



**ENVIRONMENTAL
DEFENDERS OFFICE NT**

7 Searcy Street, Darwin, NT
GPO Box 4289 Darwin NT 0801
Tel. 08 8981 5883
edont@edont.org.au
www.edont.org.au

4 September 2017

The Panel
Independent Scientific Inquiry into Hydraulic Fracturing in the NT
By email: fracking.inquiry@nt.gov.au

Dear Panel

Supplementary written submissions following appearance on 1 August 2017.

Thank you for the opportunity to make a further written submission to the Panel on matters raised during our oral submissions to the public hearing on 1 August 2017. I apologise to the Panel that this submission comes later than I had undertaken to provide it.


These supplementary submissions address the following matters:

1. Structural changes required to give effect to regulatory reform recommendations made by the EDO. The desirability of establishing an independent body of some kind to assist in regulation of the Industry.
2. Staging of regulatory reforms and structural changes to reflect the difference in risk associated with exploration vs production.
3. Legislative mechanisms to fund regulatory oversight.
4. Regulation of methane emissions.
5. Regulation of impacts of increased truck movements and traffic associated with an oil and gas industry.
6. Responses to the Interim Report from experts briefed by the EDO.

Should anything in this supplementary submission require further clarification, or if we can be of further assistance to the Panel, please feel free to contact the office.

Kind regards

Environmental Defenders Office (NT) Inc


David Morris
Principal Lawyer

Independent Scientific Inquiry into Hydraulic Fracturing in the Northern Territory

Supplementary submission 1 September 2017

Structural changes required to give effect to regulatory reform recommendations made by the EDO. The desirability of establishing an independent body of some kind to assist in regulation of the Industry

In summary we suggest the following structural changes are required:

Stage 1.

1. The establishment of a *Chief Environmental Regulator (CER)* under the *Northern Territory Environmental Protection Act (NT)*.
2. The conferral of compliance jurisdiction on the Northern Territory Environment Protection Authority (**NTEPA**).
3. The conferral of merits review jurisdiction on the *Northern Territory Civil and Administrative Tribunal* for various decisions under the *Petroleum Act / Regulations*.
4. Legislative enforceability of the *Land Release Policy*.
5. Amendments to the Regulations that sees mandated input into the permitting regime from relevant expertise areas within government.
6. Mandated baseline testing and publication.

State 2.

1. The establishment of an independent scientific body to undertake bioregional assessments and to provide advice to decision makers.
2. The establishment of a dedicated *Petroleum Compliance Unit* within the NTEPA overseen by the CER.

Structural changes directed to compliance activities

It is the EDO's opinion that community confidence in the industry and a corresponding social licence, will not be achieved unless the community has confidence in the Government to effectively regulate the industry. The two things are inextricably linked.

Central to that confidence will be the creation of circumstances where compliance with regulations and conditions¹ is enforced, with appropriate consequences where they are not.

Our submissions in relation to the regulatory reforms required are specified in our original submission to the Inquiry and our submission to the *Hawke Inquiry*. Our recommendations with respect to structural reforms, however, are as follows:

1. The creation of a statutorily appointed *Chief Environmental Regulator (CER)* under the *Northern Territory Environment Protection Authority Act 2012(NT)*. The CER will be responsible for overseeing the compliance functions of the Northern Territory EPA and will have:
 - Independent authority to commence prosecutions under legislation conferring compliance power on the NTEPA, including the *Petroleum Act*.
 - Security of tenure similar to that which would be expected of other roles that need to be seen to be independent of the government of the day which appoints them.
 - A statutory role in reviewing conditions that will be imposed on EMPs issued under the *Petroleum Regulations* to ensure that conditions imposed are enforceable.
 - A statutory requirement to report annually on the NTEPA's compliance work and to report on the adequacy or otherwise of compliance resources.
 - A statutory role in providing advice to the Minister/NTEPA/DPIR on matters which relate to compliance.
 - Ombudsman like powers of investigation.

One of the key advantages of the CER is that it will provide rigour to environmental compliance across the board, rather than singling out the gas industry. In the short term - at the exploration stage - having the CER provide input into the conditions placed on EMPs will ensure that conditions on EMPs are enforceable and appropriate when considered from a compliance perspective.

2. The conferral of the compliance jurisdiction on the NTEPA. These functions currently sit with the Department of Primary Industry and Resources (**DPIR**) (for on-site compliance), a state of affairs, which has been patently inadequate. We refer the Panel to the *Regulatory Capture* sector of our initial submission and also to the comments of the NTEPA in their *Redbank Copper Mine - Environmental Quality Report* at page 47 which stated:

Government agencies may have been challenged by the tension that can exist between supporting development and ensuring appropriate environmental management, and agencies have operated with little strategic guidance on how best to achieve an appropriate economic and environmental balance.²

¹ Including those standards put forward by industry under a hybrid regulatory regime which allows for some objective based regulation.

² Northern Territory Environment Protection Authority (2014) *Redbank Copper Mine – Environmental Quality Report* at p 47.

The EDO notes that currently Department of Environment and Natural Resources (**DENR**) does not have a publicly available *Compliance and Enforcement Policy*. The DPIR has a brief *Compliance and Enforcement Policy*³ - created in 2016, however, that 3-page document falls well short of the kind of document, which one would commonly expect, of a body responsible for those functions.⁴

3. The establishment of a Petroleum Compliance Unit, overseen by the CER, within the NTEPA. (Under a production scenario).

Structural changes directed to risk abatement

4. Changes that ensure the enforceability of the *Land Release Policy*. This should include a secondary veto right for holders of Aboriginal Land prior to the issue of a production licence.
5. The removal of the current structure which sees water entitlements conferred on gas operations (and mining operations) via an unpublished licencing regime and a memorandum of understanding between the DPIR and the DENR. The exemption under the *Water Act* (NT) must be abolished and gas industry entitlements must be licenced in a transparent way that demonstrates where the water is to be taken from, in what quantity and how the total entitlements within an area remain within the sustainable limit.
6. Requirement for EMPs (including at the exploration stage) to be commented upon by a variety of government entities to fully inform the Mines Minister prior to his/her decision to approve/not approve an EMP. This change reflects the fact that exploration activities are unlikely to meet the threshold requirements for environmental impact assessment by the NTEPA. While not a “structural” change per se, taking up this recommendation will have the effect of ensuring that relevant expertise (located variously within government) is utilised in the decision making process.
7. The establishment of an Independent Scientific Expert Body with the following functions:
 - a. The preparation of bioregional assessments;
 - b. Providing advice to the Minister for the Environment and Minister for DPIR as requested; and
 - c. Providing input into the conditions imposed upon “production EMPs”.

The creation of a stand-alone independent regulator for the gas industry in the NT, such as the Queensland Gas Commission, would be overkill. Conferring compliance jurisdiction on the NTEPA, strengthening it and ensuring it is adequately resourced is a better way of addressing the question marks that exist around regulator independence. Additionally, we do not see the need for an independent scientific body to be established at the exploration stage.⁵ On the other hand, in a production scenario, the current lack of data - about water resources, areas of important habitat, the distribution of flora and fauna and the interaction between threatening processes on a landscape scale - makes it impossible to pursue a precautionary approach without a great deal more information. That information should not be collected by industry and should not be confined to a particular licence area but rather should be looked at by basin or bioregion. A production scenario necessitates the establishment of an independent scientific body.⁶

³ See https://minerals.nt.gov.au/_data/assets/word_doc/0019/270730/Compliance-and-Enforcement-Policy-DME.docx

⁴ See as an example, the NSW EPA Compliance Policy here: <http://www.epa.nsw.gov.au/resources/legislation/130251epacomp.pdf>

⁵ Assuming “exploration” is defined and is subject to strict limits.

⁶ The value of an expert panel is currently being realised with the significant impact of the IESC. See for example: <http://www.iesc.environment.gov.au/system/files/resources/1849e5a1-01ed-4673-b351-be94b1df1e88/files/iesc-advice-narrabri-2017-086.pdf>

A precondition to a production scenario should be an independent bioregional assessment conducted by that independent body. The NTEPA and the Environment Minister should consider the outcomes of the bioregional assessment and recommendations of the independent body before issuing an environmental approval.

What we envisage is a body similar in structure and makeup to the *Independent Expert Scientific Committee on Coal Seam Case and Large Coal Mining Development (IESC)*. However, unlike the bioregional assessments undertaken by the IESC, the NT body should not be confined to assessments of water resources. In consideration of the large knowledge gaps in the NT, bioregional assessments should also cover terrestrial matters including the mapping of important habitat, the distribution of flora and fauna and the interaction between threatening processes.

Staging of regulatory reforms & structural changes

We outline in this section the structural and regulatory changes that are necessary prior to (a) the issue of new exploration permits or exploration EMPs (**Stage 1**)⁷; and (b) the application for production licences (**Stage 2**)⁸. Those stages can be further divided into four as follows:

- (1) *Stage 1:*
 - (a) *Tenure – Grant of the exploration permit*
 - (b) *Exploration – Grant of an “exploration EMP”*

- (2) *Stage 2:*
 - (a) *Environmental approval for production*
 - (b) *Production – Grant of “production EMP”*

Our recommendations are made considering the need to - at both stages:

- protect the environment; and

- provide the community with a requisite level of confidence in the regulatory regime.

To attempt to set out what we envisage we have created two flowcharts [See attachments A & B], which outline generally the look of the regulatory regime after our recommended changes have been implemented.⁹

We thought carefully about whether sufficient environmental protection and community confidence could be achieved at **Stage 1** simply through reform of subordinate legislation, guidelines and policies; avoiding the need for legislation to pass through the Parliament. It cannot.

