, the Western Australian legislation was drawn up with the view of generation of baseload power by geothermal energy. For comparison, in Victoria, there is a depth and temperature restriction to its geothermal regulations, while Western Australia made the decision not to be as prescriptive. However, a significant

Table 1. Some examples of small scale geothermal usage

| Country | Temperature range | Location | Notes |
|----------------|---------------------------|---|---|
| United Kingdom | 90–150 °C (Medium) | England and Wales (Permo-Triassic sandstones) | Hot sedimentary aquifers (HSA) |
| | Below 90 °C (Low) | Southampton | HSA – commercial district heating |
| France | 57–85 °C | Paris Basin, Dogger Formation | In use since the 1970s. Extracted water is reinjected at about 40 °C |
| Germany | 85–160 °C | Molasse Basin, Malm Formation | Used for health resorts and thermal baths at Unterhaching |
| Austria | 105 °C, reducing to 85 °C | Bad Blumau | Brine is used for electricity generation then used for district heating |
| Hungary | 30–100 °C | Various spas | As of 2009, 910 wells have been producing thermal water |
| China | 40–90 °C | Beijing | Water being used for large scale district heating |
| USA – Nevada | 103 °C | e.g. Peppermill Casino | Used in Nevada since 1984; e.g. heating the resort |
| USA – Alaska | 73 °C | Chena Hot Springs | Geothermal fluids power two Organic Rankine Cycle turbines to produce electricity |

number of smaller scale, non-electricity-generating projects have occurred over the past few years largely in the Perth metropolitan area (Figure 1). This type of geothermal activity has grown to such a level in Western Australia that many operations are occurring outside the *PAGERA67* because of the lack of clarity on the small scale, non-commercial exclusion. In these cases, the geothermal operations are being carried out under the *Rights in Water and Irrigation Act 1914*.

It is of some concern that geothermal developments outside *PAGERA67* may have detrimental effects for holders of Geothermal Exploration Permits. Accordingly, the Department of Mines and Petroleum commissioned Sinclair, Knight and Merz (SKM) to undertake a review of small scale and non-commercial operations in other jurisdictions in order to gain a

better understanding about how such geothermal operations are regulated. SKM reviewed regulation of geothermal operations in other Australian states, the United Kingdom, France, Germany, Austria, Hungary, Turkey, China and North America.

Some relevant findings of the SKM review are summarised in Table 1.

It is of interest to note that the Australian Geothermal Reporting Code states that “geothermal energy” is taken to include only thermal energy from the earth to which legal rights of extraction can, in principle, be obtained. Many jurisdictions place a minimum temperature for the legal right of extraction of thermal energy. The SKM review found that in Europe there are a number of geothermal developments analogous to the geological setting in Western Australia,

where no minimum temperature is stated in the country’s legislation. Several countries exempt hot water extracted from wells drilled to less than 100 m and any use related to ground source heat pumps. Additionally, it was found that no definitions of “small scale” are specifically stated in the European setting. The review also noted that without the subsidies and incentives in place in Europe, many geothermal schemes would not be economic.

The Department of Mines and Petroleum is still considering how to handle Part II Section 7 references to small scale and not for commercial purpose in *PAGERA67*. It is anticipated that some clarification will be included in the new resource management regulations and associated guidelines to be released later in 2012 or early 2013. ■

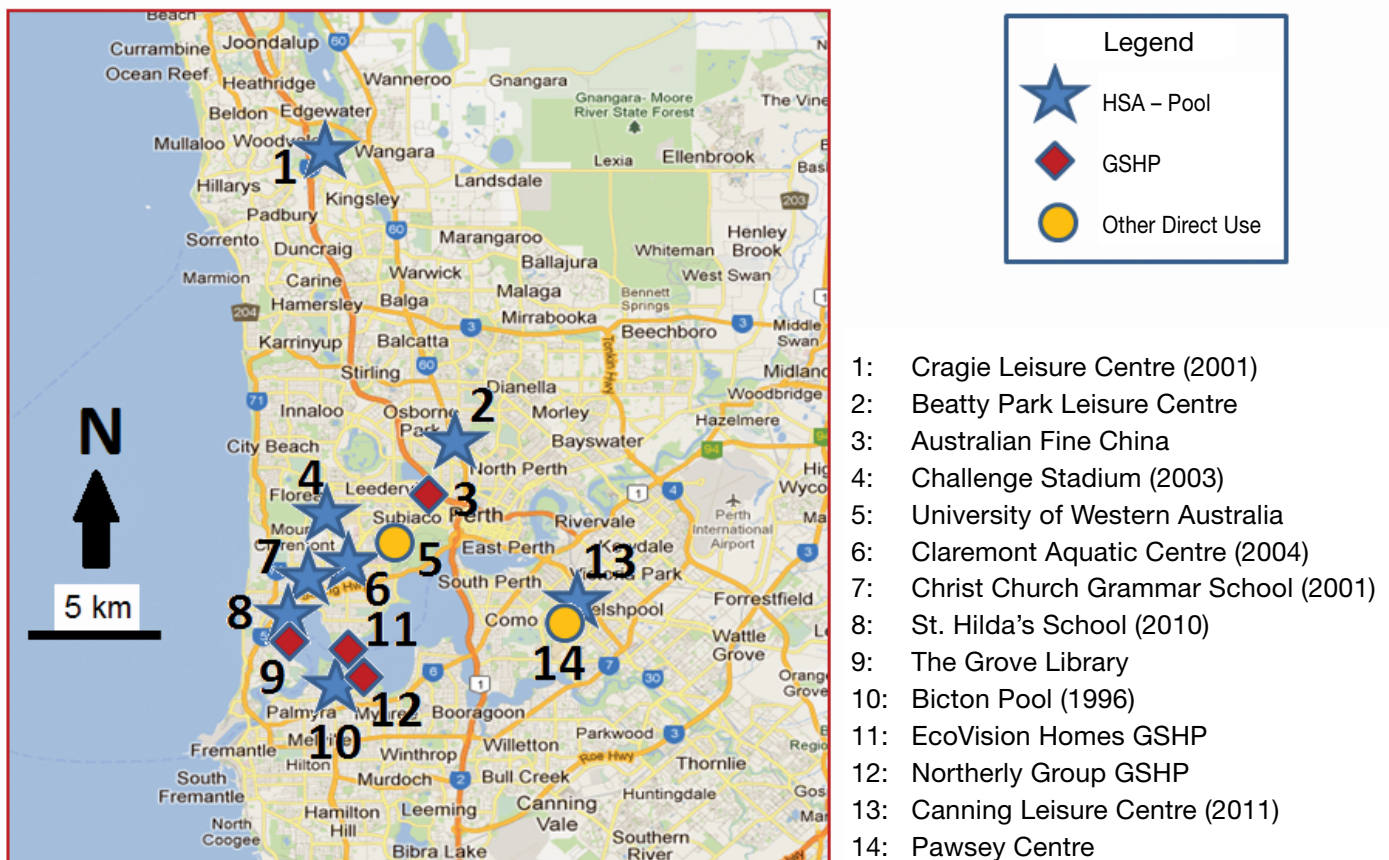


Figure 1 | “Small scale” and “noncommercial” geothermal projects in the Perth metropolitan area. HSA refers to hot sedimentary aquifer, and GSHP refers to ground source heat pumps.

Grant Bolton and Colin Hayes are acknowledged as the sources for this information. Mark Ballesteros is acknowledged for permission to use this figure.

Further Enhancements to the Petroleum and Geothermal Register (PGR)

Hazel Harnwell

Manager Project Coordination and Information Management
Business Development Branch



The PGR Drilling Management Development Team

Various PGR project teams have been working steadfastly away to complete and roll out new modules while at the same time continuing with ongoing development for others. In July this year, the Acreage Release Bidding System went live. This module presented a number of new development challenges due to the complexity of the process.

In conjunction with the Bidding module, functionality for the lodgement of Exploration Permits and Drilling Reservations was also introduced.

