

Executive Summary

In June 2016, the NSW Government introduced the NSW Strategic Release Framework for Coal and Petroleum Exploration. The Framework implements a new process for issuing prospecting titles and is overseen by the Advisory Body for Strategic Release. The Advisory Body will make recommendations to the Minister about release of areas for petroleum exploration based on consideration of geological, social, environmental, economic and operator capability factors.

The Geological Survey of NSW (GSNSW) identifies potential areas for release for petroleum exploration, based on geological resource assessments, for consideration by the Advisory Body.

The GSNSW recommended the Pondie Range Trough for consideration by the Advisory Body under the Strategic Release Framework in 2017. The Pondie Range Trough is a sedimentary sub-basin in the Darling Basin in Western NSW and the assessed petroleum prospectivity, relative to other underexplored basins and sub-basins in the State's west, is in the highest tier. The Pondie Range Trough is predominantly prospective for tight gas and has some potential for conventional gas. There is no potential for coal seam gas.

Introduction

NSW contains ten main sedimentary basins that have known petroleum resources or prospectivity potential (Figure 1). There have been oil and gas shows from previous exploration in the main sedimentary basins and potential for discovery of conventional gas/oil, tight gas/oil, shale gas/oil and coal seam gas.

The relatively well explored coal-bearing basins in the eastern one third of NSW have identified coal seam gas resources. In contrast, the basins in the western two thirds of NSW are relatively underexplored, but have potential for the discovery of petroleum resources.

The GSNSW has an ongoing program to acquire, analyse and deliver new precompetitive data to improve understanding of the prospectivity of the underexplored basins in the western two thirds of NSW. This program is a part of the New Frontiers Minerals and Energy Exploration Initiative and is expected to progressively identify additional areas for consideration for strategic release.

The GSNSW has identified the Pondie Range Trough for consideration by the Advisory Body for release as a new petroleum prospecting area (Figure 1).

This area was selected based on the current understanding of the level of prospectivity and history of petroleum exploration. The Pondie Range Trough is considered a "Frontier Basin" with respect to petroleum exploration – it is relatively underexplored.