We do, however, consider that reform can occur in stages to reflect the lower level of impact and risk of activities occurring during **Stage 1**, as compared to activities under **Stage 2**.¹⁰ This is contingent upon exploration having clear limits.¹¹

We raise with the Panel the difficulty (noted during oral submissions) we have had with making these recommendations due to the moving feast that is the reform of environmental legislation in the Northern Territory at present. The Government has slated reviews of – at least (and relevantly) – the *Environmental Assessment Act*, *Water Act*, *Waste Management and Pollution Control Act*, and the development of *Resource Management Regulations*.¹²

Our recommendations in relation to the staging of the structural changes and major elements of the regulatory reforms are set out in the tables below:

⁷ Encompasses stages 1-4 as described in the *Interim Report* at 5.2.2

⁸ Encompasses stages 5 and after as described in the *Interim Report* at 5.2.2

⁹ We note that not all of our recommended regulatory changes can be identified on the flowcharts and we have attempted to just give a representation of the main elements of the framework we propose.

¹⁰ Whether in reality it is more efficient to simply undertake the entirety of the reforms in one go is a matter for the Government and our suggestions merely indicate a level of regulation we see as necessary at each stage.

¹¹ Issues have been raised with the EDONT in relation to “exploration creep” where activities that are not required to simply prove resources are undertaken under the guise of “exploration”. Large-scale activities occurring under an exploration permit are not unique to the gas industry. For example, in 2013, Sherwin Iron undertook a “bulk sample” under an exploration permit which it announced to the ASX as a full scale mining operation.

¹² Prior to reviewing the DPIR submission to the Panel, the EDONT was not aware of the development of *Resource Management Regulations* and we remain in the dark about what they will be designed to achieve.

Stage 1 – Major changes necessary prior to the authorisation of new applications for explorations permits or the issuing of exploration EMPs

	Structural/Regulatory change required	Legislation/ Department	Rationale
1	Water licencing exemption for gas industry abolished.	<i>Water Act</i>	<p>The gas industry, even at the exploration stage, has the potential to use a great deal of water and the current arrangements are entirely insufficient to both safeguard the environment and engender public confidence.</p> <p>Legislative reform of the <i>Water Act</i> (NT) has been promised by Government and this must occur prior to any new gas activities – which use water – being authorised.</p>
2	Rigorous baseline testing requirements – including reporting - introduced into legislation	<i>Petroleum Regulations</i>	<p>These changes are required prior to Stage 1. Establishing the cause of damage/contamination is equally important whether it occurs at exploration or production stage.</p>
3	Compliance/prosecution powers which currently reside with DPIR are vested upon the NTEPA	<i>Petroleum Act</i> DPIR, NTEPA	<p>This recommendation is consistent with the recommendations we have made to the NTEPA and the DENR with respect to the broader environmental reforms.</p> <p>Streamlining of compliance activities with one body responsible for breaches occurring on and offsite.</p> <p>Reduced potential for regulatory capture and enhanced community confidence in the regulatory framework.</p>
4	Creation of a Chief Environmental Regulator	<i>Northern Territory Environment Protection Authority Act</i> NTEPA	<p>This recommendation is made in recognition of the need to strengthen compliance functions of the NTEPA and also to foster public confidence in the Government's ability to require compliance with environmental laws.</p> <p>Importantly this recommendation is directed to more effective compliance on environmental matters across the board.</p>
5	Introduction of 3P merits review rights into legislation	<i>Petroleum Act & Petroleum Regulations</i>	<p>Consistent with our initial submissions about operationalizing the precautionary principle and the finding of the Panel in the Interim Report that "In any mature and robust regulatory system, both forms of review will co-exist".</p>
6	Amendment of s 30 of the <i>Petroleum Act</i> to place strict parameters around the activities, which can be conducted under an exploration permit.	<i>Petroleum Act</i>	<p>This submission has recommended a framework which stages the regulatory imposition on industry, which reflects the increase in impact and risk, associated with production vis-à-vis exploration.</p> <p>To allow for some of the more costly and time consuming regulatory reforms to take place at a later stage, reducing short term regulatory burden, we have recommended a two stage approach. This recommendation is predicated upon strict legislative parameters being set around what constitutes</p>

			<p>“exploration”.</p> <p>The Gunner Government’s commitment is that if it lifts the ban it will allow hydraulic fracturing activities only in “highly regulated circumstances in tightly prescribed areas”. That must apply to exploration, albeit in an appropriate way.</p>
7	<p>All applications must be subject to an EMP. Currently the <i>Petroleum Act</i> contains a loophole which can see the requirements of the <i>Petroleum Regulations</i> avoided.</p>	<i>Petroleum Act</i>	<p>The use of this loophole, to avoid the application of the <i>Petroleum Regulations</i> was used by the previous CLP government to authorise work by Origin Energy that would have otherwise required an approved EMP.</p> <p>The justification given at the time was that Origin’s application for an exploration permit had been received prior to the introduction of the <i>Petroleum Regulation</i>. The Government assured the EDO at the time that no other applications would avoid the requirements of the <i>Regulations</i>.</p> <p>In practice, the community can have little comfort from this assurance while the ability to avoid the requirements of the <i>Regulations</i> still exists.</p>
8	<p>Fit & Proper person test introduced into the <i>Petroleum Act</i></p>	Minister DPIR <i>Petroleum Act</i>	<p>It is appropriate, particularly in the case of the gas industry, where there is a wide variation in the capacity of different players to have the history of an applicant and whether they are a suitable applicant assessed by the Minister prior to the issue of an exploration permit (tenure).</p> <p>It is our opinion that the current requirement of s 16(e) does not go far enough to enable consideration of whether an applicant is fit and proper. For example, that subsection does not require an applicant to provide evidence of their historical compliance or otherwise with environmental laws.</p>
9	<p>Introduction of additional considerations into the <i>petroleum regulations</i> to address current issues with silos within government and to address localised habitat impacts of exploration</p>	<i>Petroleum Regulations</i>	<p>Given the uncertainty associated with much of the NT’s terrestrial environment, decision makers must have in place mechanisms that ensure that unacceptable impacts do not occur during the exploration phase.</p> <p>Given that individual exploration activities are unlikely to be the subject of full EIA, other mechanisms need to be developed prior to full bioregional assessments.</p>
10	<p>Creation of a Code of Practice for Well Integrity (with requirement for 3P sign off)</p>	<i>Petroleum Regulations</i>	<p>This change will provide minimum standards to ensure that best practice is used for well construction and decommissioning. It is also a change that has been generally supported by the Industry.</p> <p>It is as important to have high quality well construction/decommissioning at the exploration stage as it is at the production stage.</p> <p>The Code should also make provision for the independent inspection of wells in line with the recommendation of Dr Tina Hunter.</p>
11	<p>Reverse onus offence provision for water pollution offences</p>	<i>Waste Management Pollution Control Act</i>	<p>See our original submission.</p>

Stage 2 – Changes that will only be necessary should industry make an application for a production licence.

	Structural/Regulatory change required	Legislation/ Department	Rationale
1	Establishment of a independent scientific body to undertake bioregional assessments and provide advice to relevant Ministers in relation to production applications.	<i>Petroleum Act Environment Minister DPIR Minister</i>	<i>It is unlikely that a production (Stage 2) scenario in the Territory will occur for some 5-10 years. Currently it is unclear whether the industry is viable in the NT. Given that, it seems unnecessary (assuming limits are placed on exploration activities – as above) to go to the expense of establishing an independent scientific body at this stage.</i>
2	<i>Reforms that require bioregional assessments as a precondition to the issue of a production licence</i>	<i>Environmental Assessment Act Petroleum Act</i>	<i>While localised risks of exploration (within appropriate limits) can be managed via the reforms we recommend, at the commercial production stage the major knowledge gaps about the NT conditions present a risk that cannot be managed without taking a landscape scale approach.</i>
3	<i>Veto right for traditional owners of land subject to ALRA incorporated into the Petroleum Act</i>	<i>Petroleum Act</i>	<i>Obviously this change is not a necessity until such time as an applicant is seeking (or is required by the Minister to seek) a production licence.</i>
4	<i>The establishment of a Petroleum Compliance Unit within the NTEPA</i>	<i>Procedural/ Structural</i>	<i>Under a production scenario a far greater level of compliance resourcing would be required. It would be appropriate at that stage to have a specialist unit located within the NTEPA responsible for gas industry compliance operations. Funding mechanisms are discussed below.</i>

Legislative mechanisms to fund regulatory oversight

The resourcing of regulatory oversight of development in the Territory is a challenge generally. Current mechanisms to ensure compliance with the Territory's environmental laws have failed or indeed the laws themselves have allowed unacceptable activities to occur without consequence.

It is true that the gas industry has some unique features, which may yet see it banned by the Northern Territory government. However, if the gas industry is permitted (under in a highly regulated way), it will be of paramount importance that industry operations comply with the requirements that are set for them. Experiences overseas have shown that many of the potential risks associated with the gas industry are realised because of compliance failures, sloppy operations and lack of regulatory oversight.

It is also true that at the exploration phase at least (assuming that strict limits are placed on the extent of activity which can occur under an exploration permit) the amount of regulatory oversight will be less and more manageable than under a production scenario.

That being the case, our submissions on this point suggest that while a range of mechanisms to see the gas industry fund regulatory activities might be available, the majority of the costs of stage 1 improvements should be borne by

Funding mechanisms – Exploration Stage

The EDO considers that in addition to the annual fee issued at the "tenure" stage, an additional licence fee should be paid upon the issue of an EMP (**the exploration EMP fee**). The exploration EMP fee would vary depending on the level of risk assigned to an application. All exploration EMP fees recovered should be directed towards the resourcing of regulation of gas exploration activities (including compliance activities undertaken by the NTEPA).

The consequence of this structure would be that applicants would pay a different EMP fee depending on the level of risk assigned to their exploration activities as permitted under an EMP.

High Risk EMP = \$X

Moderate Risk EMP=\$Y

Low Risk EMP=\$P

Negligible Risk EMP=\$V

A number of factors could be considered when assigning a level of risk including:

- The activities sought to be permitted
- The applicant's environmental history
- The nature of the applicant (e.g publicly listed company)
- The sensitivity of the surrounding environment

Our recommendation for the establishment of a CER is not made solely because of the potential for a gas industry. In fact, the establishment of a CER would provide much needed rigour to compliance activities in relation to environmental laws generally. In light of that, it would be unfair and unwarranted to single out the gas industry to pay for the establishment and resourcing of that position.