To develop the online module for each of these application types, it was necessary to take into account that an Exploration Permit or Drilling Reservation application, under the *Petroleum and Geothermal Energy Resources Act 1967 (PGERA67)* may be applied for out of a Special Prospecting Authority with an Acreage Option (SPA/AO). The online lodgement process needed to be adapted to accommodate the linkage between an SPA/AO title and a resulting Exploration Permit or Drilling Reservation application.

Acreage for Special Prospecting Authorities under the *PGERA67* and *Petroleum Submerged Lands Act 1982 (PSLA82)* is not available through the bidding process and these applications are submitted separately outside of the process. For SPAs under the *PGERA67*, there is an additional complexity in that the Act provides for an Acreage Option (AO) which, once granted, gives the SPA/AO title holder the opportunity to take up the option and select blocks from the SPA/AO title acreage area

to apply for an Exploration Permit or Drilling Reservation.

Exploration Permits and Drilling Reservations are awarded to those applicants who will undertake the fullest assessment of an area's petroleum or geothermal energy potential in accordance with sound resource management principles and having regard to safety and the environment. An SPA is awarded if the proposed activity is appropriate to the number of blocks requested and can be completed within six (6) months. Prior to the introduction of the Acreage Release Bidding System module, Petroleum Tenure and Land Access Branch staff had to manually enter all applications into the system.

The most critical aspect in the development of the Bidding System was ensuring the confidentiality of bids in accordance with State legislation. Major benefits of the module are:

- bids for Exploration Permits to be lodged, paid for and received online;
- the amount of time required to manually enter applications into the system will decrease;
- a reduction in data entry errors;
- the creation of a seamless process from the lodgement of a bid to the refusal of an application or acceptance of a title; and
- linkages between various application types (e.g. SPA/AO to an Exploration Permit or Drilling Reservation) to show the history of the titles and blocks.

Work has advanced on the Native Title module, which is planned for release later this year. This module will provide internal functionality allowing the business area to record and manage Native Title cases relating to the assessment of an application for a title. Case officers will be able to manage individual cases within PGR as well as use the data for internal reporting purposes.

Development has commenced on a Drilling Management module that will track the complete life cycle of a well via the lodgement and processing of applications for Completions, Interventions, Suspensions, Variations, Testing, and Abandonments. This development is in preparation for the new *Resource Management and Administration Regulations*. The module will ensure internal users consistently assess, approve and monitor well activities. It will also provide an internal reporting function. As part of the system development process, current work practices and procedures are being reviewed to ensure that workflows and checklists appropriately reflect legislative and business requirements. It will be the first time that technical data for a drilling activity will be captured and stored in one central location.

Jeff Haworth, of the Petroleum Division, said that PGR has become more than an electronic register and was increasingly becoming an integral part of managing regulatory functions within the Petroleum Division, particularly in relation to well integrity and resource management matters. ■

Petroleum Division Certified in AS/NZS ISO 9001:2008

Hayden Samuels

Approvals Monitoring Officer
Business Development Branch



Hayden Samuels (left) and Mark Gabrielson of the Petroleum Division discussing QMS process charts

The Petroleum Division has achieved AS/NZS ISO 9001:2008 recertification after being systematically audited in February 2012.

DMP is the only agency in Australia that has achieved the AS/NZS ISO 9001:2008 rating for its management of petroleum tenure and land access, petroleum resource management, environmental approvals, and strategic business development areas respectively.

AS/NZS ISO 9001:2008 is a Quality Management System certified by the International Organisation for Standardisation ("ISO"). This standard replaced AS/NZS 9001:2000 after it was published on December 30, 2008. The Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee. The objective of the revision was to improve clarity.

The Petroleum Division is committed to achieving quality within all of the organisation's areas of responsibility that applies to those processes associated with upstream petroleum approvals, investigations, development of policies and legislation, preparation of Ministerials and resource management for the upstream petroleum industry that comply with the various aspects of State and Commonwealth Acts and petroleum legislation. This has allowed the division to satisfactorily identify and meet the expectations of our customers (workforce, industry, government, and public).

The Quality Management System (QMS) has been established, documented and maintained with the specific objective of ensuring that all work provided by the Petroleum Division meets the specified requirements of the customer and quality objectives at a consistent level. The structure is derived from applying the principles of the AS/NZS ISO 9001:2008 standard to the business processes.

The Petroleum Division believes commitment to quality in delivering service is the responsibility of every member of the division. Management endeavor's to lead by example through their own practices and standards and through allocation of necessary resources to support quality practices. All staff contribute to the quality process through use of the quality management system and through suggestions for improvements to the processes and procedures.

To provide consistency and auditability, all activities are performed against the relevant AS/NZS ISO 9001:2008 standard (e.g. Petroleum Division or branch guidelines or procedures, industry guidelines), within the framework of the QMS.

Continuous improvement in the services we provide is achieved by:

- Audits and formal reviews of processes, activities, and procedures.
- Ongoing awareness by all staff of the possibility for improving, streamlining and eliminating unnecessary steps.

- Management support and encouragement for suggesting and implementing improvement recommendations.
- Soliciting feedback from customers on a regular basis.
- Implementing recommended improvement actions.

Communication, education and training are essential components in the implementation of the QMS to ensure all staff are empowered to contribute to the system, its practices, and procedures and this then ensures that sound controls are distributed and promoted internally and externally. Assistance has been given to support the training needs of staff at all levels so they possess the understanding and competence for their role within the QMS. Staff are also required to perform their duties in accordance with the Department of Mines and Petroleum's Core Values and Code of Conduct.

In order to be granted certification, each branch within the division was required to demonstrate that it:

- consistently meets statutory and regulatory requirements;
- follows set procedures to ensure consistency in customer services; and
- allows for the continual improvement of its management systems.

The certification is valid for three years, expiring in 2015. The division will be audited annually during this time. ■

Table 1. 2011 Production by Field and Cumulative Production as at 31 December 2011

