

Strategic Analysis Paper

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The Scientific Inquiry into Hydraulic Fracturing in the Northern Territory – Part One: Methodology and Summary of Findings

Christopher Johns

Research Manager, Northern Australia and Land Care Research Programme

Key Points

- Hydraulic fracturing or fracking, is the process of pumping a fluid mixture into the earth to fracture impermeable rock to access gas resources.
- A strong antipathy surrounding fracking exists in the community, however, this view is not universal.
- The Northern Territory Government established an independent Scientific Inquiry into Hydraulic Fracturing of Onshore Unconventional Reservoirs in the Northern Territory.
- The Inquiry's task is to identify the known problems of fracking and assess the ways in which those problems can be dealt with.
- The conclusion of the Inquiry is that the challenges and risks associated with any onshore shale gas industry in the NT are manageable provide the necessary safeguards are adopted.

Summary

In September 2016 the Northern Territory Government announced a moratorium on hydraulic fracturing (fracking) of onshore unconventional reservoirs including the use of hydraulic fracturing for exploration, extraction and production. This was followed by the announcement of an independent Scientific Inquiry into Hydraulic Fracturing of Onshore Unconventional Reservoirs in the Northern Territory particularly the environmental, social and economic risks and impacts. The Inquiry was chaired by the [Honourable Justice Rachel Pepper](#). Justice Pepper oversees a [panel](#) of 10 scientists with expertise in disciplines such as water, geology, ecology, health, sociology and engineering.

Detailed to follow is Part One of an edited Summary of the Draft Final Report that was released for comment in December 2017. The full Summary and the complete draft Final Report is available from the Inquiry website, frackinginquiry.nt.gov.au.

Analysis

Hydraulic fracturing or fracking, is the process of pumping a fluid mixture into the earth to fracture impermeable rock to access gas resources. The process can provide an abundant source of natural gas for domestic and export markets, but it faces strong community opposition over environmental and social concerns. In the United States, the 'shale gale' gas revolution turned the US from an energy importer into an energy exporter. It transformed the energy market in North America and significantly affected world trade in gas and oil. With this change, however, came cost. In some jurisdictions the industry developed in a virtual legislative void, with poor regulatory governance resulting in even poorer environmental outcomes. The term 'fracking', whether for coal seam, tight or shale gas, has therefore become synonymous with water contamination, water depletion, land degradation, air pollution and chronic health problems.

These issues, and the understandable public anxiety accompanying them, have led to fracking being legislatively prohibited in Victoria and is the subject of moratoria in Tasmania, New South Wales and Western Australia. Overseas it has been banned in countries such as France, Germany and Scotland, two provinces in Canada and in several states in the US. The development and regulation of any onshore unconventional gas industry is an equally contentious matter in the Northern Territory. Three Territory governments have commissioned reviews and inquiries into the onshore unconventional petroleum industry to identify, address and alleviate community concerns in this regard.

On 14 September 2016, the Chief Minister of the Northern Territory, announced a moratorium on hydraulic fracturing of onshore unconventional shale reservoirs in the NT. The Chief Minister also announced that he would appoint an independent scientific panel to inquire into the potential impacts and risks associated with hydraulic fracturing. Accordingly, on 3 December 2016, the Government announced that it had established the **Scientific Inquiry into Hydraulic Fracturing of Onshore Unconventional Reservoirs and Associated Activities in the Northern Territory**. The Government stated that the moratorium will stay in place for the duration of the Inquiry.

The Inquiry Terms of Reference require the Inquiry Panel to assess and determine the following:

- the nature and extent of the risks identified with the hydraulic fracturing of onshore unconventional shale reservoirs and its associated activities on the environmental (aquatic, terrestrial and atmospheric), social, cultural and economic conditions of the NT;
- whether these risks can be mitigated to an acceptable level;
- if they can, by what methodology or methodologies can these risks be mitigated; and
- whether the existing regulatory framework is sufficient to implement these methodologies, and if not, what changes need to be made.

The Inquiry noted a strong antipathy surrounding fracking. For a sizeable majority of the people attending public hearings and community forums, the consensus was that hydraulic fracturing for onshore shale gas in the NT is not safe, is not trusted, and is not wanted. It was also noted, however, that this is not a universally held view. Many groups and individuals expressed the opinion that when adequately safeguarded by a sufficiently robust and vigorously enforced regulatory regime, the onshore extraction of shale gas could be beneficial to the NT, creating short and long-term employment opportunities and raising much needed revenue for the Government and the community. The economic modelling commissioned by the Inquiry strongly suggests that tangible economic advantages will flow to the NT if this industry is permitted to proceed.

