29 May 2017

The Hon Justice Rachel Pepper
Chair
Hydraulic Fracturing Taskforce
GPO Box 4396
Darwin NT 0801

Dear Justice Pepper

Re: HYDRAULIC FRACTURING INQUIRY – INFORMATION REQUEST - RESPONSE

Please find herein Pangaea (NT) Pty Limited's (Pangaea) response to the Hydraulic Fracturing Inquiry's Information Request contained in your letter of 28 April 2017.

We note the Inquiries Act's confidentiality provisions and have indicated below where materials submitted are confidential.

The information referred to below and/or enclosed as appendices, has been submitted to the Northern Territory Government as required under the Petroleum Act (2011) and the Schedule of Onshore Petroleum Exploration and Production Requirements (2016). Some of this information [redacted] will be released publically by the Northern Territory Government under defined time frames. However, some would not be and we thus request strict confidentiality for these items.

For the avoidance of doubt information annexed throughout the document from 1 through 7 is to be treated as commercial in confidence. And throughout the document, specific sections relating to data and information may also be marked commercial in confidence and should be treated so.

To assist the Inquiry in its process, Pangaea are pleased to respond to your request for information. Where appropriate we have directed you to the pertinent sections of Pangaea's Inquiry submission.

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Petroleum Resource Information

- **Up to date published estimates of potential shale and tight gas resources in the Northern Territory held by Pangaea.**

[redacted]

- **Professional advice from Pangaea as to estimates of which (if any) of the resources have the potential to be developed, the factors influencing this, and in what timeframe.**
  - Pangaea's technical focus in the last several years has centred on the unconventional potential of the McArthur and Roper basins. The accumulated knowledge acquired through our work programs, which have included, 7 wells, 1,800 km 2d seismic, 29,000 line km airborne gravity, 3,539 m core, two (2) DFITs and two (2) vertical well stimulations, has systematically and scientifically allowed us to define areas for development and production, and provide focus for additional appraisal and exploration (Appendix 1).

    Pangaea's assessment has confirmed world-class shale plays within multiple units underlying the contiguous blocks EP 167, EP 168, EP 169, EP 198 and EP 305:

    - The development potential of the mid-Velkerri source rock whose proven geological and geomechanical characteristics are analogous with major producing US shale plays;
    - Further appraisal potential of the middle Velkerri Shales beyond the initial development area, corresponding to the notified Gas Discovery Area;
    - Initial exploration potential of the middle Velkerri Shales in EP 169 which is contiguous with the gas discovery in the middle Velkerri Shale directly to the north in Origin Energy operated permits EP 76, EP 117 and EP 198 – Appendix 1 and 2; and
    - Exploration potential of the Roper basin strata within the tenements, including oil within the Kyalla and Velkerri B Shales.
  - As above, we refer the Inquiry to the Petroleum Discovery Report EP 167 and EP 168.
  - Pangaea believes that the middle Velkerri shale in the Beetaloo basin has demonstrated world class characteristics comparable to US producing plays (thickness, richness, mineralogy, pressure, drilling depths etc.) over a wide area, and can have meaningful commercial levels of production within a handful of years given the combination of:
    - Continued systematic evaluation of the sub-surface extending previous data collected by the industry including 24 vertical and 1 horizontal Velkerri shale well, basin-wide gravity/magnetic data , ~6,000 km seismic, 10+kms of core, and multiple DFITs and hydraulic fracture stimulations;
    - Highly consistent lithology and uniform reservoir properties (total organic content, overpressure, mineralogy) across this regionally extensive play;
    - Greater than 500tcf of gas in place;

- Multiple development areas across all hydrocarbon types to efficiently develop and produce reservoirs, initially with pilot pads and wells;
- The application of best-in-class technology and practices including using continual, rapid US innovation and learning;
- Flat, accessible topography, local logistics hubs and service providers;
- Environmental baselining including flora, fauna and hydrology data sets;
- Use of local content and development of local businesses; and
- Foundation infrastructure in place for development (national highway grid, rail network and existing and under construction pipelines).

These factors permit modular blueprint development, keeping planning as simple and efficient as possible in addition to limiting the footprint on the environment.

Pangaea's next step in progressing the commercial development and production, and further exploration and appraisal, of these regionally extensive shales across geologically contiguous permits EP 167, EP 168, EP 169, EP 198 and EP 305 requires the use of hydraulic fracturing stimulation techniques - without which this gas cannot be extracted.