Funding mechanisms – Production Stage

The substantial additional costs arising from our recommended approach to regulating a production phase gas industry will be:

- The establishment and resourcing of a *Petroleum Compliance Unit (PCU) within the NTEPA*
- The establishment and resourcing of an Independent Scientific Panel (**ISP**)
- The costs associated with the ISP undertaking bioregional assessments.

Costs of the PCU

It is reasonable to expect that these substantial costs be met by the industry that is creating the need for them. The Panel is likely to be familiar with the recent move by the Federal Government to amend the *Australian Securities and Investments Commission's* regulatory model to ensure that the costs of ASIC's regulatory activities are borne by those who create the need for regulation.¹³ The *ASIC Supervisory Cost Recovery Levy Act 2017* and *ASIC Supervisory Cost Recovery Levy Regulations 2017* do this by a combination of "annual supervisory levies" and "significant fee increases".

This approach has great appeal should the gas industry move into a production phase.

ASIC's approach to Annual Supervisory Levies is to recover the actual costs expended during the financial year to undertake regulatory activities.¹⁴ A simplified version of ASIC's approach could be used to adequately resource the *Petroleum Compliance Unit* within the NTEPA by the imposition of a levy on the issue of an EMP (**production EMP levy**). The ASIC approach to generating Levy metrics, applied to the production EMP levy, could be based upon three factors:

- Number of wells approved
- Relative risk of the company (which would vary the levy)
- Relative risk of the surrounding environment (which would vary the levy).

This full cost recovery of regulation approach is not unique to ASIC. In fact, it has precedent in the regulation of oil and gas operations with respect to health and safety in Queensland. In 2010 in Queensland "a full cost recovery model, called the *P&G Safety and Health Fee*, was introduced".¹⁵ That fee was introduced as a response to the unprecedented growth of the industry and was designed to recoup from industry the costs of employing new inspectors, up-skilling existing inspectors and the administrative costs of regulating the industry. The categories of fees covered 15 activities associated with the industry that would be liable for a fee.¹⁶ Any amounts received would be put directly back into the funding of the compliance activities of the PCU.

Costs of the ISP

¹³ See *ASIC Supervisory Cost Recovery Act 2017*

¹⁴ <http://download.asic.gov.au/media/4373947/rep535-published-14-july-2017.pdf>

¹⁵ <http://www.qca.org.au/getattachment/70f749ee-01ca-4287-a400-c0fd9312a071/DNRM-Petroleum-and-Gas-Safety-and-Health-Fee-%E2%80%93-Pos.aspx>

¹⁶ <http://www.qca.org.au/getattachment/70f749ee-01ca-4287-a400-c0fd9312a071/DNRM-Petroleum-and-Gas-Safety-and-Health-Fee-%E2%80%93-Pos.aspx>

The costs associated with bioregional assessments and the establishment of the ISP are more complex. Our model requires a bioregional assessment to be undertaken prior to the issue of a production licence. Because of this, the establishment of the ISP and its work will need to begin in advance of the first company that is ready to enter the production phase. How then does one equitably apportion the costs of a bioregional assessment, in a way that the first company ready to enter production does not bear the entire cost of the assessment?

This problem is most easily overcome under a play based regulation scenario where costs of the assessment can be apportioned between all companies within a given bioregion. In these circumstances, costs could be apportioned on the basis of a licensee's exploration area or on the number of wells they propose to drill under the plan for the entire play.

Alternatively the government could seek to claw back the costs of the ISP through the imposition of expensive up-front licence fees charged for production permits when they are sought.

Regulation of methane emissions

By letter dated 27 July 2017, the Panel asked for us to address 5 questions in relation to methane emissions from gas industry activities. In relation to the following questions, they fall outside of areas where we would claim to have sufficient expertise to provide meaningful input to the Panel:

- 1) *The technologies that are currently available to obtain baseline measurements of emissions, including the possible use of drones.*
- 2) *The scope, including the location, of any emissions monitoring that should occur during the exploration, development and production phase, such as, for example, wellheads during completion, liquids unloading, compressor seals and gathering stations.*

The EDO does not have a sufficient knowledge area to provide meaningful commentary. The *Melbourne Energy Institute Report, A review of current and future methane emissions from Australian Unconventional Oil and Gas Production*, referenced at page 40 of our previous submission does touch on these points.¹⁷

Additionally, our submission to the *Hawke Inquiry* referenced a number of regulatory provisions in the United States, which regulated air emissions from hydraulic fracturing operations.

- 3) *The use of emission limits that, if exceeded, would trigger an investigation, make-good requirements and/or a penalty*

The EDONT supports the use of emissions limits and believes that limits imposed must be calculated having regard to Australia's international obligations with respect to climate change and the application of the principles of ecologically sustainable development.

Obviously, if emissions limits are exceeded, there must be consequences that are proportionate to the failure and act as a disincentive to further exceedances. The EDO supports the use of strict/absolute liability offences for these types of occurrences.

- 4) *The need for transparency when setting emission limits*

Without transparency community confidence in the regulation of methane emissions will be damaged. Publication of the emissions limits and public reporting of actual emissions will provide greater scrutiny of gas operators and provide a greater disincentive to breach emissions limits.¹⁸

- 5) *Whether or not baseline measurements and on-going monitoring should be undertaken by an independent body.*

Best practice jurisdictions are now requiring baseline measurements of air quality in advance of hydraulic fracturing operations. The use of independent bodies to undertake those measurements is undoubtedly a way to foster public confidence in the results.

¹⁷ <http://climate-energy-college.org/files/site1/docs/6032/20161023%20Review%20of%20Methane%20Emissions.pdf>

¹⁸ See for example, real time Air Quality Monitoring Data of SO₂ emissions from McArthur River Mine here: <http://www.mcarthurrivermine.com.au/en/sustainability/environment/Pages/air-quality-monitoring.aspx>

Regulation of impacts of increased truck movements and traffic associated with a gas industry in the NT

The EDO's focus - in its initial submission - was on regulatory changes required to protect the environment and public health from risks associated with the gas industry. We did not in any thorough way address the issues of social licence or economic costs/benefits of the industry.

In relation to the increase in heavy vehicle movements arising from an operational gas industry the EDO's original submission focused on edge impacts, the spread of weeds and the fauna road fatalities. A number of mechanism including speed limits and nighttime driving restrictions can help to mitigate those impacts.

During our presentation to the Panel we were asked to provide an opinion on potential regulatory mechanisms to address increased truck movements associated with the gas industry. This submission looks at mechanisms to address the road damage from a greater level of heavy vehicle usage.

Road damage

One of the key impacts of a gas industry (particularly under a production scenario) will be the increase in heavy truck movements on remote Territory roads. Roads have a lifespan that is significantly reduced by their use by heavy vehicles.¹⁹ The cost of maintaining damaged roads sustained because of increased truck movements should not be borne by the Territory taxpayer. Instead it should be cost borne by the developer and factored into the economic viability of any given gas project.

In Australia the costs for heavy vehicles are determined by vehicle registration (collected by each state and territory) and for fuel-based road user charges determined by the National Transport Commission and collected by the Commonwealth Government.²⁰ A recent article by Philip Laird from the University of Wollongong, published in *the Conversation*, cast some doubts about whether the current charges are sufficient to offset the cost of road repair occasioned by heavy vehicle use.²¹

It is beyond the scope of this supplementary submission to make additional comment on the arrangements currently overseen by the National Transport Commission under the *National Transport Commission Act 2003* (Cth).

Notwithstanding the above, it might be possible for the NT to impose road maintenance obligations by way of some kind of "developer contribution".

Various pieces of planning legislation throughout Australian jurisdictions (including the NT) contemplate "developer contributions" where developers will be required to make payments to upgrade facilities or infrastructure to cater for the demand or damage generated by their development. In some jurisdictions – for example NSW - gas developments are required to obtain planning consent, thereby being caught within the development contribution framework. This is not the case in the Northern Territory and the *Petroleum Act* does not make provision for "development contributions".

¹⁹ <http://www.abc.net.au/news/2017-08-18/outback-wa-roads-struggling-to-cope-with-heavy-traffic/8814098>

²⁰ <https://www.ntc.gov.au/heavy-vehicles/heavy-vehicle-charges/>

²¹ <https://theconversation.com/trucks-are-destroying-our-roads-and-not-picking-up-the-repair-cost-79670>

Many local government authorities in NSW have contributions plans, which levy charges on operators using heavy vehicles on Council roads.²² The creation of a mechanism in the *Petroleum Act*, similar to that provided by s 94 of *Environmental Planning & Assessment Act (NSW)*²³ to allow the NT Government to require certain contributions for road infrastructure maintenance could be an effective mechanism to safeguard the public from being burdened with costs generated by the gas industry's use of the NT road network.