| Field | Operator | 2011 Production by Field | | | Cumulative Production | | | Permit |
|----------------|--------------|--------------------------|------------|--------------------------------|-----------------------|------------|--------------------------------|------------|
| | | Oil | Condensate | Gas | Oil | Condensate | Gas | |
| | | kL | kL | 10 ³ m ³ | kL | kL | 10 ³ m ³ | |
| Agincourt | Apache | 7,816 | 70 | 2,774 | 532,884 | 4,050 | 30,683 | TL/1 |
| Albert | Apache | 8,372 | 56 | 1,674 | 70,121 | 96 | 8,041 | TL/6 |
| Angel | Woodside | 0 | 2,388,899 | 8,078,987 | 0 | 7,160,823 | 24,063,508 | WA-3-L |
| Apium | AWE | 0 | 31 | 2,338 | 0 | 385 | 32,941 | L1 |
| Bambra | Apache | 44,308 | 38,629 | 423,039 | 353,416 | 153,279 | 1,269,754 | TL/1 |
| Barrow Island | Chevron | 292,823 | 0 | 27,460 | 50,589,474 | 0 | 5,343,409 | L1H |
| Blacktip | Eni | 0 | 10,954 | 606,534 | 0 | 22,050 | 1,250,722 | WA-33-L |
| Blina | Buru Energy | 978 | 0 | 0 | 297,795 | 0 | 0 | L6 |
| Boundary | Buru Energy | 220 | 0 | 0 | 20,963 | 0 | 0 | L6 |
| Cliff Head | Roc Oil | 174,103 | 0 | 817 | 1,838,201 | 0 | 8,213 | WA-31-L |
| Corybas | AWE | 0 | 37 | 4,448 | 0 | 216 | 11,577 | L2 |
| Cossack | Woodside | 29,304 | 0 | 757 | 12,877,611 | 0 | 385,734 | WA-9-L |
| Cowle | Chevron | 4,491 | 0 | 1,675 | 535,757 | 0 | 91,303 | TL/4 |
| Crest | Chevron | 157 | 0 | 462 | 275,211 | 108 | 63,148 | L12, L13 |
| Crosby | BHP Billiton | 1,127,653 | 0 | 61,126 | 3,036,273 | 0 | 133,316 | WA-42-L |
| Dongara | AWE | 1,127 | 0 | 20,718 | 194,221 | 49,681 | 12,909,840 | L1, L2 |
| Double Island | Apache | 13,539 | 77 | 4,798 | 705,717 | 2,903 | 56,600 | TL/9 |
| Echo/Yodel | Woodside | 0 | 143,523 | 158,395 | 0 | 10,891,375 | 13,725,948 | WA-23/24-L |
| Enfield | Woodside | 1,098,813 | 0 | 113,426 | 10,221,972 | 0 | 875,735 | WA-28-L |
| Eremia | AWE | 1,508 | 0 | 1,565 | 244,014 | 0 | 14,600 | L1 |
| Eskdale | BHP Billiton | 80,977 | 0 | 140,094 | 479,877 | 0 | 408,404 | WA-32-L |
| Exeter | Santos | 40,513 | 0 | 281 | 2,553,642 | 0 | 5,278 | WA-27-L |
| Goodwyn | Woodside | 0 | 1,023,606 | 5,152,944 | 0 | 45,323,059 | 134,008,701 | WA-5-L |
| Halyard | Apache | 0 | 46,419 | 381,116 | 0 | 46,419 | 381,116 | WA-13-L |
| Harriet | Apache | 23,261 | 869 | 10,676 | 8,223,500 | 61,086 | 1,503,127 | TL/1 |
| Hermes | Woodside | 359,977 | 0 | 22,444 | 13,041,458 | 0 | 867,312 | WA-16-L |
| Hovea | AWE | 10,926 | 0 | 3,367 | 1,168,641 | 251 | 103,837 | L1 |
| Jingemia | Origin | 17,993 | 0 | 1,731 | 733,006 | 0 | 35,541 | L14 |
| John Brookes | Apache | 0 | 130,450 | 2,300,669 | 0 | 875,778 | 14,256,540 | WA-29-L |
| Laminaria East | Woodside | 18,234 | 0 | 1,903 | 1,567,649 | 70,625 | 28,437 | WA-18-L |
| Lee | Apache | 4 | 902 | 7,327 | 4 | 108,395 | 714,849 | TL/1 |
| Little Sandy | Apache | 1,232 | 11 | 655 | 93,463 | 467 | 13,956 | TL/6 |
| Macedon | BHP Billiton | 0 | 0 | 16,725 | 0 | 0 | 33,486 | WA-42-L |
| Mohave | Apache | 7,324 | 138 | 3,606 | 162,376 | 369 | 30,435 | TL/6 |
| Mount Horner | AWE | 48 | 0 | 0 | 298,141 | 0 | 0 | L7 |
| Mutineer | Santos | 287,103 | 0 | 1,973 | 6,331,621 | 0 | 14,927 | WA-26-L |
| North Alkimos | Apache | 1,390 | 4 | 859 | 12,634 | 98 | 22,682 | TL/6 |
| North Rankin | Woodside | 0 | 574,250 | 5,622,741 | 0 | 25,271,883 | 199,153,425 | WA-1-L |
| Pedirka | Apache | 6,458 | 54 | 3,497 | 333,396 | 1,308 | 40,698 | TL/6 |
| Perseus | Woodside | 0 | 1,986,441 | 10,888,405 | 0 | 24,157,408 | 119,385,927 | WA-1-L |
| Ravensworth | BHP Billiton | 2,340,147 | 0 | 135,777 | 2,964,712 | 0 | 259,920 | WA-42-L |
| Redback | Origin | 0 | 127 | 113,928 | 0 | 142 | 125,103 | L11 |
| Roller | Chevron | 38,797 | 0 | 14,141 | 7,156,359 | 0 | 770,034 | TL/7 |
| Rose | Apache | 0 | 190 | 1,658 | 0 | 205,069 | 999,129 | TL/1 |
| Saladin | Chevron | 60,973 | 0 | 20,834 | 15,529,297 | 0 | 1,761,885 | TL/4 |
| Searipple | Woodside | 0 | 56,936 | 53,137 | 0 | 1,290,013 | 1,276,824 | WA-1-L |
| Simpson | Apache | 2,407 | 3,243 | 2,664 | 846,498 | 12,271 | 87,062 | TL/1 |

Table 1. 2011 Production by Field and Cumulative Production as at 31 December 2011

| Field | Operator | 2011 Production by Field | | | Cumulative Production | | | Permit |
|--|--------------|--------------------------|------------------|--------------------------------|-----------------------|--------------------|--------------------------------|---------|
| | | Oil | Condensate | Gas | Oil | Condensate | Gas | |
| | | kL | kL | 10 ³ m ³ | kL | kL | 10 ³ m ³ | |
| Skate | Chevron | 0 | 0 | 215 | 266,950 | 8,873 | 178,182 | TL/7 |
| South Plato | Apache | 480 | 6 | 216 | 702,912 | 899 | 51,691 | TL/6 |
| Stag | Apache | 396,032 | 0 | 8,983 | 8,956,222 | 0 | 407,704 | WA-15-L |
| Stickle | BHP Billiton | 914,784 | 0 | 65,655 | 2,458,238 | 0 | 170,287 | WA-42-L |
| Stybarrow | BHP Billiton | 1,161,179 | 0 | 67,575 | 7,569,638 | 0 | 455,757 | WA-32-L |
| Sundown | Buru Energy | 1,241 | 0 | 0 | 73,508 | 0 | 0 | L8 |
| Van Gogh | Apache | 1,024,832 | 0 | 139,597 | 2,903,118 | 0 | 296,612 | WA-35-L |
| Victoria | Apache | 4,710 | 54 | 1,542 | 57,132 | 429 | 9,977 | TL/6 |
| Vincent | Woodside | 1,352,271 | 0 | 172,030 | 4,305,031 | 0 | 907,720 | WA-28-L |
| Wanaea | Woodside | 55,672 | 0 | 12,549 | 39,241,582 | 0 | 8,423,159 | WA-11-L |
| Wandoo | Vermillion | 473,740 | 0 | 40,133 | 13,097,233 | 0 | 1,046,644 | WA-14-L |
| West Cycad | Apache | 5,973 | 182 | 5,168 | 214,793 | 527 | 35,804 | TL/9 |
| West Terrace | Buru Energy | 394 | 0 | 0 | 39,522 | 0 | 0 | L8 |
| Wonnich | Apache | 0 | 27,783 | 340,794 | 0 | 466,721 | 4,686,000 | TL/8 |
| Woollybutt | Eni | 164,058 | 0 | 4,505 | 5,467,936 | 0 | 154,434 | WA-25-L |
| Yammadery | Chevron | 467 | 0 | 10,212 | 858,223 | 0 | 117,938 | TL/4 |
| Cumulative production for developed fields currently not producing | | | | | 46,945,988 | 3,311,131 | 29,041,439 | |
| Total | | 11,658,809 | 6,433,941 | 35,283,319 | 276,447,930 | 119,498,187 | 582,547,055 | |

Table 2a. Petroleum Reserves Estimates by Basin as at 31 December 2011 (metric units)