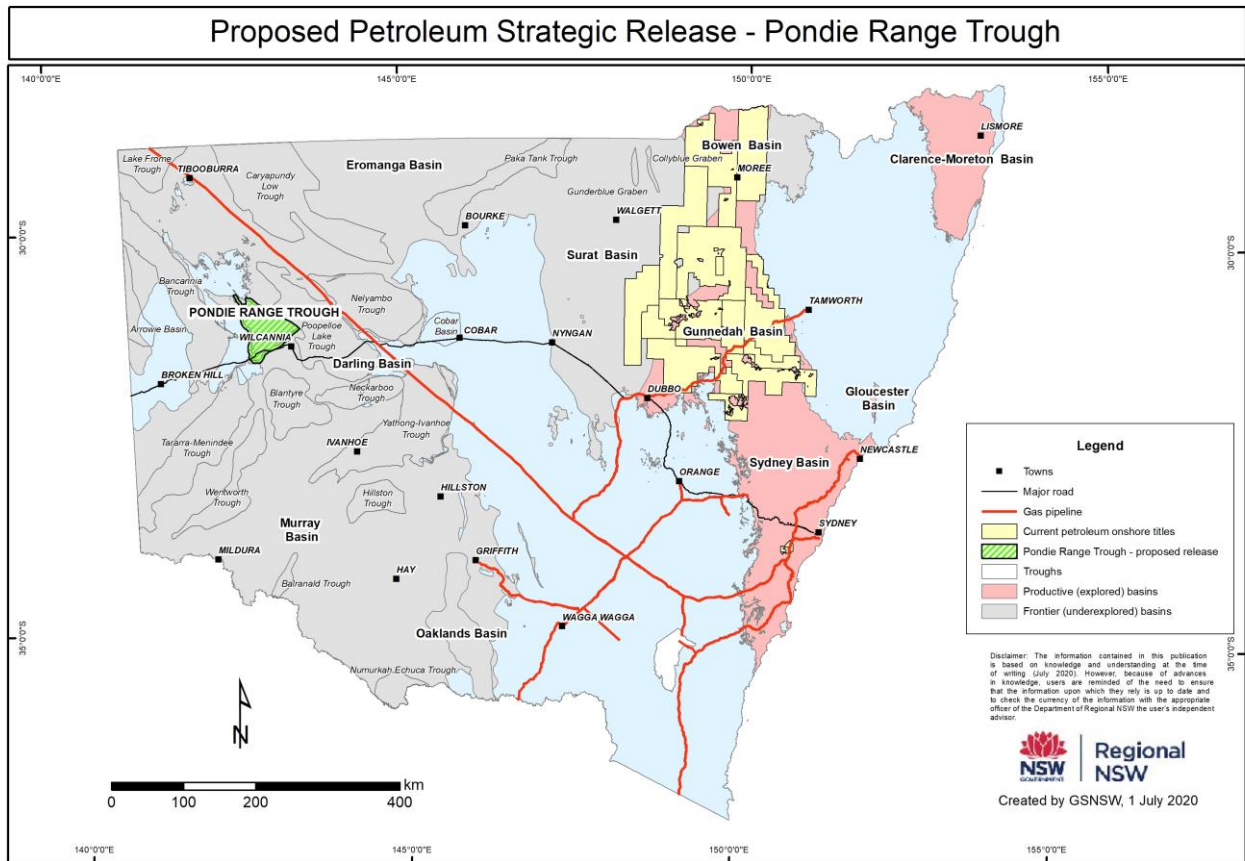


Figure 1 – Pondie Range Trough - potential strategic release area and current petroleum titles in NSW.

Pondie Range Strategic Release Area

The Pondie Range Trough is a sub-basin of the Late Silurian to Early Carboniferous Darling Basin, located in western New South Wales. It is approximately 5 km northwest of Wilcannia and extends west. There are no towns or villages within the trough (Figure 2). The Pondie Range Trough is partially overlain by the Eromanga Basin (part of the Great Australian Basin).

The Pondie Range Trough is a roughly triangular shaped trough approximately 80 by 40 km across (3 200 km²). Based on the seismic data interpretation as well as gravimetric depth-to-basement estimates, maximum sediment thicknesses of 8-12 km are attained within the Pondie Range Trough (Pearson, 2003).

There are untested petroleum plays present in the Pondie Range Trough. The elements required to form a petroleum deposit are potentially within the trough, but more exploration is needed to confirm this. The trough is relatively close to the Moomba-Sydney gas pipeline and the Barrier Highway intersects the southern part of the trough.