²² See for example: [Ballina Shire Heavy Haulage Contributions Plan 2011](#) and [Coffs Harbour Mines and Extractive Industries Developer Contributions Plan 2016](#)

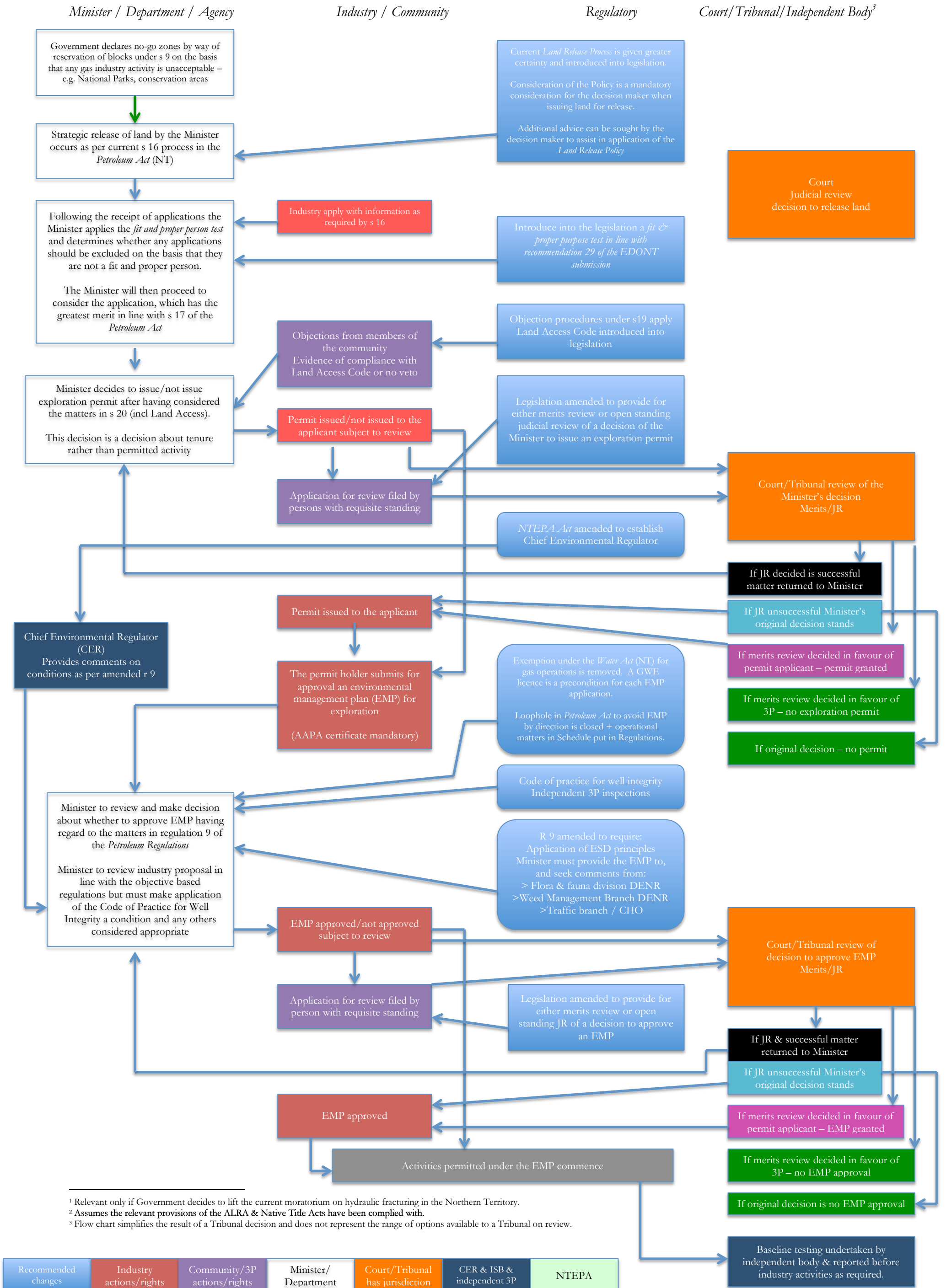
²³ s 94 *Environmental Planning & Assessment Act 1979 (NSW)* – accessible here: http://www.austlii.edu.au/cgi-bin/viewdoc/au/legis/nsw/consol_act/epaaa1979389/s94.html

Responses to the Interim report by experts briefed by EDONT

In the EDONT's original submission to the Panel, we included submissions from experts that we briefed on behalf of the Lock the Gate Alliance to put before the Panel independent expert testimony. Two of those experts have prepared a written review of the interim report. We attach review from:

- Dr Scott Wilson [*Attachment C*]
- Dr Renata Bali [*Attachment D*]

FLOW CHART OF SUGGESTED REGULATORY STRUCTURE¹ TENURE & EXPLORATION²

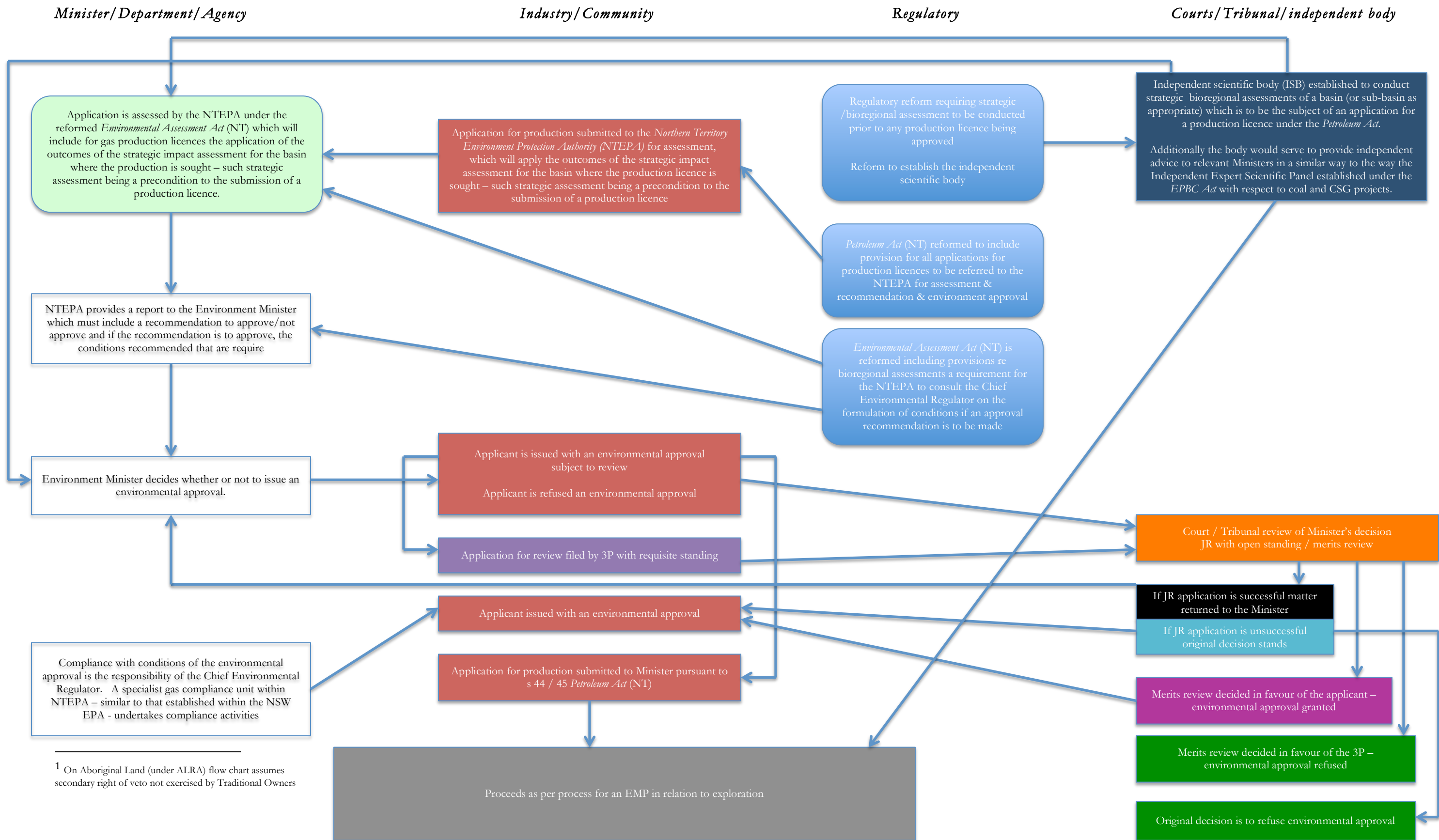


¹ Relevant only if Government decides to lift the current moratorium on hydraulic fracturing in the Northern Territory.

² Assumes the relevant provisions of the ALRA & Native Title Acts have been complied with.

³ Flow chart simplifies the result of a Tribunal decision and does not represent the range of options available to a Tribunal on review.

FLOW CHART OF SUGGESTED REGULATORY STRUCTURE¹ PRODUCTION LICENCE UNDER THE PETROLEUM ACT (NT)



¹ On Aboriginal Land (under ALRA) flow chart assumes secondary right of veto not exercised by Traditional Owners



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EXPERT ADVICE

**SCIENTIFIC INQUIRY INTO
HYDRAULIC FRACTURING IN THE
NORTHERN TERRITORY**

REVIEW OF JULY 2017 INTERIM REPORT

DR SCOTT WILSON



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PREAMBLE

1. This report was requested by Environmental Defenders Office NT, on behalf of Lock the Gate Alliance, to comment on the Interim Report of the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory (July 2017).
2. I, Dr Scott Paton Wilson, am an expert in the field of ecotoxicology with over 20 years' experience, specialising in water quality and impacts of inorganic and organic contaminants to aquatic species and their ecosystems.
3. The context of this report specialises in points relevant to the groundwater and surface water quality, alterations to these and potential biological and ecological effects. I do not provide comment on whether or not hydraulic fracturing (fracking) in the NT should proceed, but discuss issues that should be considered in any consideration of fracking in the NT.
4. I acknowledge that I have read and prepared the following report in accordance with the NT Supreme Court Practice Direction for Expert Reports and the Expert Witness Code of Conduct.