| Basin | Oil | | Sales Gas | | Condensate | |
|--------------------|---------------|--------------|-----------------|-----------------|---------------|---------------|
| | GL | | Gm ³ | | GL | |
| Category 1 | P50 | P90 | P50 | P90 | P50 | P90 |
| Bonaparte | 0.000 | 0.000 | 21.181 | 9.429 | 0.356 | 0.158 |
| Browse | 0.000 | 0.000 | 63.712 | 44.174 | 19.450 | 13.016 |
| Northern Carnarvon | 58.969 | 24.123 | 1,152.046 | 917.330 | 72.001 | 57.661 |
| Perth | 1.022 | 0.712 | 0.20 | 0.138 | 0.001 | 0.001 |
| Total | 59.99 | 24.84 | 1,237.14 | 971.07 | 91.81 | 70.84 |
| Category 2 | P50 | P90 | P50 | P90 | P50 | P90 |
| Bonaparte | 0.000 | 0.000 | 60.698 | 34.118 | 1.650 | 0.957 |
| Browse | 0.000 | 0.000 | 504.300 | 504.300 | 66.300 | 66.300 |
| Northern Carnarvon | 4.329 | 2.117 | 720.511 | 406.398 | 38.347 | 19.622 |
| Total | 4.33 | 2.12 | 1,285.51 | 944.82 | 106.30 | 86.88 |
| Category 3 | P50 | P90 | P50 | P90 | P50 | P90 |
| Browse | 0.000 | 0.000 | 348.207 | 276.519 | 74.537 | 60.408 |
| Northern Carnarvon | 8.263 | 4.975 | 105.548 | 67.226 | 13.829 | 8.514 |
| Perth | 0.000 | 0.000 | 1.148 | 0.454 | 0.001 | 0.000 |
| Total | 8.26 | 4.98 | 454.90 | 344.20 | 88.37 | 68.92 |
| Category 4 | P50 | P90 | P50 | P90 | P50 | P90 |
| Bonaparte | 0.000 | 0.000 | 13.180 | 0.446 | 0.074 | 0.022 |
| Browse | 0.000 | 0.000 | 34.790 | 16.175 | 3.382 | 1.259 |
| Canning | 0.046 | 0.017 | 2.737 | 0.707 | 0.620 | 0.151 |
| Carnarvon | 50.338 | 31.756 | 494.842 | 308.921 | 21.808 | 13.927 |
| Perth | 0.000 | 0.000 | 5.500 | 5.500 | 0.000 | 0.000 |
| Total | 50.38 | 31.77 | 551.05 | 331.75 | 25.88 | 15.36 |
| GRAND TOTAL | 122.97 | 63.70 | 3,528.60 | 2,591.84 | 312.36 | 242.00 |

Table 2b. Petroleum Reserves Estimates by Basin as at 31 December 2011 (field units)

| Basin | Oil | | Sales Gas | | Condensate | |
|--------------------|---------------|---------------|---------------|--------------|-----------------|-----------------|
| | MMbbl | | Tcf | | MMbbl | |
| Category 1 | P50 | P90 | P50 | P90 | P50 | P90 |
| Bonaparte | 0.000 | 0.000 | 0.748 | 0.333 | 2.243 | 0.998 |
| Browse | 0.000 | 0.000 | 2.249 | 1.559 | 122.339 | 81.869 |
| Northern Carnarvon | 370.906 | 151.730 | 40.684 | 32.395 | 452.876 | 362.677 |
| Perth | 6.430 | 4.481 | 0.006 | 0.004 | 0.006 | 0.006 |
| Total | 377.34 | 156.21 | 43.69 | 34.29 | 577.46 | 445.55 |
| Category 2 | P50 | P90 | P50 | P90 | P50 | P90 |
| Bonaparte | 0.000 | 0.000 | 2.143 | 1.204 | 10.378 | 6.025 |
| Browse | 0.000 | 0.000 | 17.809 | 17.809 | 417.014 | 417.014 |
| Northern Carnarvon | 27.232 | 13.318 | 25.444 | 14.351 | 241.195 | 123.418 |
| Total | 27.23 | 13.32 | 45.40 | 33.36 | 668.59 | 546.46 |
| Category 3 | P50 | P90 | P50 | P90 | P50 | P90 |
| Browse | 0.000 | 0.000 | 12.296 | 9.765 | 468.828 | 379.960 |
| Northern Carnarvon | 51.975 | 31.295 | 3.727 | 2.374 | 86.983 | 53.553 |
| Perth | 0.000 | 0.000 | 0.040 | 0.016 | 0.011 | 0.005 |
| Total | 23.84 | 14.78 | 23.60 | 17.17 | 755.02 | 547.45 |
| Category 4 | P50 | P90 | P50 | P90 | P50 | P90 |
| Bonaparte | 0.000 | 0.000 | 0.465 | 0.015 | 0.469 | 0.143 |
| Browse | 0.000 | 0.000 | 1.228 | 0.571 | 21.277 | 7.919 |
| Canning | 0.289 | 0.109 | 0.096 | 0.024 | 3.899 | 0.949 |
| Carnarvon | 316.616 | 199.740 | 17.475 | 10.909 | 137.171 | 87.601 |
| Perth | 0.000 | 0.000 | 0.194 | 0.194 | 0.000 | 0.000 |
| Total | 316.91 | 199.85 | 19.46 | 11.71 | 162.82 | 96.61 |
| GRAND TOTAL | 773.45 | 400.67 | 124.60 | 91.52 | 1,964.69 | 1,522.14 |

NOTES
Canning Basin reserves are too small to measure.
Category 1 comprises current reserves of those fields which are producing hydrocarbons or have been declared commercial (FFDP approved and FID).
Category 2 comprises estimates of recoverable reserves which are held under Retention Leases and have not yet been declared commercially viable.
Category 3 comprises estimates of contingent resources which are held in other licences and have been declared commercially viable but may or may not have a FFDP and have not yet reached FID.
Category 4 comprises estimates of contingent resources which are held in other licences and have not yet been declared commercially viable and are not held under a Retention Lease.
Reserves estimates for 2012 have not yet been submitted by industry to DMP.

Table 3. Petroleum Wells in Western Australia, Onshore and State Waters Operating 2011–12 Fiscal Year

| Well Name | Class | Offshore | Title | Operator | Latitude |
|------------------------|-------|----------|-----------|----------|-----------|
| Canning Basin | | | | | |
| Ungani 2 | EXT | On | EP 391 R2 | Buru | -17.99058 |
| Yulleroo 3 | EXT | On | EP 391 R2 | Buru | 17.84983 |
| Lawford 1 Deepening | NFW | On | EP 417 R1 | Buru | -19.99272 |
| Paradise 1 Deepening | NFW | On | EP 371 R1 | Buru | -17.99989 |
| Pictor East 1 | | | | | |
| Ungani 1 | NFW | On | EP 431 | Buru | -18.77064 |
| Ungani 1 | NFW | On | EP 391 R2 | Buru | -17.99044 |
| Valhalla 2 | NFW | On | EP 371 R1 | Buru | -18.06781 |
| Valhalla North 1 | NFW | On | EP 371 R1 | Buru | -18.02578 |
| Carnarvon Basin | | | | | |
| Bambra 10 | DEV | Off | TL/1 R1 | Apache | -20.60221 |
| Hannah 1 | NFW | Off | TP/8 R3 | Apache | -20.80658 |
| Perth Basin | | | | | |
| Evandra 2 | NFW | On | L 1 R1 | AWE | -29.34830 |

Classification

DEV Development Well

EXT Extension Well

NFW New Field Wildcat

Table 4. Surveys in Western Australia Operating 2011–12 Fiscal Year

| Survey Name | Class | On Off | Title | Operator | Commenced | Completed | 2D Line km @ 31/12/2011 | 3D km ² @ 31/12/2011 |
|-------------------------------------|---------|--------|---|----------------------------------|------------|------------|-------------------------|---------------------------------|
| Canning Basin | | | | | | | | |
| Athos 2D S.S. | 2D | On | EP 473, EP 438 | Buru Energy Limited | 25/08/2011 | 15/09/2011 | 299 | |
| Commodore East 2D S.S. | 2D | On | EP 390 R2, EP 471 | Buru Energy Limited | 18/09/2011 | 29/09/2011 | 167 | |
| Yulleroo 3D S.S. | 3D | On | EP 391 R2, EP 428, EP 436 | Buru Energy Limited | 17/07/2011 | 20/08/2011 | | 184 |
| King Sound Airborne Gravity Survey | GRAVITY | On | EP 104 R5 | Arc Energy Limited | 10/12/2011 | 17/12/2011 | 2,316 | |
| Yakka Munga Airborne Gravity Survey | GRAVITY | On | EP 391 R2, EP 428, EP 436 | Buru Energy Limited | 5/12/2011 | 17/12/2011 | 3,332 | |
| Perth Basin | | | | | | | | |
| Warradarge 2D S.S. | 2D | On | DR 11 | Westralian Gas and Power Pty Ltd | 29/08/2011 | 28/09/2011 | 23 | |
| Irwin 3D S.S. | 3D | On | EP 320 R4, EP 368 R3, L1 R1, L2 R1, L7 R1 | Origin Energy Resources Limited | 16/02/2012 | 10/04/2012 | | 273 |
| Perth Basin #6 ESR Survey | ESR | On | SPA 1 AO | Southern Sky Energy Pty Ltd | 19/03/2012 | 22/03/2012 | 2,100 | |