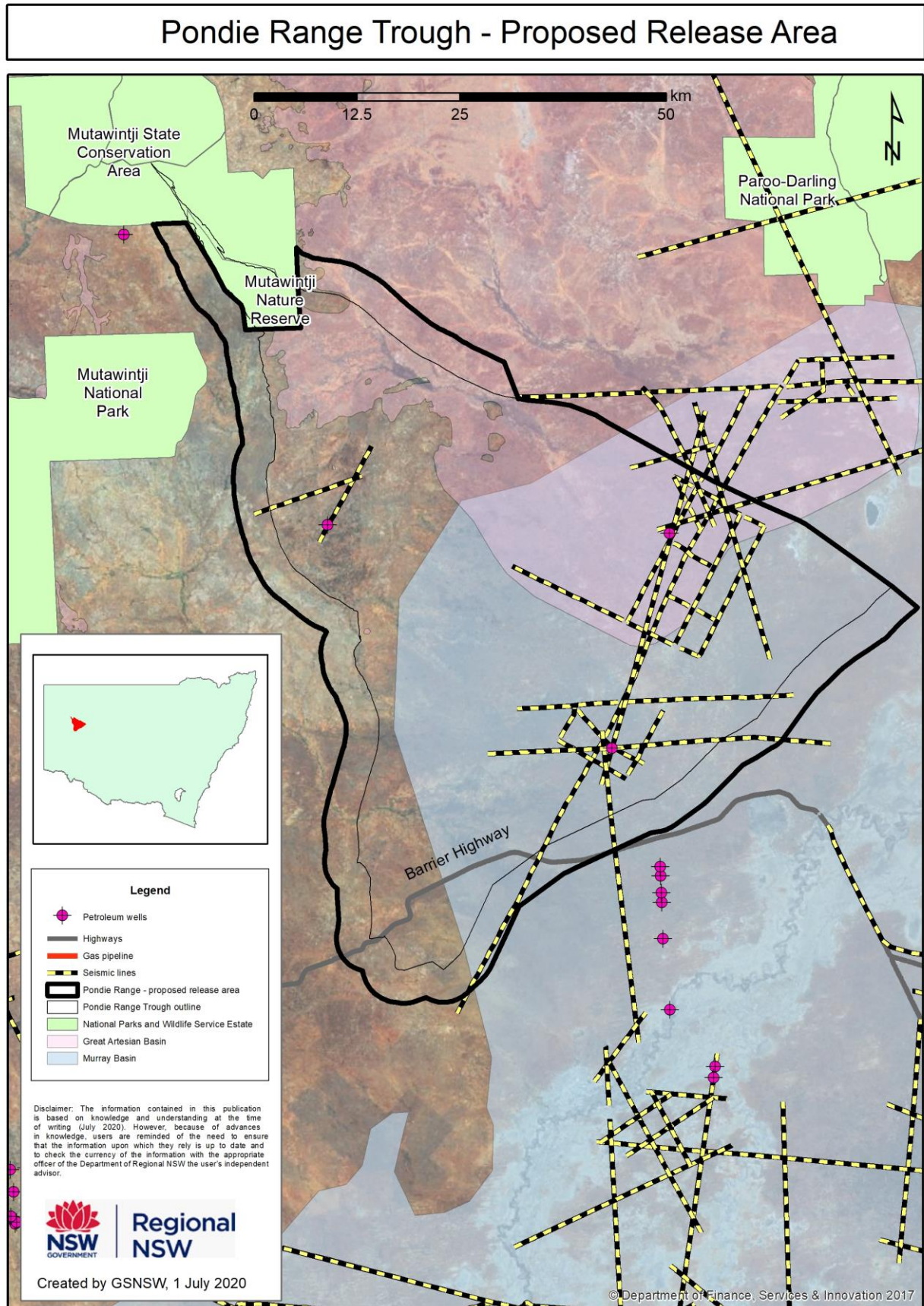


Figure 2 – Pondie Range Trough showing the proposed release area, seismic lines and wells. The proposed release excludes national parks and reserves and has a buffer of 4 km outwards from the interpreted geological boundary of the trough.

History of exploration

The Pondie Range Trough is underexplored for petroleum. Seismic surveys were acquired mostly over the eastern half of the trough and only two exploration wells have been drilled.

The history of petroleum exploration titles is shown in Table 1. Eight PELs and two PSPAUTHs have been held over various parts of the trough from 1958 to 2013 (Figure 3). In 2013 the NSW Government was granted an exploration licence for Group 8 minerals to assess the geothermal energy and CO₂ storage potential, as part of the CO₂ Storage Assessment Program undertaken by Coal Innovation NSW. In 2014 the exploration well Mena Murtee-1 was drilled identifying the presence of potential reservoirs.

Exploration data

The exploration data includes well completion reports, geochemical analyses, seismic surveys, gravity and magnetics surveys, and soil gas surveys. There are also interpretative geological reports available for the trough (Table 1).

Pondie Range-1 commenced drilling in 1966 and was completed in 1967 by Mid-Eastern Oil NL. There are also seven stratigraphic wells in the Pondie Range Trough. Six of them, Pondie Range DDH1 to DDH6, drilled by Planet Exploration Company Pty Ltd in 1968-1969, are less than 150 m deep, but limited data are preserved on these wells. The seventh well Mena Murtee-1 is a deep stratigraphic test well drilled by Coal Innovation NSW. There were no hydrocarbon shows during drilling, but the soil gas survey showed elevated background methane, ethane and propane values over the Pondie Range anticline. There is reasonable porosity and permeability within the Middle to Upper Devonian formations, but neither Pondie Range-1 nor Mena Murtee-1 drilled through any potential 'traps'.