INTERIM REPORT

5. In my opinion the material presented in the Interim Report relating to water issues was on the whole covered in a fair and even manner.
6. The Panel succinctly highlighted the absence or gaps in information or data and recommended relevant further study or research, where appropriate.
7. In terms of the flowback and produced water, the Panel acknowledged the differences in chemical composition and the limited data available on these from shale gas extraction in Australia. Also raised was that part of the constituents of these waters are different from the fracturing fluids, likely to be either from the formation itself or are degraded or transformed products. Further to this the organic and inorganic constituents of these waters will vary from site to site. From a risk assessment perspective, these facts highlight a critical need for understanding and reporting the composition of these waters.
8. While publically reporting of the composition of the hydraulic fracturing fluid is mandated in the Northern Territory, the composition of the flowback and produced waters is not. These potentially more hazardous substances should also require, similar to that in the United Kingdom, full public disclosure.
9. In the UK, the Onshore Shale Gas Well Guidelines stipulate that operators disclose:
 - a. The estimated and actual volume of fluid to be recovered during flowback;
 - b. The expected rates, pressures and temperatures of fluid recovery and production;
 - c. Water compositional analysis;
 - d. Water mineralogical analysis;
 - e. Any identified contamination issues;



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- f. Any radioactive contaminated fluids;
 - g. The proposed method of handling the recovered fluids, including but not limited to, tank requirements, pipeline requirements, flaring, flow-back and storage periods, recycle and re-use for other activities;
 - h. Proposed disposal method of the recovered fluids up to the end location;
 - i. Proposed volume of flow-back fluids to be recycled and re-used; and
 - j. Regulatory approval and compliance records.
10. These measures should also be included in any requirements by operators of onshore shale gas developments in the NT.
11. In agreeance with the Panel, no untreated wastewater from the fracturing operations should be discharged to the surface or re-injected into aquifers. All wastewater should be stored and treated appropriately, and be designed to handle worst case scenario conditions. The suggested reduction of activities during the wet season should assist in this.
12. The Panel has acknowledged that it requires a range of further information to address knowledge gaps to better assess the water related risks of the onshore shale gas development in the NT. In particular, I see the need for strict protocols and wide-ranging baseline information, where not available, to be developed and/or collected. These processes are imperative before any informed decision-making can take place.

RESPONSE TO SCIENTIFIC INQUIRY INTO HYDRAULIC FRACTURING IN THE NORTHERN TERRITORY INTERIM REPORT

I was briefed by Environmental Defenders Office NT on behalf of Lock the Gate Alliance to provide scientific feedback on the Interim Report (Interim Report) of the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory. In particular I was asked to consider Chapter 8 (Land) and to address the following issues raised by the Interim Report:

- Consider scientific and community feedback on the key risks, their assessments and potential mitigation options as outlined in the Interim Report;
- Seek further advice on issues such as weed management in the NT, and extent of vegetation clearing required for roads and pipelines;
- Consider the need for bioregional assessment of the Beetaloo Sub-basin to obtain further information on the terrestrial ecosystem and biodiversity; and
- Refine recommendations for appropriate mitigation measures for each key risk that would be required for onshore unconventional shale gas development to proceed.

I also read Chapters 1-7 of the Interim Report for context, Chapter 14 (Regulatory Reform), Appendix 13 and have referred to the Petroleum Act and the Petroleum Environment Regulations. In preparing this report, I have cited relevant pages from my original submission where applicable (Bali 2017).

LACK OF PRECAUTIONARY APPROACH

I note that Chapter 7 (Water) clearly outlines the knowledge gaps and takes a precautionary approach by recommending, in some cases, that a 'case-by-case' approach be taken, that further information be sought or that no assessment be made until further information is obtained. The Panel also clearly stated that, although much of the literature reviewed pertained to the US experience, there were technological, geological, biophysical and regulatory differences from Australia.

In my opinion, Chapter 8 (Land) does not take a similarly precautionary approach, even though relevant information for Australian conditions is clearly missing. Most of the references cited in the review of key issues (pp. 64-65) are from the US. Just because "extensive scientific literature on the impacts of shale gas and other onshore oil and gas development on terrestrial biodiversity and ecosystem health" have been undertaken, this should not be interpreted to mean that we are able to predict with any certainty the potential impacts of shale gas development in Australia. From an ecological perspective, most of the shale gas development in the US has occurred in heavily forested environments inhabited by different suites of flora and fauna and therefore cannot be directly compared to semi-arid and arid landscapes and biota in Australia.

The Interim Report highlights major gaps in our knowledge. There is uncertainty about the growth and distribution of the shale gas industry in the NT as acknowledged in the Interim Report:

-current very limited understanding of the distribution of an economically viable shale gas resource, meaning that there is very high uncertainty over the location and scale of potential development. (p. 70)
- Industry forecasts are for low well pad densities but this is not certain given that the shale gas industry is at such an early stage of development in the NT.(p.66)
- The percentage of area cleared in development areas when well pads are spaced by 1 km, 3 km and 5 km are estimated at 13.1%, 2.6% and 1.3%. The Panel will seek further advice on well pad areas. (p. 68)

There is a paucity of data relating to the distribution of flora and fauna in the NT, also acknowledged in the Interim Report:

- The NT has never been systematically surveyed for plants or animals. (p. 62)
- The distributions of most species are known only in general terms at best, very limited knowledge of geographic patterns of diversity and endemism. (p. 62)
- Knowledge is particularly scant for terrestrial invertebrates...which may play critical roles in the functioning of ecosystems. (p. 62)
- Current information on species distributions and patterns of diversity and endemism are inadequate for making robust assessment of risks to biodiversity at the regional scale. (p. 70)
- Knowledge of the distributions of plant and vertebrate species, including threatened species, is sparse. Such information requires extensive field surveying, which is beyond the scope of this Inquiry.(p. 70)
- In neither case is the information currently adequate for effective regional-scale planning that minimises risks to biodiversity in prospective regions for shale gas development in the Northern Territory. (p. 66)

Given this level of uncertainty, I would have expected the Interim Report to take a more precautionary approach to risk assessment by deferring it until information becomes available, recommending a case-by-case assessment or raising the risk level (i.e. low to medium, medium to high) to accommodate uncertainty.

Importantly, the regulatory framework relating to the protection of flora and fauna is not robust and binding and there is no guarantee that it would be effective in enforcing any recommendations made by the Panel or in protecting ecosystems. The Interim Report states in the introduction to Chapter 14 (Regulatory Reform) that:

“The design and implementation of a robust regulatory framework is the principal way by which the Government can ensure that any onshore unconventional shale gas industry develops in a manner that protects the environment, is safe to humans, and is consistent with community expectations. There is, however, a real risk that the current regulatory framework in the Northern Territory may not achieve these objectives.”[emphasis mine]

With regard to terrestrial ecosystems, Chapter 8 lists the following regulatory issues:

- Industry policy is to avoid National Parks and other conservation reserves but such exclusion is not currently enshrined in legislation. (p. 69)
- There are current Northern Territory guidelines that define high value ‘no go’ zones, but these are not prescriptive (they are defined as ‘Areas of high ecological value – as determined through the Northern Territory’s robust environmental assessment process) and are guidelines only.
- There is no express statutory requirement for a weed management plan under the Petroleum Act supporting regulations.
- DPIR’s guidelines, which are not enshrined in legislation, require that a weed management plan must be part of an application to drill or hydraulically fracture.

Chapter 14 further outlines the deficiencies of the Petroleum Act, the Petroleum Environment Regulations and the Petroleum Schedule in protecting the environment, namely that:

- The Petroleum Schedule is not enforceable, does not necessarily promote the best practice and does not facilitate the development of new and effective ways to mitigate environmental risks. (p. 105)
- Guidelines on the operation and application of the Petroleum Environment Regulations have no enforceable legal effect. (p. 105)
- There remains uncertainty about what level of risk the Minister can, or should, consider to be “acceptable”. (p. 105)
- ...the Petroleum Act does not, of itself, expressly mention or operationalise the principles of ESD or the precautionary principle. (p. 107)
- National parks and reserves are currently not ‘no go zones’ which means these parks and reserves can be the subject of an application for an exploration permit unless it is also a ‘reserved block’. (p. 107)

Of particular importance to this discussion is the paucity of ‘no go zones’ in the NT (see Figure 14.4, Chapter 14) and the role of the regulatory framework in declaring future ‘no go zones’. ‘No go zones’ can be created as a result of:

- Exploration veto by traditional Aboriginal owners under the Land Rights Act;

- The land release process; and
- Declaration by the Minister that an area will not be subject to petroleum exploration (i.e. reserved blocks).

The land release process allows the government to strategically release land for exploration; land that is not released becomes a 'no go zone'. However, prior to the introduction of the new land release process in 2014, permit applications were submitted over 85% of the NT, including areas with high conservation and cultural values. The Panel is concerned that there are granted permits over areas that are clearly intended to be 'no go zones', that terms such as 'areas of high ecological value' are not defined or mapped, that the policy has no legislative force and that the Minister is not statutorily required to consider assessment criteria as part of the land release or grant processes.

From an ecological point of view, it is clear that the regulatory framework has prioritised the development of the shale gas industry, that existing 'no go zones' are woefully inadequate and that the process of declaring future 'no go zones' does not have regulatory certainty. This, together with substantial knowledge gaps regarding flora and fauna distributions over the NT and the under-representation of National Parks and conservation reserves in shale gas basins, warrants a precautionary approach be taken to risk assessment.

CUMULATIVE IMPACT ASSESSMENT MISSING

The Interim Report has named weed spread, changed fire regimes and predation by cats and foxes as primary drivers of biodiversity loss and species extinction:

- Weed invasion is a major driver of terrestrial biodiversity decline globally. (p. 64)
- ...the consequences of significantly altered fire regimes is high given the key importance of fire as a driver of vegetation dynamics and greenhouse gas emissions...(p. 68)
- The small mammal fauna has suffered severe depredations by feral animals, especially foxes and cats. (p. 62)

While assessing these as separate issues may simplify the process, it fails to take into account the interactions between them (see Bali 2017, p. 13-16), including:

- The interaction between recent burning and predation by cats;
- The interaction between grazing and fire on small mammal decline; and
- The interaction between invasive plants and high intensity fires on ecological communities.

In the case of fire, the Interim Report concludes that "the likelihood of significance in relation to biodiversity impacts is relatively low because the savannah biota generally has a high degree of resilience to moderate variation in

fire regimes.” However, the Panel does not consider the cumulative effects of predation, grazing, weeds and changed fire regimes on biodiversity, in particular small mammal population declines. Importantly, it does not consider the role of climate change in changing the frequency, intensity and distribution of fires in the future. The Interim Report appears to make its assessment based on past predicted climate trends and does not take into consideration the uncertainty of future catastrophic and unpredictable environmental events. A paper cited in the Interim Report (Souther *et al.* 2014) cautions that:

As cumulative impacts’ methodology and knowledge improve, research should move toward detecting synergies between shale development and other likely drivers of extinction, such as climate change, as site-specific or single variable risk assessments likely underestimate threats to ecological health.