Class – Classification

2D - 2D Reflection, 3D - 3D Reflection, ESR - Electronic Spin Resonance

| Longitude | Gnd Elev/ Water Depth | RT/ KB | Spud Date | TD Date | Rig Release Date |
|-----------|-----------------------|--------|------------|------------|------------------|
| 123.01403 | 78 | 84 | 2/11/2011 | 13/12/2011 | 4/01/2012 |
| 122.89156 | 47 | 53 | 25/05/2012 | | |
| 126.63092 | 293 | 298 | 28/09/2011 | 23/09/2011 | 27/10/2011 |
| 124.57653 | 64 | 69 | 12/05/2012 | 11/06/2012 | 24/06/2012 |
| 123.72592 | 143 | 148 | 9/08/2011 | 28/08/2011 | 2/09/2011 |
| 123.16411 | 55 | 61 | 13/08/2011 | 24/09/2011 | 18/10/2011 |
| 124.76783 | 110 | 116 | 6/06/2011 | 17/07/2011 | 31/07/2011 |
| 124.72975 | 109 | 115 | 16/01/2012 | 22/02/2012 | 18/03/2012 |
| | | | | | |
| 115.61414 | 23 | 44 | 30/03/2012 | 12/04/2012 | 31/05/2012 |
| 115.65721 | 21 | 38 | 10/11/2011 | 17/11/2011 | 21/11/2011 |
| | | | | | |
| 115.02088 | 17 | 22 | 9/04/2012 | 16/04/2012 | 19/04/2012 |



Table 5. List of Petroleum and Geothermal Titles and Holders in Western Australia as at 3 July 2012

| PETROLEUM (SUBMERGED LANDS) ACT 1982 Exploration Permit | | | |
|--|--|--------|---|
| Title | Registered Holders (*denotes Nominee) | | |
| TP/7 R3 | Apache Oil Australia Pty Ltd | TPL/11 | Chevron (TAPL) Pty Ltd |
| | Pan Pacific Petroleum (South Aust) Pty Ltd | | Mobil Australia Resources Company Pty Limited |
| | Santos (BOL) Pty Ltd | | Santos Offshore Pty Ltd |
| | Tap (Shelfal) Pty Ltd | | * Chevron Australia Pty Ltd |
| TP/8 R3 | Apache Northwest Pty Ltd | TPL/12 | Apache East Spar Pty Ltd |
| | Kufpec Australia Pty Ltd | | Apache Kersail Pty Ltd |
| | Tap (Harriet) Pty Ltd | | Santos (BOL) Pty Ltd |
| TP/15 R2 | Westranch Holdings Pty Ltd | | * Apache Oil Australia Pty Ltd |
| TP/23 R1 | Apache Northwest Pty Ltd | TPL/13 | Apache East Spar Pty Ltd |
| | | | Apache Kersail Pty Ltd |
| | | | Apache Northwest Pty Ltd |
| | | | Apache Oil Australia Pty Ltd |
| | | | Kufpec Australia Pty Ltd |
| | | | Santos (BOL) Pty Ltd |
| | | | Tap (Harriet) Pty Ltd |
| | | TPL/14 | Kufpec Australia Pty Ltd |
| | | | Tap (Harriet) Pty Ltd |
| | | | * Apache Northwest Pty Ltd |
| | | TPL/15 | BHP Billiton Petroleum (North West Shelf) Pty Ltd |
| | | | BP Developments Australia Pty Ltd |
| | | | Chevron Australia Pty Ltd |
| | | | Japan Australia LNG (MIMI) Pty Ltd |
| | | | Shell Development (Australia) Proprietary Limited |
| | | | * Woodside Energy Ltd |
| | | TPL/16 | BHP Billiton Petroleum (North West Shelf) Pty Ltd |
| | | | BP Developments Australia Pty Ltd |
| | | | Chevron Australia Pty Ltd |
| | | | Japan Australia LNG (MIMI) Pty Ltd |
| | | | Shell Development (Australia) Proprietary Limited |
| | | | * Woodside Energy Ltd |
| | | TPL/17 | Apache Northwest Pty Ltd |
| | | | Santos (BOL) Pty Ltd |
| | | TPL/18 | ARC (Offshore PB) Limited |
| | | | AWE Oil (Western Australia) Pty Ltd |
| | | | Roc Oil (WA) Pty Limited |
| | | TPL/19 | Kansai Electric Power Australia Pty Ltd |
| | | | Tokyo Gas Pluto Pty Ltd |
| | | TPL/20 | Woodside Burrup Pty Ltd |
| | | | Apache Northwest Pty Ltd |
| | | | Santos Offshore Pty Ltd |
| | | TPL/21 | Chubu Electric Power Gorgon Pty Ltd |
| | | | Mobil Australia Resources Company Pty Limited |
| | | | Osaka Gas Gorgon Pty Ltd |
| | | | Shell Development (Australia) Proprietary Limited |
| | | | Tokyo Gas Gorgon Pty Ltd |
| | | | * Chevron (TAPL) Pty Ltd |
| | | TPL/22 | Chubu Electric Power Gorgon Pty Ltd |
| | | | Mobil Australia Resources Company Pty Limited |
| | | | Osaka Gas Gorgon Pty Ltd |
| | | | Shell Development (Australia) Proprietary Limited |
| | | | Tokyo Gas Gorgon Pty Ltd |
| | | | * Chevron (TAPL) Pty Ltd |

Table 5. List of Petroleum and Geothermal Titles and Holders in Western Australia as at 3 July 2012

| | |
|--------|---|
| TPL/23 | Apache PVG Pty Ltd |
| | BHP Billiton Petroleum (Australia) Pty Ltd |
| TPL/24 | Chubu Electric Power Gorgon Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Osaka Gas Gorgon Pty Ltd |
| | Shell Development (Australia) Proprietary Limited |
| | Tokyo Gas Gorgon Pty Ltd |
| | * Chevron (TAPL) Pty Ltd |

**PETROLEUM (SUBMERGED LANDS) ACT 1982
Production Licence**

| Title | Registered Holders (* denotes Nominee) |
|---------|---|
| TL/1 R1 | Kufpec Australia Pty Ltd |
| | Tap (Harriet) Pty Ltd |
| | * Apache Northwest Pty Ltd |
| TL/2 R1 | Apache Oil Australia Pty Ltd |
| | Pan Pacific Petroleum (South Aust) Pty Ltd |
| | Santos (BOL) Pty Ltd |
| | Tap (Shelfal) Pty Ltd |
| TL/3 R1 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| | * Chevron Australia Pty Ltd |
| TL/4 R1 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| | * Chevron Australia Pty Ltd |
| TL/5 | Kufpec Australia Pty Ltd |
| | Tap (Harriet) Pty Ltd |
| | * Apache Northwest Pty Ltd |
| TL/6 | Kufpec Australia Pty Ltd |
| | Tap (Harriet) Pty Ltd |
| | * Apache Northwest Pty Ltd |
| TL/7 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| | * Chevron Australia Pty Ltd |
| TL/8 | Kufpec Australia Pty Ltd |
| | Tap (Harriet) Pty Ltd |
| | * Apache Northwest Pty Ltd |
| TL/9 | Kufpec Australia Pty Ltd |
| | Tap (Harriet) Pty Ltd |
| | * Apache Northwest Pty Ltd |
| TL/10 | Apache Northwest Pty Ltd |
| | Kufpec Australia Pty Ltd |
| | Tap (Harriet) Pty Ltd |