We believe these shales can be safely and sustainably developed in the "NT way" to alleviate supply pressures on the east coast of Australia, to expand Australia's LNG industry, promote energy security and provide economic and public benefits to Territorians for decades to come.

- **Ranges of indicative gas volumes that could be developed and levels of confidence for these resources.**

[redacted]

- **All digital information relating to the boundaries of all potential shale and tight gas resources identified by Pangaea in the Northern Territory.**

[redacted]

- **All information relating to the geology and geochemistry of these prospective resources.**

[redacted]

[redacted]

Petroleum Industrial Water Use Information

- **Estimates of water requirements for the life cycle of the industry, broken down into development stages i.e. exploration, drilling, production etc. (assumptions on likely development scenarios to be included).**
  - Refer to Pangaea's Submission Table 7.1 – Section: 'Water Supply and Distribution (quantity)' pages 21-22.
  - Refer to Pangaea's Submission Table 7.4 – Section: 'Public Health' pages 25-26 details potential water use by Pangaea under a development scenario.
- **Likely source of water for potential developments in the Northern Territory.**
  - Pangaea supports initiatives around pursuing Northern Territory topographic/ environmentally led water solutions such as but not limited to water damming and surface catchment initiatives and alternate non potable aquifer sources.
  - Refer to Pangaea's Submission Appendix A '2016 Appraisal Campaign EMP', section 3.2.5 'Existing Dam Upgrade' and 3.2.6 'New Dam Construction', which details the engineering design for upgrading and construction of dams for water supply.
  - Refer to Pangaea's Submission Appendix A '2016 Appraisal Campaign EMP', section 3.2.4 'Water Bores' references to the Jamison Aquifer.
  - Refer to Pangaea's Submission Table 7.1 – Section: 'Water Supply and Distribution (quantity)' pages 21-22 talks about the Jamison Aquifer.
  - Proposed federal policy - New bioregional and geological resource assessments – Federal Budget 2017:
    - The Government believes that gas reserves should be explored on a case by case basis, and will provide $30.4 million for new combined geological and bioregional resource assessments in three onshore areas that are underexplored but prospective for unconventional gas. This new work builds on Australia's world leading Bioregional Assessments program to assess any potential impacts from unconventional gas projects on waterways and aquifers. Over the next four years the new program will provide independent scientific advice to governments, landowners and the community, business and investors on future secure and reliable gas supply. Refer to Appendix 5.
- **Estimates of volumes of waste water to be produced by potential development for the life cycle of the industry, broken down into development stages i.e. exploration, drilling, production etc. (assumptions on likely development scenarios to be included).**
  - Refer to Pangaea's Submission Appendix A '2016 Appraisal Campaign EMP', section 3.2.7 'Evaporation Ponds' (pages 35-36), which details the engineering design for evaporation ponds on the drill pads, being fully bunded, lined and fenced and able to withstand a 1-in-50 year rainfall event.

- **Likely economical recycle rates for wastewater reuse.**
  - Refer to Pangaea's Submission Table 7.1 – Section: 'Water' Water supply and distribution (quantity), pages 20-21 discusses water use for Pangaea's development analogue scenario.
  - Based on water chemistry and return volumes from stimulated horizontal wells, economically recyclable wastewater reuse rates and water management solutions are to be determined. Refer to Pangaea's Submission Appendix K 'Improving the Water Efficiency of Unconventional Development' by Schlumberger.
- **Best estimates of likely discharges (controlled and uncontrolled) into the environment from a potential development detailing frequency, number quantity and quality.**
  - Refer to Pangaea's Submission Table 7.1 – Section: 'Water' Water Quality, pages 17-21 discusses controlled and uncontrolled water (discharge) management.
  - Refer to the report 'Hydraulic Fracturing for Oil and Gas: Impacts from Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States'[1] by the US EPA, specifically:
    - Chapter 7 'Produced Water Handling' Section 7.2 'Volume of Hydraulic Fracturing Flowback and Produced Water' pages 359 discusses quantities.
    - Chapter 7 'Produced Water Handling' Section 7.3 'Chemical Composition of Produced Water' pages 365 discusses qualities.
    - Chapter 8 'Wastewater Disposal and Reuse' Section 8.2 'Volumes of Hydraulic Fracturing Wastewater' pages 404-407 discusses frequency.
- **List of the likely chemicals in waste waters and their individual and combined toxicity.**
  - Refer to Pangaea's Submission Table 7.4 'Public Health', Drilling and fracking chemicals, pages 59-63 discusses chemicals in waste waters.
  - Refer to Pangaea's Submission Table 7.1 'Water', Water Quality, page 18 discusses treatment.
  - Refer to the report 'Hydraulic Fracturing for Oil and Gas: Impacts from Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States'[2] by the US EPA, specifically:
    - Chapter 7 'Produced Water Handling' Section 7.3 'Chemical Composition of Produced Water' page 365 discusses likely chemicals.
    - Chapter 8 'Wastewater Disposal and Reuse' Section 8.5 'Potential Impacts of Hydraulic Fracturing Wastewater Constituents on Drinking Water Resources' page 452 discusses toxicity.
- **Details of storage, treatment and transport requirements by Pangaea for waste waters.**
  - Refer to Pangaea's Submission Table 7.1 – Section: 'Surface Water Protection' pages 17-18.
  - Refer to Pangaea's Submission Table 7.2 – Section: 'Land' Soil Health page 46-50.
  - Refer to Pangaea's Submission Table 7.1 – Section: 'Water' Water Quality, pages 17-21.