Whereas climate change has been discussed in relation to greenhouse gas emissions in Chapter 9, there has been no obvious consideration of the interaction of climate change with other population stressors as a cumulative impact on terrestrial ecology. The emphasis throughout Chapter 8 is that only those areas covered by national parks, conservation reserves and/or areas of high conservation significance be set aside as ‘no go’ zones. At the same time, areas of high conservation significance are under-represented in shale basins but are included in areas presently covered by exploration licenses (Chapter 14). The Panel does not set out a clear framework to develop a network of ‘no go zones’. This approach is likely to lead to the creation of islands of habitat within a matrix of shale gas development, and is not consistent with a comprehensive and representative reserve network recommended to maintain resilience in the face of climate change (see Bali 2017, p. 20-25).

I am concerned that the Interim Report appears more reactive than proactive and that its approach is piecemeal rather than holistic. Examples are discussed below in this report. In particular, I note that the published literature often refers to the rapid development of unconventional gas fields, once approved. The opinion of eight eminent conservation biologists is that shale gas development “vastly outpaces scientific examination” and that environmental impacts associated with large-scale developments such as resource extraction, and more than the sum of their parts.¹

The Strategic Environmental Assessment (SEA) recommended by the Panel, means that there is only one chance to conduct a comprehensive biodiversity assessment pre-approval. If that is the case, then every effort should be made to ensure that bioregional surveys are as comprehensive, representative and wide-ranging as possible. As part of this process, a proactive approach should be taken to identify and protect a network ‘no go zones’.

¹<http://insider.si.edu/2014/08/biological-fallout-shale-gas-production-still-largely-unknown/>

In my opinion, the recommended mitigation measures (i.e. for weed spread and habitat loss and fragmentation) will do little to stem the tide of biodiversity loss and consequently will significantly impact ecosystem function. The *State of the Environment Report* (SOE) (Australia 2016) has clearly shown that accepted and best practice mitigation measures have not been successful in controlling pest plants and animals, the effects of altered fire regimes or the continuing decline in species due to habitat loss and fragmentation (Bali 2017).

I note that the Panel has approached impact assessment from the perspective of clearing associated with individual well pads, roads and pipelines and will be seeking more information about well pad areas and densities. I also note that published papers cited in the Interim Report caution against this localised approach to impact assessment when considering cumulative impacts that affect ecosystems at a landscape scale:

Most regulation of HVHFF has occurred at the level of the individual wellpad; however, to protect biodiversity and ecosystem services, it may be necessary to plan and regulate at the level of the whole Marcellus-Utica region (Kiviat 2013).

The few studies that consider cumulative impacts suggest that shale-gas development will affect ecosystems on a broad scale (Kiesecker et al. 2009; Jones and Pejchar 2013; Evans and Kiesecker 2014). For example, Evans and Kiesecker (2014) found that energy development – primarily from shale – in a large portion of the Marcellus Shale could result in the construction of >500,000 ha of impervious surface, leaving >400,000 ha of affected forest (Souther et al. 2014).

The comments below relate to particular sections within the Interim Report.

8.2 Key Issues Raised

In my opinion, the key issues or 'impacts' as described here do not follow the accepted and well-used ecological impact categories. While the data may have been collected under these headings as part of the community workshops, the Panel should have endeavoured to bring them into line with commonly accepted definitions to streamline risk assessment and facilitate comparisons with other studies.

For example, there is a vast literature examining biodiversity impacts at the landscape scale that state that it is impossible to separate the effects of habitat loss and fragmentation on biodiversity. It serves no practical purpose to separate vegetation clearing from habitat loss and fragmentation. All vegetation, even open fields, crops and lawns, have habitat values.

Similarly, it is illogical from an ecological perspective to separate 'habitat loss and fragmentation' and 'road and pipelines as ecological barriers and corridors'. Linear developments such as roads and pipelines cause fragmentation, isolation and degradation (through edge effects) of habitats. They also act as movement

barriers or population sinks (through loss or degradation of habitat, road mortality, noise and disturbance) and as vectors for pest plants, animals and pathogens. All of these factors act to cumulatively fragment, isolate and degrade habitats.

The Interim Report states that the spread of weeds:

- *"is especially an issue for shale gas development because it involves such extensive linear infrastructure in the form of pipelines and roads, which are primary sites of weed dispersal and establishment and act as corridors for the spread of weeds into new regions."*
- *"is also assessed as high because it historically occurs with extensive regional development, particularly associated with access corridors."*
[emphasis mine]

Weeds are a major cause of habitat loss and degradation and act cumulatively with altered fire regimes and grazing to exacerbate small mammal extinctions. Road and pipeline easements act as corridors for feral animals and weeds.

Road mortality can be classified under the headings 'increased human activity' and 'habitat loss and fragmentation'. As discussed above road mortality is inextricably linked to roads as barriers to movement. Roads will also open up vast areas to human disturbance.

It should also be noted that the literature review relating to 'vegetation clearing' and 'habitat loss and fragmentation' refers mainly to forested environments, including core and edge habitats. However edge effect distances can be expected to vary with vegetation structure and community type and geographic and local context; there is virtually no information available for edge effects in arid and semi-arid habitats in Australia.

Key issues that more accurately reflect ecological impacts (and mitigation) related to shale gas development are:

- Habitat loss and fragmentation (incorporating vegetation clearing, roads and pipelines as ecological barriers and road kills);
- Spread of weeds;
- Drinking of wastewater by wildlife;
- Noise, light and increased human disturbance.

8.3 Preliminary Assessment

As an introduction to this section, it should be noted that the Inquiry's Terms of Reference require the Panel to determine:

- *"the level of environmental impact and risk that would be considered acceptable in the Northern Territory context"; and that*

- "...the level of risk is deemed to be "acceptable" must always be a level that is consistent with the principles of ESD, which includes the precautionary principle".[emphasis mine]

The preliminary assessment utilises a risk assessment matrix categorising both risks and consequences of the impact occurring as high, medium or low (Appendix 13, Interim Report).

Although this is the preferred risk assessment used by the mining and oil and gas industries, I do not agree that it incorporates sufficient transparency or objectivity into the assessment process. The risk assessment matrix was first developed in order to investigate the effects of the release of particular chemical pollutants into the 'receiving environment', but has been broadened to consider most environmental impacts.

The categories low, medium and high are highly simplified and do not indicate the continuum of possible outcomes (e.g. low-medium vs high-medium). It is not scientifically useful to shoehorn complex ecological functioning into this type of rigid framework, especially when we lack the knowledge to predict ecological outcomes. This makes the risk assessment process very subjective and open to interpretation (Cox 2008).

A summary of the Interim Report risk assessment results are shown in Table 1.

Based on my understanding of the scientific literature and my experience assessing environmental impacts, I disagree with the Panel's decision that impacts on wildlife related to *"...noise, light, increased human activity, roads and pipelines as barriers and corridors for fauna movement, and the drinking of wastewater, represent low risks without a need for mitigation."*[emphasis mine]

This conclusion is not supported by statements made throughout Chapter 8 or by references cited.

Low risk is defined as minor, short-term damage to an area of limited significance but not affecting ecosystem functions. Ecosystem function is broadly defined as energy flow between trophic levels and includes processes such as photosynthesis and decomposition and interactions amongst different levels of biota including predation, parasitism and grazing. Loss of biodiversity or severe habitat fragmentation can result in loss of ecosystem function through 'homogenisation' of habitats, increased predation pressure and/or reduced resilience of populations to environmental perturbations. The evidence shows that "both the magnitude and stability of ecosystem functioning are likely to be significantly altered by declines in local biodiversity" (Naeem *et al.* 1999, Hooper *et al.* 2005). At its worst, this may lead to 'cascading effects' where interrelationships between key variables change fundamentally and irreversibly.

TABLE 1: Summary of risk assessment matrix for terrestrial ecology as per Panel’s Interim Report

IMPACT	PRE-MITIGATION RISK	MITIGATION RECOMMENDED
Noise and light	Low impact	None
Increased human activity	Low impact	None
Road/pipelines as barriers/corridors	Low impact	None
Drinking of wastewater	Low impact	None
Landscape amenity	Consequence: High Likelihood: Medium	Clearly defined and legislatively enshrined ‘no go’ zones; specification of a minimum acceptable well pad spacing/density
Inappropriate development due to inadequate knowledge of biodiversity	Consequence: High Likelihood: High	Exclusion from conservation reserves and sites of conservation significance (possible), Strategic Environmental Assessment (EPBC Act 1999)
Weed spread	Consequence: High Likelihood: High	Weed management plans; further information required
Changed fire regimes	Consequence: High Likelihood: Medium (low for biodiversity and high for greenhouse gas emissions)	Regional baselines for fire regimes established 10 years prior; annual fire mapping; ongoing mitigation through early season burning or fire control; fire management partnerships
Habitat loss and fragmentation Likelihood of significant impacts	Consequence: Medium(at regional scale) Likelihood: Medium (at a regional scale)	Minimisation of clearing; rehabilitation; offsetting
Inappropriate location of infrastructure	Consequence: Medium Likelihood: Medium	Avoid sensitive areas
Chemical spills	Consequence: Low Likelihood: Medium	See Chapter 7

In my opinion, it is unjustifiable and irresponsible to recommend that mitigation measures are not required. These should always be applicable regardless of the risk level, especially when they are readily available, well-used and reasonably effective. This is consistent with a precautionary and best practice approach.

Each of these potential impacts is discussed separately below.

Roads and pipelines as barriers and corridors

I do not agree that 'roads and pipelines as ecological barriers and corridors' can be considered 'low' when referring to water flow and fauna pests but 'high' when assessed in relation to weed spread or 'medium' when considered as part of 'habitat loss and fragmentation'.