Thirty seismic lines, totalling about 375 km, were completed from 1965 to 2004. The quality of seismic data is variable and can be divided into two groups.

The first group is the data acquired prior to 1983 and is generally of poor to moderate quality. Not all of this data is digital, as some old paper records have not been converted. The second group encompasses the seismic data acquired by BHP Petroleum in 1983, GSNSW and Eastern Star Gas in 2004. The second group of data is vastly superior to that of the first group and is all digital. These data were reprocessed in 2004, taking advantage of improved processing algorithms and more powerful computers leading to improved and less noisy data.

Table 1 - Historic petroleum exploration titles over or partially over the Pondie Range Trough.

TITLE CODE	TITLE NO	TITLE HOLDER	ACT	APPROX. YEAR OF OPERATION	EXPLORATION HIGHLIGHTS	AREA
PEL	15	Frome Broken Hill Co Pty Ltd	1955	1958	Desktop studies	eastern Pondie Range Trough

TITLE CODE	TITLE NO	TITLE HOLDER	ACT	APPROX. YEAR OF OPERATION	EXPLORATION HIGHLIGHTS	AREA
PEL	35	Planet Exploration Company Pty Ltd Oil Development NL	1955	1959-1963	Airborne magnetometer survey, Darling area, joint venture (AM015); Seismic survey – Tibooburra refraction - reflection survey (SS028) (outside of trough); Desktop studies.	north-western tip of Pondie Range Trough
PEL	38	Woodside Darling River Oil Co NL (title holder) & Mid-Eastern Oil NL (operator)	1955	1960-1967	Drilling: Pondie Range-1 (WCR123); Mt Jack-1 (WCR069) (outside of the trough). Seismic surveys: White Cliffs (SS047 and SS051); Mt Jack (SS016); Core sampling: Pondie Range-1(L0000151); Mt Jack -1 (L0000150); Gravity survey: White Cliffs (GR016). Airborne magnetometer survey – Darling area (AM015).	eastern Pondie Range Trough
PEL	78	Planet Exploration Company Pty Ltd	1955	1962-1968	Seismic survey: Mootwingee (SS042); Gravity surveys: Mootwingee (GR020 and GR014); Stephens Creek (GR011); Aeromagnetic survey: Mootwingee (AM020); Desktop studies.	western Pondie Range Trough
PEL	142	Planet Exploration Company Pty Ltd	1955	1968-1969	Drilling: Pondie Range DDH1-6 (WCR 167); Gravity surveys: Pondie Range (GR039) and Peri Lake (GR030).	eastern Pondie Range Trough (same as PEL 38)
PEL	155	Planet Exploration Company Pty Ltd	1955	1969-1970	Seismic survey: Mootwingee – refraction; Drilling: Gnalta-1 (WCR144) (outside the trough).	western Pondie Range Trough

TITLE CODE	TITLE NO	TITLE HOLDER	ACT	APPROX. YEAR OF OPERATION	EXPLORATION HIGHLIGHTS	AREA
PEL	250	Comserv (No. 779) Pty Ltd	1955	1980-1991	Seismic surveys: Darling (SS134) and Blantyre (SS143); Gravity survey: Pondie Range Trough - regional (PGR1981/06)	Pondie Range Trough
PSPAUTH	1	Department of Mineral Resources	1991	1993-1994	Desktop studies	Pondie Range Trough
PEL	424	Acer Energy Ltd	1991	1998-2013	Seismic survey: Pondie Range - regional (GS2012/0770); Soil gas sampling (GS2004/216); Desktop studies.	Pondie Range Trough
PSPAUTH	12	Hardie Infrastructure Pty Ltd	1991	2006-2008	Desktop studies	Pondie Range Trough
EL	9066	Secretary of Regional NSW	1992-minerals	2013-current	Drilling: Mena Murtee-1 (GS2015/0405); Geothermal potential and carbon capture and storage assessments.	Pondie Range Trough