**PETROLEUM (SUBMERGED LANDS) ACT 1982
Retention Lease**

| Title | Registered Holders (* denotes Nominee) |
|---------|--|
| TR/1 R2 | Kufpec Australia Pty Ltd |
| | Tap (Harriet) Pty Ltd |

| | |
|---------|---|
| | * Apache Northwest Pty Ltd |
| TR/3 R2 | Apache Northwest Pty Ltd |
| TR/4 R1 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| | * Chevron Australia Pty Ltd |
| TR/5 R1 | BHP Billiton Petroleum (North West Shelf) Pty Ltd |
| | BP Developments Australia Pty Ltd |
| | Chevron Australia Pty Ltd |
| | Shell Development (Australia) Proprietary Limited |
| | * Woodside Energy Ltd |
| TR/6 | Chevron (TAPL) Pty Ltd |
| | Chevron Australia Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |

**PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967
Access Authority to Deviated Well**

| Title | Registered Holders (* denotes Nominee) |
|-------------|---|
| ADW 8/90-1 | Chevron (TAPL) Pty Ltd |
| ADW 12/91-2 | Kufpec Australia Pty Ltd |
| ADW 10/92-3 | Kufpec Australia Pty Ltd |
| ADW 8/90-1 | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| ADW 10/92-3 | Tap (Harriet) Pty Ltd |
| ADW 12/91-2 | Tap (Harriet) Pty Ltd |
| | * Apache Northwest Pty Ltd |
| ADW 10/92-3 | * Apache Northwest Pty Ltd |
| ADW 8/90-1 | * Chevron Australia Pty Ltd |

**PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967
Drilling Reservation**

| Title | Registered Holders (* denotes Nominee) |
|-------|--|
| DR 9 | Backreef Oil Limited |
| DR 11 | Titan Energy Ltd |

**PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967
Exploration Permit**

| Title | Registered Holders (* denotes Nominee) |
|-----------|---|
| EP 61 R7 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| | * Chevron Australia Pty Ltd |
| EP 62 R7 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| | * Chevron Australia Pty Ltd |
| EP 104 R5 | Arc Energy Limited |
| | FAR Ltd |
| | Gulliver Productions Pty Ltd |
| | Indigo Oil Pty Ltd |

Table 5. List of Petroleum and Geothermal Titles and Holders in Western Australia as at 3 July 2012

| | | | |
|-----------|---|-----------|---|
| | Pancontinental Oil & Gas NL | | * Empire Oil Company (WA) Limited |
| | Phoenix Resources PLC | EP 417 R1 | Buru Energy Limited |
| EP 110 R4 | Pancontinental Oil & Gas NL | | New Standard Onshore Pty Ltd |
| | Strike Energy Limited | EP 424 | Pancontinental Oil & Gas NL |
| EP 129 R5 | Buru Energy Limited | | Strike Energy Limited |
| EP 307 R5 | Kufpec Australia Pty Ltd | EP 426 | Allied Oil & Gas Plc |
| | Tap (Harriet) Pty Ltd | | ERM Gas Pty Ltd |
| | * Apache Northwest Pty Ltd | | Empire Oil Company (WA) Limited |
| EP 320 R4 | ARC (Beharra Springs) Pty Ltd | | Westranch Holdings Pty Ltd |
| | * Origin Energy Developments Pty Limited | EP 428 | Buru Energy Limited |
| EP 321 R3 | Alcoa of Australia Limited | | Diamond Resources (Canning) Pty Ltd |
| | Latent Petroleum Pty Ltd | EP 429 | Kingsway Oil Limited |
| EP 325 R3 | Advent Energy Ltd | EP 430 | Empire Oil Company (WA) Limited |
| | Bow Energy Ltd | EP 431 | Buru Energy Limited |
| | Rough Range Oil Pty Ltd | | Diamond Resources (Fitzroy) Pty Ltd |
| | Strike Energy Limited | EP 432 | Allied Oil & Gas Plc |
| EP 357 R3 | Chevron (TAPL) Pty Ltd | | ERM Gas Pty Ltd |
| | Mobil Australia Resources Company Pty Limited | | * Empire Oil Company (WA) Limited |
| | Santos Offshore Pty Ltd | EP 433 R1 | Lansvale Oil & Gas Pty Ltd |
| | * Chevron Australia Pty Ltd | | Pace Petroleum Pty Ltd |
| EP 358 R2 | Apache Northwest Pty Ltd | EP 434 R1 | Pace Petroleum Pty Ltd |
| | Kufpec Australia Pty Ltd | | Rough Range Oil Pty Ltd |
| | Tap (Harriet) Pty Ltd | | * Lansvale Oil & Gas Pty Ltd |
| EP 359 R2 | Bounty Oil & Gas NL | EP 435 R1 | Australian Oil Company No 3 Pty Limited |
| | Lansvale Oil & Gas Pty Ltd | | Bounty Oil & Gas NL |
| | Pace Petroleum Pty Ltd | | Rough Range Oil Pty Ltd |
| | Phoenix Resources PLC | EP 436 | Buru Energy Limited |
| | * Rough Range Oil Pty Ltd | | Diamond Resources (Fitzroy) Pty Ltd |
| EP 368 R3 | Westranch Holdings Pty Ltd | EP 437 | CalEnergy Resources (Australia) Limited |
| | * Empire Oil Company (WA) Limited | | Key Petroleum (Australia) Pty Ltd |
| EP 371 R1 | Buru Energy Limited | EP 438 | Buru Energy Limited |
| | Diamond Resources (Canning) Pty Ltd | | Diamond Resources (Canning) Pty Ltd |
| EP 381 R3 | Whicher Range Energy Pty Ltd | | Gulliver Productions Pty Ltd |
| EP 386 R3 | Onshore Energy Pty Ltd | | Indigo Oil Pty Ltd |
| EP 389 R2 | ERM Gas Pty Ltd | EP 439 | Falcore Pty Ltd |
| | Empire Oil Company (WA) Limited | | Indigo Oil Pty Ltd |
| | Wharf Resources PLC | | Jurassica Oil & Gas Plc |
| EP 390 R2 | Buru Energy Limited | | Longreach Oil Limited |
| | Diamond Resources (Canning) Pty Ltd | | Vigilant Oil Pty Ltd |
| EP 391 R2 | Buru Energy Limited | | * Rough Range Oil Pty Ltd |
| | Diamond Resources (Fitzroy) Pty Ltd | EP 440 | Empire Oil Company (WA) Limited |
| EP 407 R1 | Alcoa of Australia Limited | EP 441 R1 | Apache Northwest Pty Ltd |
| | Latent Petroleum Pty Ltd | EP 443 | ConocoPhillips (Canning Basin) Pty Ltd |
| EP 408 R1 | CalEnergy Resources (Australia) Limited | | New Standard Onshore Pty Ltd |
| | Whicher Range Energy Pty Ltd | EP 444 | Rough Range Oil Pty Ltd |
| EP 412 R1 | Bounty Oil & Gas NL | EP 447 | GCC Methane Pty Ltd |
| | * Rough Range Oil Pty Ltd | EP 448 | Gulliver Productions Pty Ltd |
| EP 413 R2 | Arc Energy Limited | | Indigo Oil Pty Ltd |
| | Bharat PetroResources Limited | | United Orogen Limited |
| | Norwest Energy NL | EP 449 | Kingsway Oil Limited |
| EP 416 R1 | Allied Oil & Gas Plc | EP 450 | ConocoPhillips (Canning Basin) Pty Ltd |
| | ERM Gas Pty Ltd | | New Standard Onshore Pty Ltd |