There is no scientific basis to conclude that barriers that can disrupt "important ecological processes, especially those involved in the flow of water" or the "smaller scale run-off/run-on dynamics that are particularly important in semi-arid landscapes" be assessed as 'low' risk and not requiring mitigation.

Furthermore, the Interim Report recognises predation by cats and foxes as a primary driver of small mammal extinction in the NT:

- The small mammal fauna has suffered severe depredations by feral animals, especially foxes and cats. (p. 62)
- Species from the northern higher rainfall zone have undergone recent population crashes, likely due to predation by cats, exacerbated by removal of shelter due to fire and high levels of grazing. (p. 62)
- Roads and pipelines can act as corridors to facilitate movement and hunting by predators (with cascading effects on their prey). (p. 64)

Cascading effects would be expected to have a significant long-term impact on ecosystems and equate to 'serious environmental harm'.

Bali (2017, p. 12-14; Table 1) discussed the role of pest species in the decline of small mammals in the NT. In the Sturt Plateau bioregion, cats are widespread, foxes are gradually increasing and cane toads are recently established. Each of these fauna pest species uses roads and easements as movement corridors and is implicated in declining populations of threatened fauna species. There are at least 4 threatened small mammal species at risk of further declines in the Beetaloo Sub-basin due to increased predation pressure.

As discussed above, it is my opinion that 'roads and pipelines as ecological barriers and corridors' should not subject to a separate risk assessment, but should instead be considered under the broader heading of 'habitat loss and fragmentation' (see below).

Noise, light and increased human activity

The Interim Report states that “pipeline compressor stations are a long-term source of increased noise” and that:

“Chronic noise can influence wildlife in many ways, with animals relying on vocal communication such as birds being especially affected.” (p. 65)

It cites references describing long-term effects of compressor noise on passerine species breeding success (Bayne *et al.* 2008; Francis *et al.* 2011, Thomas *et al.* 2014). Francis and Barber (2013) caution that ‘habituation’ to noise can still be associated with a decrease in fitness. Furthermore, all these authors have recommended mitigation measures be applied in order to reduce impacts.

Another paper cited by the Panel (Brittingham *et al.* 2014) cautioned that:

“Because chronic noise has been shown to have numerous costs to wildlife, compressors have potential to have long-term effects on habitat quality.”[emphasis mine]

Anthropogenic disturbance is a major cause of worldwide declines in biodiversity (Stone *et al.* 2009). This includes noise, light and other human disturbance. The studies cited in the Interim Report provide evidence that chronic noise can significantly impair breeding success, lower fitness and have long-term impacts on habitat quality. These indices are generally thought to be indicators of population health and should not be considered as causing “minor, short-term damage of limited significance”.

Importantly, these authors recommend mitigation to reduce the effects of noise near compressor stations. In light of the existence of appropriate and effective mitigation measures, I can think of no practical or scientific reasons why the Panel would recommend that no mitigation be applied. In my opinion, the risk of this impact may be low if mitigation is applied.

The Interim Report notes that light can affect wildlife through “direct mortality and through changes in foraging behaviour and success”. There is evidence to show that light pollution can cause habitat fragmentation by preventing fauna from accessing suitable habitat, especially in the case of bats (in Moore *et al.* 2014). While the Interim Report did not cite any papers regarding light impacts associated with shale gas development, any reasonably effective mitigation measures that reduce light pollution should be implemented (Gaston *et al.* 2012).

Increased human activity is inseparable from other impacts related to increase accessibility such as noise, lighting, traffic, rubbish, increased fire (deliberate and accidental) and the spread of weeds and feral animals. As pointed out in

the Interim Report, it is also intricately associated with the NT's remote and inaccessible landscapes:

"New roads will increase access to, and therefore disturbance of surrounding areas. The latter is especially important for the Northern Territory's remote and 'wild' landscapes, many areas of which are currently inaccessible to most people." (p. 65)

In order to protect these values, it will be necessary to apply mitigation measures wherever possible (i.e. to control traffic, to minimise the spread of weeds and predators, to reduce noise and light, etc.).

It is overly simplistic to describe the impacts of human activity as road mortality. In fact, road mortality should be considered together with 'habitat loss and fragmentation' (i.e. roads come before traffic).

Drinking of wastewater by wildlife

I agree that the risk of chemical spills and poisoning may be low, but mitigation should still be required. Although mitigation is likely to be applied through stringent industry measures applied to avoid spills, leaks and overflows of chemicals or polluted water, it should also be necessary that all practical measures are undertaken to ensure that fauna do not have ready access to wastewater. For example, ACOLA (2013) recommends exclusion fencing around containment ponds, exclusion netting above the surface of dams and absence of lighting around ponds that might attract insectivorous fauna species.

8.3.1 Landscape Amenity

While I understand the amenity value of the "largely undeveloped" nature of NT landscapes (wilderness value) to the community, it is my opinion that the Panel has chosen to assess this from an anthropocentric viewpoint rather than a scientific one:

- Impacts on landscape amenity values are directly related to the density and visibility of well pads and associated infrastructure. (p. 66)
- In well-forested (higher rainfall) country, well pads would not be visible from the ground beyond 100 m or so, whereas in open (low rainfall areas), they would be visible from several hundred metres. (p. 66)

The Panel then describes what a gas field might look like from a high vantage point or a plane. I would suggest that, while human perception is important, it is more critical from a scientific point of view to ensure that the affected ecosystems continue to function and thrive at the landscape scale, firstly by ensuring that sufficiently large and resilient 'no go' zones are provided and protected and possibly by enforcing a minimum acceptable well pad spacing density to limit habitat loss and fragmentation. These measures will also act

concurrently to maintain iconic wilderness values. I should emphasize that well pad spacing and density should take ecological criteria into primary consideration.

While I agree that there is a need for “clearly defined and legislatively enshrined ‘no go’ zones with defined minimum offset distances around such areas”, my submission (p. 22-25) outlined the references and reasoning why these should not be confined to national parks, conservation reserves and recognised areas of high ecological value. A major reason for this, as stated in the Interim Report, is that the majority of national parks and other protected areas lie outside shale basins.

Moreover Eco Logical (2013) noted that:

- A rich biota of native plants and animals occurs in the shale gas region, including many endemics and threatened species, and various threatened ecological communities;
- Biodiversity and ecosystem value in shale gas regions are not well represented in formal conservation reserves (e.g. National Parks)

I also note that the restrictions in regard to the avoidance of National Parks and conservation reserves are not enshrined in legislation and that the guidelines defining high value ‘no go’ zones are not prescriptive.

Although it is reasonable for the Panel to recommend that all current parks, reserves and areas of high ecological value are legislatively protected from gas development, this should only be considered as a first step towards the development of a comprehensive and representative network of reserves supporting a diversity of fauna species and vegetation communities throughout the NT. This would provide more resilience in the face of increased industrial development and climate change. It could be developed to connect areas of iconic outback landscapes, thus preserving landscape amenity over much of the NT.

Secondly, it is important that ‘no go’ zones be identified and protected in shale gas regions. This requires a proactive approach; if the Panel is not able to take a proactive approach as indicated in Chapter 14 of the Interim Report, then it should take a more precautionary approach in assessing risks.

In my opinion, it is unclear whether the Panel can confidently predict that ecosystems in shale gas regions will be protected in the long-term solely through setting minimum acceptable well pad spacing/densities and making existing parks and reserves into ‘no go zones’.

8.3.2 Inappropriate planning of regional development due to inadequate knowledge of biodiversity assets

I agree with the Panel that the consequences of biodiversity impacts due to inadequate knowledge of biodiversity are high and that region-wide ecological data is lacking.

In my opinion, the Panel should not hesitate to recommend that shale gas development should be excluded from all current conservation reserves and sites of conservation significance as a first step towards developing a 'no go zone' network. I agree that these may not be representative of broader regional biodiversity values, but nevertheless they are recognised as having outstanding ecological, cultural, scenic, historic and/or natural heritage values and are therefore worthy of protection from industrial development in the long-term.

The Panel is of the opinion that the implementation of the findings of a strategic basin-wide assessment of biodiversity values conducted prior to development would mitigate the high risk of proceeding with shale gas development without adequate knowledge of biodiversity. It argues that this is most widely recognised method for limiting the impacts of regional development on biodiversity and provides "a clear planning framework for development that gives certainty to both industry and communities, and achieves better environmental outcomes by addressing cumulative impacts."

I would argue that, based on reviews of the current SEA process (Marsden 2013, Pope and Moore 2013), this method may expedite industry approval but does not necessarily achieve better environmental outcomes or address cumulative impacts. This is of concern as the Panel argues in Chapter 8 that strategic assessment would achieve better environmental outcomes by "addressing cumulative impacts". Cumulative risks are also discussed in Chapter 14 (Section 14.4.7).

Both Marsden (2013) and Pope and Moore (2013) were conducted in wake of recommendations from the Hawke Report (2009) that highlighted the strengths and weaknesses of planning and assessment methods applied to achieve biodiversity conservation at the landscape scale. Relevant criticisms of the SEA process include:

- It is discretionary and lacks detailed procedures;
- It fails to adequately manage cumulative impacts of actions or threatening processes (including climate change) at a landscape or ecosystem scale; and
- It considers only MNES and fails to include 'ecosystems of national significance' and 'vulnerable ecological communities'.

Marsden (2013) recommends that the SEA could be strengthened by specifying mandatory requirements, inserting an 'improve or maintain' test, enhancing provision for community engagement and implementing a 'call in' power for plans, policies and programs likely to have a significant impact on MNES.