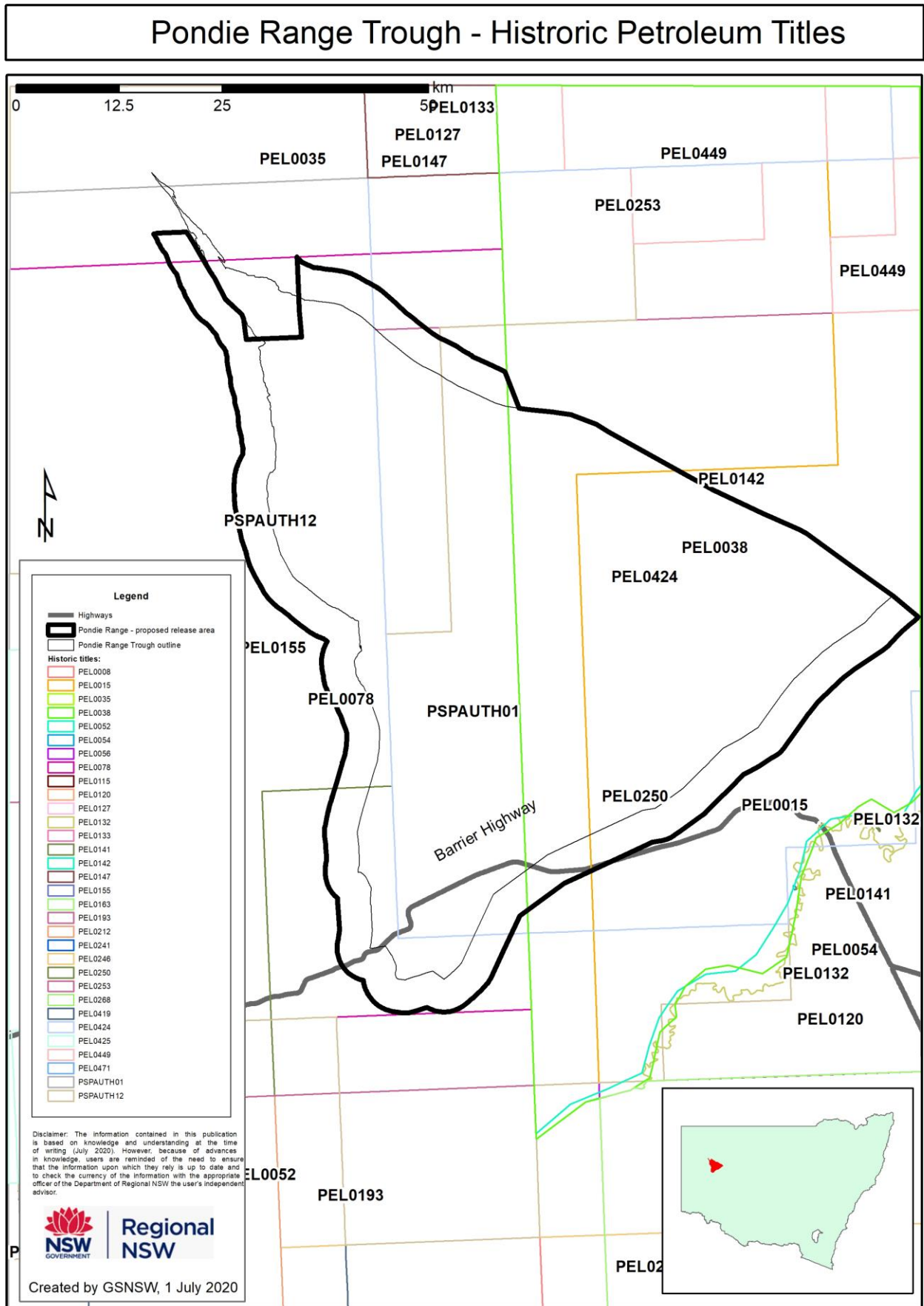


Figure 3 - Historic petroleum titles granted over parts of the Pondie Range Trough.