Table 5. List of Petroleum and Geothermal Titles and Holders in Western Australia as at 3 July 2012

| PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967 Geothermal Exploration Permit | |
|---|---|
| Title | Registered Holders (* denotes Nominee) |
| EP 451 | ConocoPhillips (Canning Basin) Pty Ltd |
| | New Standard Onshore Pty Ltd |
| EP 453 | Budside Pty Limited |
| | Pobelo Pty Ltd |
| EP 454 | Empire Oil Company (WA) Limited |
| EP 455 | Titan Energy Ltd |
| | * Arc Energy Limited |
| EP 456 | ConocoPhillips (Canning Basin) Pty Ltd |
| | New Standard Onshore Pty Ltd |
| EP 457 | Rey Resources Ltd |
| | * Gujarat NRE Oil Limited |
| EP 458 | Rey Resources Ltd |
| | * Gujarat NRE Oil Limited |
| EP 460 | Falcore Pty Ltd |
| | Indigo Oil Pty Ltd |
| | Jurassica Oil & Gas Plc |
| | Longreach Oil Limited |
| | Vigilant Oil Pty Ltd |
| | * Rough Range Oil Pty Ltd |
| EP 461 | Falcore Pty Ltd |
| | Indigo Oil Pty Ltd |
| | Jurassica Oil & Gas Plc |
| | Longreach Oil Limited |
| | Vigilant Oil Pty Ltd |
| | * Rough Range Oil Pty Ltd |
| EP 464 | Exceed Energy (Australia) Pty Ltd |
| EP 465 | Australia Zhongfu Oil Gas Resources Pty Ltd |
| EP 466 | Rough Range Oil Pty Ltd |
| EP 467 | ERM Gas Pty Ltd |
| EP 468 | Officer Petroleum Pty Ltd |
| EP 469 | Warrego Energy Pty Ltd |
| EP 470 | Energetica Resources Pty Ltd |
| EP 471 | Buru Energy Limited |
| | Diamond Resources (Canning) Pty Ltd |
| EP 472 | Buru Energy Limited |
| | Diamond Resources (Canning) Pty Ltd |
| EP 473 | Buru Energy Limited |
| | Diamond Resources (Canning) Pty Ltd |
| EP 474 | Buru Energy Limited |
| EP 475 | Energetica Resources Pty Ltd |
| EP 476 | Buru Energy Limited |
| | Diamond Resources (Canning) Pty Ltd |
| EP 477 | Buru Energy (Acacia) Pty Ltd |
| | Diamond Resources (Canning) Pty Ltd |
| EP 478 | Buru Energy (Acacia) Pty Ltd |
| | Buru Energy Limited |
| EP 479 | ERM Gas Pty Ltd |
| | Empire Oil & Gas NL |
| EP 480 | ERM Gas Pty Ltd |
| | Empire Oil & Gas NL |
| GEP 1 | The University of Western Australia |
| | * Green Rock Energy Limited |
| GEP 2 | Green Rock Energy Limited |
| GEP 3 | Green Rock Energy Limited |
| GEP 4 | Green Rock Energy Limited |
| GEP 5 | Granite Power Limited |
| GEP 6 | Granite Power Limited |
| GEP 7 | GT Power Pty Ltd |
| GEP 8 | GT Power Pty Ltd |
| GEP 9 | GT Power Pty Ltd |
| GEP 10 | BHP Billiton Worsley Alumina Pty Ltd |
| | Green Rock Energy Limited |
| GEP 11 | BHP Billiton Worsley Alumina Pty Ltd |
| | Green Rock Energy Limited |
| GEP 12 | BHP Billiton Worsley Alumina Pty Ltd |
| | Green Rock Energy Limited |
| GEP 13 | New World Energy Limited |
| GEP 14 | New World Energy Limited |
| GEP 15 | New World Energy Limited |
| GEP 16 | New World Energy Limited |
| GEP 17 | New World Energy Limited |
| GEP 18 | New World Energy Limited |
| GEP 19 | New World Energy Limited |
| GEP 20 | New World Energy Limited |
| GEP 21 | New World Energy Limited |
| GEP 22 | AAA Energy Pty Ltd |
| GEP 23 | Green Rock Energy Limited |
| GEP 24 | Green Rock Energy Limited |
| GEP 25 | Green Rock Energy Limited |
| GEP 26 | Green Rock Energy Limited |
| GEP 27 | Green Rock Energy Limited |
| GEP 28 | Green Rock Energy Limited |
| GEP 29 | Geothermal Energy Pty Ltd |
| GEP 30 | New World Energy Limited |
| GEP 31 | New World Energy Limited |
| GEP 32 | New World Energy Limited |
| GEP 33 | New World Energy Limited |
| GEP 34 | New World Energy Limited |
| GEP 35 | New World Energy Limited |
| GEP 36 | New World Energy Limited |
| GEP 37 | Greenpower Energy Limited |
| GEP 38 | Greenpower Energy Limited |
| GEP 39 | Green Rock Energy Limited |
| GEP 40 | Green Rock Energy Limited |
| GEP 41 | Green Rock Energy Limited |
| GEP 42 | GT Power Pty Ltd |
| GEP 43 | Kagara Ltd |

Table 5. List of Petroleum and Geothermal Titles and Holders in Western Australia as at 3 July 2012

| PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967 Production Licence | |
|--|---|
| Title | Registered Holders (* denotes Nominee) |
| L 1 R1 | APT Parmelia Pty Ltd |
| | Arc Energy Limited |
| | Origin Energy Developments Pty Limited |
| L 2 R1 | Origin Energy Developments Pty Limited |
| | * Arc Energy Limited |
| L 4 R1 | Arc Energy Limited |
| L 5 R1 | Arc Energy Limited |
| L 6 R1 | Buru Energy Limited |
| L 7 R1 | Arc Energy Limited |
| L 8 R1 | Buru Energy Limited |
| L 9 R1 | BHP Billiton Petroleum (Australia) Pty Ltd |
| L 10 R1 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| | * Chevron Australia Pty Ltd |
| L 11 | ARC (Beharra Springs) Pty Ltd |
| | * Origin Energy Developments Pty Limited |
| L 12 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| | * Chevron Australia Pty Ltd |
| L 13 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| | * Chevron Australia Pty Ltd |
| L 14 | Arc Energy Limited |
| | Geary, John Kevin |
| | Norwest Energy NL |
| | Origin Energy Developments Pty Limited |
| | Roc Oil (WA) Pty Limited |
| L 15 | Buru Energy Limited |
| | FAR Ltd |
| | Gulliver Productions Pty Ltd |
| | Indigo Oil Pty Ltd |
| | Pancontinental Oil & Gas NL |
| L 16 | Rough Range Oil Pty Ltd |
| L 1H R2 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| | * Chevron Australia Pty Ltd |

| PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967 Retention Lease | |
|---|--|
| Title | Registered Holders (* denotes Nominee) |
| R 1 R1 | Arc Energy Limited |
| | FAR Ltd |
| | Gulliver Productions Pty Ltd |
| | Indigo Oil Pty Ltd |
| | Pancontinental Oil & Gas NL |

| | |
|--------|---|
| | Phoenix Resources PLC |
| R 2 R1 | BHP Billiton Petroleum (North West Shelf) Pty Ltd |
| | BP Developments Australia Pty Ltd |
| | Chevron Australia Pty Ltd |
| | Shell Development (Australia) Proprietary Limited |
| | * Woodside Energy Ltd |
| R 3 R1 | Oil Basins Limited |
| R 4 | Chevron (TAPL) Pty Ltd |
| | Chevron Australia Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| R 5 | Apache Oil Australia Pty Ltd |
| | OMV Australia Pty Ltd |

| PETROLEUM PIPELINES ACT 1969 Pipeline Licence | |
|--|---|
| Title | Registered Holders (* denotes Nominee) |
| PL 1 R1 | APT Parmelia Pty Ltd |
| PL 2 R1 | APT Parmelia Pty Ltd |
| PL 3 R1 | APT Parmelia Pty Ltd |
| PL 5 R1 | APT Parmelia Pty Ltd |
| PL 6 R3 | Arc Energy Limited |
| PL 7 R1 | Buru Energy Limited |
| PL 8 R1 | Mitsui Iron Ore Development Pty Ltd |
| | Nippon Steel Australia Pty Limited |
| | North Mining Limited |
| | Sumitomo Metal Australia Pty Ltd |
| | * Robe River Mining Co Pty Ltd |
| PL 12 R1 | Kufpec Australia Pty Ltd |
| | Tap (Harriet) Pty Ltd |
| | * Apache Northwest Pty Ltd |
| PL 14 R1 | Apache Oil Australia Pty Ltd |
| | Pan Pacific Petroleum (South Aust) Pty Ltd |
| | Santos (BOL) Pty Ltd |
| | Tap (Shelfal) Pty Ltd |
| PL 15 R1 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |
| | * Chevron Australia Pty Ltd |
| PL 16 | BHP Petroleum (Ashmore Operations) Pty Ltd |
| PL 17 | Kufpec Australia Pty Ltd |
| | Tap (Harriet) Pty Ltd |
| | * Apache Northwest Pty Ltd |
| PL 18 | ARC (Beharra Springs) Pty Ltd |
| | * Origin Energy Developments Pty Limited |
| PL 19 | BHP Petroleum (Ashmore Operations) Pty Ltd |
| PL 20 | Inpex Alpha Ltd |
| | Mobil Exploration & Producing Australia Pty Ltd |
| | * BHP Billiton Petroleum (Australia) Pty Ltd |
| PL 21 | Chevron (TAPL) Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Santos Offshore Pty Ltd |