[1] United States Environmental Protection Agency *Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States* < https://cfpub.epa.gov/ncea/hfstudy/recordisplay.cfm?deid=332990>.
[2] Ibid.

Land Access and Disturbance

- **Describe the typical access infrastructure (roads, culverts, fencing, pipeline easements etc.) required throughout the operational phase of any potential development. Include in this description, typical site selection process, policy on the utilisation of existing infrastructure, construction standards, maintenance requirements, runoff management, security.**
    - Refer to Pangaea's Submission Table 7.6 – Section: 'Social Impacts from Background and Issues Paper's Infrastructure, page 78 discusses Pangaea's annual undertaking with Genesee & Wyoming (GWA) in relation to the railway crossings and access to the railway corridor. Further information can be found in Appendix 6.
    - The Federal government recently announced in its "Towards a New Energy Future" a proposed federal policy that would complement the existing foundation infrastructure in the Territory. This is a $5.2 million study to explore the potential benefits and costs of building gas pipelines to connect gas reserves in the north and west of Australia to the south east through Moomba in South Australia. Refer to Appendix 7 for detail.
    - Additionally, a proposed federal policy for 'Accelerated onshore gas development' as part of the Federal Budget 2017 proposes $28.7 million to accelerate the development of new onshore gas supply in the Northern Territory and along the east coast of Australia. Refer to Appendix 7.
    - Pangaea has utilised strong local content, working with over 30+ NT based companies across operations, including the design, engineering, and installation of access infrastructure. For the operational phase of a potential development, Pangaea expects to continue these relationships and supporting the potential growth of the local NT workforce. An economic study[3] of development of the Eagle Ford Shale showed that, between 2008 and 2011, the development created close to US$1.3 billion of gross state product impact, supported 12,601 full-time jobs, and adds US$2.9 billion in total economic output (or revenues). By 2020, the Eagle Ford Shale is expected to create US$11.6 billion in gross state product, support close to 67,971 full-time jobs in the area, and US$21.6 billion in total economic output impact.
    - Refer to Pangaea's Submission Table 7.1 – Section: 'Surface Water Protection' page 17 temporary storage pond bunds construction standards and runoff management.
    - Refer to Pangaea's Submission Table 7.2 – Section: 'Land' pages 29-38 details impacts on the environment from road, drill pad and pipeline construction.
    - Refer to Pangaea's Submission Appendix A '2016 Appraisal Campaign EMP' discusses Land Access and Disturbance of civil operations, specifically:
        - Section 3.0 page 24 discussing access road preparation
        - Section 3.2.2 Drill Pad Preparation – pages 27-28 – includes Figure 4 and 5 "Drill Pad Layout" which details the engineering specifications for drill pad construction and layout. Note the drill pad is fully fenced for security and the evaporation pond is further fenced within the fenced drill pad.

[3] Centre for Community and Business Research, The University of Texas at San Antonio, Institute for Economic Development, *Economic Impact of the Eagle Ford Shale* (2011) < http://ccbr.iedtexas.org/economic-impact-of-the-eagle-ford-shale/>.

- Refer to Pangaea's Submission Appendix A '2016 Appraisal Campaign EMP', section 3.2.5 'Existing Dam Upgrade' and 3.2.6 'New Dam Construction' details the engineering design for upgrading and construction of dams for water supply, including detailed spillway and outlet design.

We trust that this information, combined with our Submission answers your Information Request. Please do not hesitate to ask if further information is required.

Yours sincerely

Tim Radburn
Executive Director