Petroleum Assessment Analysis – Pondie Range Trough

Name of area: **Pondie Range Trough**

Location: 1:250,000: SH/54-16 (Wilcannia)

Factor	Issue	Considerations	Petroleum Rating [MEG to tick one in each column]	Analysis
Availability of Geological data	Data density and veracity	Is the data sufficient to define a resource or potential resource and inform decision making?	<input type="checkbox"/> Data are sufficient to define a petroleum resource. <input checked="" type="checkbox"/> Data indicate the potential for the discovery of a petroleum resource. <input type="checkbox"/> Data are insufficient to assess the exploration potential for the discovery of a petroleum resource. <input type="checkbox"/> No petroleum resource potential exists.	<p><u>Historic Data:</u></p> <p>2 deep wells have been drilled. Pondie Range-1 was drilled from 1966-1967 and Mena Murtee-1 was drilled in 2014.</p> <p>6 shallow (<150 m deep) stratigraphic holes were drilled in 1968-69.</p> <p>From 1965 to 2004, 30 seismic lines covering 375 km.</p> <p>61 water bores</p> <p>Gravity and aeromagnetic surveys</p> <p>Soil gas sampling</p> <p><u>Petroleum prospectivity indications:</u></p> <p>Elevated background methane, ethane and propane values from the soil gas survey. A thick Devonian sequence is present including the Early Devonian, which is known to be a potential source rock. The above Middle-Upper Devonian has good porosity and permeability and could be potential reservoirs. Seals are intraformational or overlying the Late Devonian.</p> <p><u>Petroleum title history:</u></p> <p>8 PELs and 2 PSPAUTHs have been granted over parts of the trough.</p>

Factor	Issue	Considerations	Petroleum Rating [MEG to tick one in each column]	Analysis
<p><input checked="" type="checkbox"/> Continue Resource Assessment if 'data are sufficient' or indicate the potential for resource discovery.</p>				
Resource body characteristics	Resource type		<input checked="" type="checkbox"/> Conventional (oil, gas) <input checked="" type="checkbox"/> Unconventional (oil, gas) <ul style="list-style-type: none"> • Tight Sand / Carbonate (oil, gas) 	Unconventional and the possibility of conventional systems.
	Resource quality	Does product quality meet the likely market/utilisation?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Cannot be determined	<p>If gas has a high percentage of methane it will meet market requirements.</p> <p>Unconventional and conventional petroleum quality has not been tested.</p>
	Resource size	What is the resource size/potential resource size?	<input type="checkbox"/> Likely sufficient to support a stand-alone operation. <input type="checkbox"/> Requires further appraisal or testing to assess resource size. <input checked="" type="checkbox"/> Requires further exploration to identify resource potential.	Further seismic data are needed to define the distribution of potential source rocks. Drilling and testing are needed to better understand the trough and its petroleum potential.
	Geological resource constraints	Do other geological considerations impact the potential development of the resource?	<input checked="" type="checkbox"/> No significant resource constraints identified. <input type="checkbox"/> Resource constraints are identified but unlikely to be detrimental to the development of the resource. <input type="checkbox"/> Resource constraints indicate significant hurdles must be overcome if production were to proceed in the future.	There are insufficient data to identify resource and geological constraints.

Factor	Issue	Considerations	Petroleum Rating [MEG to tick one in each column]	Analysis
Ease of access	Existing infrastructure	Suitability of roads, power, water and outbound logistics (pipeline, rail or road)	<input type="checkbox"/> Would require little or no change to existing infrastructure. <input checked="" type="checkbox"/> Would require some upgrade to existing infrastructure. <input type="checkbox"/> Would require provision of new infrastructure.	<p><u>Pipeline:</u> The Moomba-Sydney gas pipeline is 56 km from the northeastern edge of the trough.</p> <p><u>Roads:</u> The sealed Barrier Highway goes through the southern part of the trough and the sealed Opal Miners Way goes through the middle of the trough.</p> <p><u>Rail:</u> The Orange- Broken Hill Railway is to the south of the trough.</p> <p><u>Towns:</u> Wilcannia is to the south of the trough with a population of approximately 600 people.</p>
	Proximity to existing operations	Ability to share or leverage infrastructure of existing operations	<input type="checkbox"/> Yes. Established petroleum district with local labour and service industry. <input checked="" type="checkbox"/> Possibly. Potential synergies with existing operations and infrastructure. <input type="checkbox"/> No. No synergies presently exist.	There are no existing petroleum operations in the region, but the gas pipeline is about 90 km from the centre of the trough and 56 km from the edge of the trough.
	Capital costs	Style of operation the resource would support and likely capital costs and lead times	<input type="checkbox"/> Potential conventional operations with relatively low capital and earliest product to market. <input type="checkbox"/> Potential unconventional operations with likely favourable geological characteristics to facilitate resource flow with probable medium capital outlays. <input type="checkbox"/> Potential unconventional operations with likely less favourable geological characteristics to facilitate resource flow, with probable significant capital outlays. <input checked="" type="checkbox"/> Unable to reasonably determine at this time.	Cannot determine until further exploration and studies are completed.