The task of the Inquiry was not to recommend to the Government that it retain or lift the moratorium. That decision is inherently political, and as such, is for the Government alone to make. Rather, the work of the Inquiry is to identify and assess, based on the most current and best available relevant scientific evidence, the environmental, social, cultural and economic risks associated with hydraulic fracturing for onshore shale gas in the NT, and to make recommendations to mitigate those risks, where possible, to acceptable levels.

Evidence and Risk Assessment Methodology

Having regard to the most current and relevant **scientific** literature and submissions received, the Panel collected and analysed the available evidence concerning the final list of issues, or risks, identified after consultation with the community, industry, Land Councils, local government, environmental groups, and government agencies. The issues were grouped into the following broad categories or themes:

- water quality and quantity;
- land;
- air;
- public health;
- Aboriginal people and their culture;
- social impacts;
- economic impacts;
- land access; and
- regulatory reform.

The principles of ecologically sustainable development are at the core of the Panel's analysis.

Shale Gas Extraction and Development

The commercial production of shale gas is the culmination of a process spanning several years, which includes exploration, drilling, hydraulic fracturing, testing and economic analysis. It is possible that even after several years of exploration and investigation, the potential resource can be found to be uneconomic. Even if the resource is economic, it will take several more years of development before full-scale production comes online. Based on overseas experience, an individual shale gas well can be expected to produce for several decades before finally being decommissioned.

Well Integrity

The possibility that water resources, particularly groundwater, could be contaminated by activities associated with the extraction of shale gas is the major concern. Accordingly, much attention was paid to the issue of well integrity. Well integrity is defined as 'maintaining full control of fluids (or gasses) within a well at all times by employing and maintaining one or more well barriers to prevent unintended fluid movement between formations with different pressure regimes or loss of containment to the environment.'

The Inquiry Panel commissioned the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to conduct an extensive and in-depth review of all aspects of this topic. The CSIRO reviewed the well barrier

and well integrity failure rates reported in open source reporting. It found that the term ‘well barrier failure’ is identified in several ways, including by sustained casing pressure in the well. By contrast, ‘well integrity failure’ is identified by the detection of hydrocarbons in nearby water wells, gas migration outside the surface casing or detection of solutes in groundwater. CSIRO notes that many studies of well integrity do not make the distinction between the failure of individual barriers and well integrity failure, a distinction that is critical because full integrity failure (that is, the failure of multiple barriers) is required to constitute a pathway for the contamination of the environment.

CSIRO found overall, largely using data from the US, that the rate of well integrity failure with the potential to cause environmental contamination is approximately of 0.1%, with several studies finding no well integrity failure. The rate for a single well barrier failure was much higher, however, in the order of 1-10 percent. There were very few single barrier failures observed, however, for wells constructed to prescribed standards of construction.

Abandonment (where the wells are decommissioned and ‘plugged and abandoned’) is the final phase in the well life cycle. This long-term issue is also of major concern to communities. The goal of plugging and abandoning the well is to ensure the integrity of the well in perpetuity by effectively re-establishing the natural barriers formed by impermeable rock layers drilled through to reach the resource. The aims of abandonment are to:

- prevent release of formation fluids, or well fluids, to the environment (including aquifers);
- prevent the flow of groundwater or hydrocarbons between different layers of rock; and
- isolate any hazardous materials left in the well.

CSIRO found that for shale gas wells abandoned using existing practice, if any of the potential leakage pathways were to develop, it is highly unlikely that they would allow large fluid flow rates along the well bore. The small cross-sectional areas and long vertical lengths of the pathways will tend to limit flow. The low permeability of shale gas formations is also a factor mitigating the potential for adverse impacts caused by loss of well integrity post well abandonment. Pressures within the part of the reservoir accessed by the well will have been depleted by production, and the very low permeability of the shale will prevent gas from other parts of the reservoir migrating to the well.

Water

Shale gas extraction requires the use of large quantities of water, which may be obtained from local surface or groundwater sources, or externally transported to the site. Typical water volumes used are around 1-2 megalitres (ML) for well drilling, and approximately 1-2 ML for each hydraulic fracturing stage. In the US, the most recent long horizontal wells require 30-40 fracturing stages. The indications are that this is analogous to any shale gas industry developed in the NT. The Panel notes that if 1-2 ML of water is required for each stage of fracking, and at least 20 stages of fracking are likely, based on developing industry practice, at least 40 ML of storage will be needed per well for a fully developed production scenario. This volume will not be cumulative for a multi-well pad configuration and will also depend on the extent of reuse possible, noting that the wells would be fractured sequentially rather than concurrently.