Table 5. List of Petroleum and Geothermal Titles and Holders in Western Australia as at 3 July 2012

| | | | |
|-------|---|-------|---|
| | * Chevron Australia Pty Ltd | | Chevron Australia Pty Ltd |
| PL 22 | Epic Energy (Pilbara Pipeline) Pty Ltd | | Japan Australia LNG (MIMI) Pty Ltd |
| PL 23 | APT Parmelia Pty Ltd | | Shell Development (Australia) Proprietary Limited |
| PL 24 | Alinta DEWAP Pty Ltd | | * Woodside Energy Ltd |
| | Southern Cross Pipelines (NPL) Australia Pty Ltd | PL 59 | Esperance Pipeline Co. Pty Limited |
| | * Southern Cross Pipelines Australia Pty Limited | PL 60 | Gas Transmission Services WA (Operations) Pty Ltd |
| PL 25 | Southern Cross Pipelines Australia Pty Limited | PL 61 | APT Parmelia Pty Ltd |
| PL 26 | Southern Cross Pipelines Australia Pty Limited | PL 62 | Kufpec Australia Pty Ltd |
| PL 27 | Southern Cross Pipelines Australia Pty Limited | | Tap (Harriet) Pty Ltd |
| PL 28 | Southern Cross Pipelines (NPL) Australia Pty Ltd | | * Apache Northwest Pty Ltd |
| PL 29 | Apache East Spar Pty Ltd | PL 63 | Gas Transmission Services WA (Operations) Pty Ltd |
| | Apache Kersail Pty Ltd | PL 64 | Arc Energy Limited |
| | Santos (BOL) Pty Ltd | | Origin Energy Developments Pty Limited |
| | * Apache Oil Australia Pty Ltd | PL 65 | Dalrymple Resources NL |
| PL 30 | Apache East Spar Pty Ltd | | LionOre Australia (Wildara) NL |
| | Apache Kersail Pty Ltd | PL 67 | Hamersley Iron Pty Ltd |
| | Santos (BOL) Pty Ltd | PL 68 | Gas Transmission Services WA (Operations) Pty Ltd |
| | * Apache Oil Australia Pty Ltd | PL 69 | DBNGP (WA) Nominees Pty Limited |
| PL 31 | Epic Energy (Pilbara Pipeline) Pty Ltd | PL 70 | ARC (Offshore PB) Limited |
| PL 32 | APT Pipelines (WA) Pty Limited | | AWE Oil (Western Australia) Pty Ltd |
| PL 33 | APT Pipelines (WA) Pty Limited | | Roc Oil (WA) Pty Limited |
| PL 34 | Newmont Yandal Operations Pty Ltd | PL 72 | EDL NGD (WA) PTY LTD |
| PL 35 | Plutonic Operations Limited | PL 73 | Redback Pipelines Pty Ltd |
| PL 36 | Australian Pipeline Limited | PL 74 | EDL LNG (WA) PTY LTD |
| PL 37 | Norilsk Nickel Cawse Pty Ltd | PL 75 | EIT Neerabup Power Pty Ltd |
| PL 38 | Epic Energy (Pilbara Pipeline) Pty Ltd | | ERM Neerabup Pty Ltd |
| PL 39 | Origin Energy Pipelines Pty Limited | PL 76 | APA Group |
| PL 40 | DBNGP (WA) Nominees Pty Limited | PL 77 | Sino Iron Pty Ltd |
| PL 41 | DBNGP (WA) Transmission Pty Limited | PL 78 | Hamersley Iron Pty Ltd |
| PL 42 | Apache East Spar Pty Ltd | PL 80 | Latent Petroleum Pty Ltd |
| | Apache Kersail Pty Ltd | PL 81 | Apache Northwest Pty Ltd |
| | Apache Northwest Pty Ltd | PL 82 | Epic Energy (Pilbara Pipeline) Pty Ltd |
| | Apache Oil Australia Pty Ltd | PL 83 | WA Gas Networks Pty Ltd |
| | Kufpec Australia Pty Ltd | PL 84 | Chubu Electric Power Gorgon Pty Ltd |
| | Santos (BOL) Pty Ltd | | Mobil Australia Resources Company Pty Limited |
| | Tap (Harriet) Pty Ltd | | Osaka Gas Gorgon Pty Ltd |
| PL 43 | Western Power Corporation | | Shell Development (Australia) Proprietary Limited |
| | * APT Pipelines (WA) Pty Limited | | Tokyo Gas Gorgon Pty Ltd |
| PL 44 | APT Parmelia Pty Ltd | | * Chevron (TAPL) Pty Ltd |
| PL 45 | APT Parmelia Pty Ltd | PL 85 | Chubu Electric Power Gorgon Pty Ltd |
| PL 46 | APT Parmelia Pty Ltd | | Mobil Australia Resources Company Pty Limited |
| PL 47 | DBNGP (WA) Transmission Pty Limited | | Osaka Gas Gorgon Pty Ltd |
| PL 48 | Energy Generation Pty Ltd | | Shell Development (Australia) Proprietary Limited |
| PL 52 | APT Parmelia Pty Ltd | | Tokyo Gas Gorgon Pty Ltd |
| PL 53 | APT Parmelia Pty Ltd | | * Chevron (TAPL) Pty Ltd |
| PL 54 | Western Power Corporation | PL 86 | Apache Northwest Pty Ltd |
| | * APT Pipelines (WA) Pty Limited | | Santos Offshore Pty Ltd |
| PL 55 | Global Advanced Metals Wodgina Pty Ltd | PL 87 | Apache PVG Pty Ltd |
| PL 56 | Epic Energy (WA) One Pty Ltd | | BHP Billiton Petroleum (Australia) Pty Ltd |
| PL 57 | Australian Gold Reagents Pty Ltd | PL 88 | Apache PVG Pty Ltd |
| PL 58 | BHP Billiton Petroleum (North West Shelf) Pty Ltd | | BHP Billiton Petroleum (Australia) Pty Ltd |
| | BP Developments Australia Pty Ltd | PL 89 | Crosslands Resources Ltd |

Table 5. List of Petroleum and Geothermal Titles and Holders in Western Australia as at 3 July 2012

| | |
|-------|---|
| PL 90 | Apache PVG Pty Ltd |
| | BHP Petroleum (Australia) Pty Ltd |
| PL 91 | DBNGP (WA) Nominees Pty Limited |
| PL 92 | Chubu Electric Power Gorgon Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Osaka Gas Australia Pty Ltd |
| | Shell Development (Australia) Proprietary Limited |
| | Tokyo Gas Gorgon Pty Ltd |
| | * Chevron (TAPL) Pty Ltd |
| PL 93 | Chubu Electric Power Gorgon Pty Ltd |
| | Mobil Australia Resources Company Pty Limited |
| | Osaka Gas Gorgon Pty Ltd |
| | Shell Development (Australia) Proprietary Limited |
| | Tokyo Gas Gorgon Pty Ltd |
| | * Chevron (TAPL) Pty Ltd |
| PL 94 | DBNGP (WA) Nominees Pty Limited |
| PL 95 | DBNGP (WA) Nominees Pty Limited |

Please consult DMP's online Petroleum and Geothermal Register for the most current information on Titles and Holdings.



Weatherford Rig 826
(Photo courtesy of Norwest Energy)



Century Rig 7 at Harvey 1 in the southern Perth Basin

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