Factor	Issue	Considerations	Petroleum Rating [MEG to tick one in each column]	Analysis
	Distance from market and outbound logistics (e.g. pipeline, port, rail, road)	Distance of resource from pipeline, port or a domestic market.	<input type="checkbox"/> Close. <input checked="" type="checkbox"/> Medium. <input type="checkbox"/> Far.	The Orange-Broken Hill Railways is about 120 km from the centre of the trough. The Moomba-Sydney pipeline is about 90 km from the centre of the trough.
		Level of establishment of pipeline, port or domestic market.	<input checked="" type="checkbox"/> Established. <input type="checkbox"/> Mostly established. <input type="checkbox"/> Not yet established.	Market in NSW is established with only 3.5% of gas supplied from NSW gas fields, with sole operating field at Camden expected to cease production in 2023.
Market characteristics	Customer demand		<input checked="" type="checkbox"/> Current customer demand exists. <input type="checkbox"/> Current customer demand is moderate. <input type="checkbox"/> Current customer demand is low or may not exist.	NSW requires approx. 140 PJ of gas annually. Only 3.5% of gas is produced within NSW.
Preliminary commercial viability assessment	Likely commercial viability as a stand-alone operation	Commercial viability of stand-alone operation at current market prices.	<input type="checkbox"/> Project is likely to be financially robust. <input type="checkbox"/> Project is currently marginal. <input type="checkbox"/> Project is marginal to not commercially viable at this time. <input checked="" type="checkbox"/> Unable to reasonably determine.	The region needs extensive exploration in order to determine its value.
Other strategic matters	Existing land uses	Likelihood of competing land uses impacting on the resource.	<input type="checkbox"/> Existing land uses would not impact extraction of the resource. <input checked="" type="checkbox"/> Existing land uses would have some impact on extraction of the resource but could be managed. <input type="checkbox"/> Existing land uses would likely prohibit extraction of the resource.	The land is currently being used for grazing cattle, sheep and goats. There are heritage sites that may impact exploration.

Note that some of these issues will be further or more fully

Factor	Issue	Considerations	Petroleum Rating [MEG to tick one in each column]	Analysis
<i>considered in DRNSW's strategic issues assessment</i>	Environment/ hydrology	Environmental/ hydrological constraints to the resource and likelihood to prohibit resource extraction	<input type="checkbox"/> Yes. Environmental constraints are likely. <input checked="" type="checkbox"/> Some constraints that could be managed. <input type="checkbox"/> No environmental constraints identified under current policy settings.	The Pondie Range Trough is partially overlain by the southern margin of the Great Australian Basin (Eromanga Basin). The Darling River is to the southeast of the trough, and there are several minor creeks that flow across the trough.
	Accessibility to market		<input type="checkbox"/> Product can be delivered with no hindrance. <input checked="" type="checkbox"/> Product can be delivered but with some issues. <input type="checkbox"/> Product can only be delivered with major changes.	The Moomba Sydney gas pipeline is about 90 km from centre of the trough; therefore a pipeline extension would be needed. Existing rail access is about 120 km from the centre of the trough. Highways and major roads run through the trough.
	Other constraints and critical risks	Other constraints that would prohibit or restrict further exploration or future extraction of the resource.	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> Possibly <input type="checkbox"/> No	Land access may be difficult in some locations due to landholder opposition to petroleum exploration.
Additional Comments				

END OF PETROLEUM RESOURCE ASSESSMENT TEMPLATE