Communities are understandably concerned about the amount of water required for drilling and hydraulic fracturing and the amount of wastewater produced that will require storage and treatment. Estimates based on overseas experience have been provided for the volumes of water required to develop a well and for the volumes and nature of the wastewaters that may be produced. In this context, it should be noted that the

gas companies are proposing to use multi-well pads (at least 10 wells per pad) to extract the gas. This configuration provides substantial benefits in terms of both reducing the physical footprint of any onshore shale gas industry and in management of the wastewater because it will facilitate reuse of water to drill and fracture subsequent wells on the well pad.

Chemicals Used in Fracturing

The nature of chemicals used in hydraulic fracturing is a cause of considerable anxiety to the public. Hydraulic fracturing technology has evolved rapidly over the past decade, and much greater attention is now given to the potential for contamination of below ground and surface environments. Currently a much smaller fraction of the 1,100 different chemicals historically identified as used in the US for fracking are being routinely employed. Between January 2011 and February 2013, only 35 chemicals were used in most of the fracturing operations in the US. Additionally, there has been a strong move to use less toxic and more readily degradable chemicals. There still, however, needs to be stringent controls on the transport, storage and use of these chemicals, with the least toxic chemicals available used.

Based on the evidence from the US, there is significant potential for accidental releases, leaks and spills of hydraulic fracturing chemicals. There have, however, been more than one million fracturings in North America and more than 1,300 in South Australia's Cooper Basin, there has been no reported evidence of fracturing fluid moving from the fractures to near surface aquifers.

Onshore Shale Gas in Australia and the Northern Territory

For detailed maps of the Australian and Northern Territory petroleum resources please refer to the [Inquiry Summary of the Draft Final Report](#), pages 13 and 14.

From an international perspective, Australia is considered to have substantial resources of onshore unconventional gas. While the development of coal seam gas reserves has been under way for almost two decades in Queensland, the shale gas industry in Australia is still largely in the exploration phase.

The geological basins in the NT that are currently considered to contain not only prospective rocks with the necessary prerequisites for shale gas occurrence, but have also had some confirmation through exploration drilling, are the Amadeus Basin and the Beetaloo Sub-basin in the McArthur Basin. According to [Geoscience Australia](#), total shale gas resources in the NT are currently 257,276 petajoules, with almost 70% of this estimated to occur in the Beetaloo Sub-basin. This resource is larger than any one of the North West Shelf conventional gas resources, the Cooper/Eromanga basins or the Canning Basin shale gas resources. This suggests that the Beetaloo Sub-basin is a world class resource comparable to several of the major US shale gas basins.

Several other potential basins in the NT have not been extensively or successfully tested to date. These include the broader McArthur Basin, the Wiso Basin, the Georgina Basin, the Perdika Basin and the onshore component of the Bonaparte Basin. Given the long lead time from exploration to production, the most likely area for any possible shale gas development in the foreseeable future (5-10 years), if the moratorium is lifted by the Government, is the Beetaloo Sub-basin.

The scale of any potential future development in the Beetaloo Sub-basin is difficult to state with any certainty at this early stage of resource assessment and testing. The estimates provided by the three petroleum companies currently involved (Origin, Santos and Pangaea) suggest that combined developments over the next 25 years could result in between 1,000 and 1,200 wells associated with around 150 pads. Whether the proposed developments would proceed in parallel or sequentially will have a significant impact on the

demand timeline for transport, drilling and hydraulic fracturing equipment, associated infrastructure, and workforce requirements.

Conclusion

The Inquiry notes in its conclusion that no industry is completely without risk and the development of any onshore shale gas industry in the NT is no exception. Having considered, however, the most current available scientific literature and data from a wide range of sources and noting the recent and continuing technological improvements in the extraction of onshore shale gas, the conclusion of the Inquiry is that the challenges and risks associated with any onshore shale gas industry in the NT are manageable. Nevertheless, with any new industry it is not uncommon for problems to emerge. The Inquiry Panel found that, provided the recommendations made in its Report are adopted and implemented, not only should the risk of any harm be minimised to an acceptable level, in some instances, they can be avoided altogether.

Any opinions or views expressed in this paper are those of the individual author, unless stated to be those of Future Directions International.

Published by Future Directions International Pty Ltd.
80 Birdwood Parade, Dalkeith WA 6009, Australia.
Tel: +61 8 9389 9831 Fax: +61 8 9389 8803
E-mail: info@futuredirections.org.au Web: www.futuredirections.org.au