However, he did not feel that the current government had the will to implement these changes:

"If anything, the likelihood is for significant amendment to environmental assessment and approvals processes to satisfy the hunger for expedited resource extraction, particularly in Queensland. For whatever reason, the delay is a failure of national environmental governance and suggests Australia remains tied to reactive responses to planning and management, as emphasised starkly by the approach to the GBRWHA. Much more needs to be done to ensure that the precautionary approach is better factored into strategic assessment and approvals processes prior to the planning of and certainly the commencement of development."[emphasis mine]

Pope and Moore (2013) compare and contrast strategic assessment and bioregional planning as landscape-scale approaches to biodiversity conservation. The authors argue that strategic assessment is "to ensure the protection of biodiversity values in the face of planned action of some kind" (i.e. reactive) whereas bioregional planning is to "proactively establish a framework for biodiversity management into the future, whether or not development of the type that might threaten biodiversity is conceived" (i.e. proactive). They list the weaknesses of the SEA process as being:

- Reactive to development planning and limited to consideration of development objectives and MNES;
- The need for enforceable planning outcomes possibly conflicting with the principles of adaptive management; and
- Focussed on protecting land with biodiversity values from development impacts but not seeking to support underpinning ecological processes.

The authors recommend that a combination of strategic planning and bioregional planning has the capability to provide biodiversity conservation and development outcomes, as well as a comprehensive sustainability-focused management framework for the region by:

- Defining spatial scales that reflect ecological, social and governance boundaries;
- Taking a holistic approach based on understanding key interactions within the sociological system and considering all identified drivers for system change;
- Ensuring meaningful community and stakeholder participation in both development of the plan and its implementation;
- Delivering planning outcomes in the form of zoning and protection of sensitive areas, as well as land management outcomes; and
- Ensuring robust monitoring, reporting and reviewing mechanisms.

I have previously outlined my concerns about relying on assessments that consider only MNES species (Bali 2017, p. 18-19). Garnett (2013) has also pointed out the problems of current lists of MNES, 85% of which are unchanged from the time the EPBC Act was introduced in 1999. Amendments to the EPBC Act in 2006 do not require the list to be updated regularly. Garnett cautions that while many species worthy of listing are not included as MNES, the presence of others that should not be there, undermines the credibility and legitimacy of the EPBC Act. The Hawke recommendations (2009) to take an 'ecosystems approach' to strategic assessment, by including 'ecosystems of national significance' and 'vulnerable ecological communities' to MNES, have not been implemented.

Whereas Marsden (2013) states that state legislation may also apply to strategic assessments, it is not clear when/how this happens. However, it states on page 116 of the Interim Report that the EPA (that is responsible for applying the NT's environmental assessment legislation), is currently of the view that the environmental impacts associated with hydraulic fracturing will not have a significant environmental impact.

I note also that the Northern Territory state environmental legislation takes a very narrow view of biodiversity impacts. Assessment of the 620-km Jemena pipeline easement that would result in the clearing of 2470 ha of habitat considered only sensitive vegetation types and 'important populations' of threatened fauna. This led to a situation where consideration of impacts on biodiversity was reduced to one species, the Plains Death Adder. A similarly narrow approach to shale gas basin assessment would, in my opinion, be likely to result in significant environmental impacts at a landscape scale.

For these reasons, it is my opinion that the implementation of a basin-wide strategic assessment would not, on its own, adequately mitigate the risk due to inadequate knowledge of biodiversity assets. However bioregional assessment, the creation of a comprehensive network of 'no go zones' and significant regulatory reform, would together act to mitigate this risk.

8.3.3 Spread of weeds

As outlined in Section 8.3 above, the role of roads and easements in the spread of weeds cannot be separated from other effects (e.g. fragmentation, edge effects, road mortality, human access, etc.). Furthermore, it is an oversimplification to consider the spread of weeds as an isolated impact when it has cumulative impacts with fire, grazing and predation. These factors are already important drivers of biodiversity loss in the NT and any shale gas development will exacerbate existing effects.

I agree with the Panel that there is a need for "increased clarity around the regulation, compliance and enforcement of comprehensive weed management

plans". However I would caution that the key elements of such plans, namely baseline assessment, prevention of weed spread and weed monitoring and management, are nothing new when it comes to weed management protocols for developments across Australia. However, as the Australia SOE reported in 2016, despite these protocols being applied, data on the distribution and abundance of pest plants and animals is lacking and management effectiveness is poor. To suggest that these protocols will work in the case of shale gas development is optimistic because:

- There is a paucity of baseline ecological data is of concern in the NT (Australia SOE 2016; Bali 2017, p. 19);
- The current regulatory framework is seriously lacking (Chapter 14, Interim Report);
- There are issues surrounding resource availability and the vast and remote areas that would need to be surveyed/monitored (Chapter 14).

While the Panel suggests that "industry would be in a position to take responsibility" for unavoidable weed infestations arising from newly created corridors and increased public accessibility, the community is rightfully sceptical, based on past experience, about whether this would actually happen. The Interim Report cautions that "the requirement for an Environmental Rehabilitation Security to be in place and the criteria used to assess its acceptability does not appear to be statutory."

The appointment of a "wholly independent competent and well resourced regulator to enforce compliance" (p. 113-4) would go a long way towards restoring the community's confidence (including the scientific community) when it comes to enforcing statutory duties, including monitoring and rehabilitation plans.

Based on past experience, despite 'best practice' weed control/monitoring protocols being implemented, the risk of weed spread as a result of shale gas development should remain high.

8.3.4 Changed fire regimes

The Panel has taken the view that, although the consequences of significantly altered fire regimes are high, the likelihood of this occurring as a result of shale gas development, is medium. This conclusion appears to assume that:

- Fire can be considered as an impact in isolation of other factors (i.e. weeds, predation, climate change);
- Similar climatic conditions and fire regimes will persist into the future;
- There is a high degree of resilience of savannah biota to fire.

This is despite the fact that "increased fire frequency and extent" due to increased human activity is "highly likely to result in increased ignitions".

However, the Panel does not appear to have considered the complex interactions between fire, grazing and predation that are likely to be a major driver of small mammal extinctions in the NT. If shale gas development results in the spread of weeds, especially introduced grasses, into remote areas, the risk of catastrophic high-intensity burns is likely to increase. These are implicated in the decline of regional biodiversity in the NT (Anderson *et al.* 2012; Woinarski *et al.* 2009). In addition, the effects of climate change can be expected to change the frequency, intensity and distribution of fires in the future (Williams *et al.* 2009; Liedloff *et al.* 2012). We can expect that, if approved, shale gas development will continue over many decades and we are just starting to feel the effects of climate change.

For these reasons, a precautionary approach should be taken. Based on our lack of knowledge and the pivotal role of fire as a driver of biodiversity loss in the NT, the likelihood of significant alterations to fire regimes should be assessed as unknown (i.e. subject to further information becoming available).

8.3.5 Habitat loss and fragmentation

There is a wealth of scientific literature that point to habitat loss and fragmentation as the primary drivers of biodiversity loss and ecosystem degradation. This is supported in the major review papers quoted in the Interim Report (Kiviat 2013, Brittingham *et al.* 2014; Souther *et al.* 2014).

Habitat loss and fragmentation associated with shale gas development are likely to have ecological impacts at a landscape scale. Although the Interim Report attempts to separate the effects of vegetation clearing from those related to fragmentation, this is not practical or realistic from an ecological perspective. While the Panel states that development would require 'substantial clearing', the CSG industry regularly argues that the actual area cleared is a very small proportion of the total development area.

It is likely that the area cleared, together with the configuration of roads and pipelines (i.e. as estimated by well pad densities over say 2,500 km²), will have cumulative impacts on biodiversity. Although the Interim Report states that, in addition to direct effects, "such clearing would have especially pervasive edge and other fragmentation effects", it does not attempt to quantify or qualify these. I would therefore strongly suggest that the key issue 'roads and pipelines as barriers and corridors' be considered as an integral part of 'habitat loss and fragmentation'.

In my opinion, the Panel does not have sufficient information to conclude that the consequences and the likelihood of habitat loss and fragmentation on biodiversity and ecological function at the regional scale are medium. I note that this is the only risk that is assessed specifically at the regional scale (i.e. compared to weed spread, fire regimes, etc.).

Medium risk is defined as “moderate effect on biological and physical environment with significant short-term effect on ecosystem functions”. I do not believe that the Panel has adequate information to make this assessment because habitat loss and fragmentation are key drivers of biodiversity loss. Furthermore, information included in the Interim Report does not support this finding:

- Section 8.3.2 states that there is a “lack of region-wide information on spatial patterns of biodiversity”;
- Section 8.3.1 states that well pad densities are unknown “at such an early stage of development in the Northern Territory”;
- Section 8.3.1 and Chapter 14 state that there is a “real risk that the current regulatory framework in the Northern Territory may not achieve these objectives” (i.e. environmental protection);
- Section 8.4 states: “Current information on species distributions and patterns of diversity and endemism are inadequate for making robust assessment of risks to biodiversity at the regional scale”;
- Section 8.4 states: “Knowledge of the distributions of plant and vertebrate species, including threatened species, is sparse. Such information requires extensive field surveying, which is beyond the scope of this Inquiry”; and
- Section 8.1.1 states: “In neither case is the information currently adequate for effective regional-scale planning that minimises risks to biodiversity in prospective regions for shale gas development in the Northern Territory”.

Given these acknowledged data gaps, in my opinion the Panel cannot assess the risk of habitat loss and fragmentation to be ‘medium’.

A regional approach to risk assessment is problematic from a landscape conservation point of view. For example, if the Beetaloo Sub-basin (covering the Sturt Plateau bioregion) is deemed to have only medium effects based on little or no data, what precedent will this set for risk assessment of other adjacent bioregions? It is essential that results from one bioregional assessment are not extrapolated to other bioregions. By assessing each bioregion in isolation, without regard to adjacent bioregions or to ecosystems at a landscape scale, there is a real risk that this could result in wholesale development of vast areas without regard to conservation planning.

A holistic approach is warranted prior to approval of shale gas development that could cover thousands of square kilometres and proceed at a rapid pace. As 85% of the NT is covered by shale gas by permit applications or exploration licences (including areas of high conservation significance), there will be little or no opportunity to revisit bioregional assessments. As discussed above, because strategic environmental assessments (SEAs) in Australia replace individual

environmental impact assessments (EIAs), there is only one chance to gather accurate and representative biodiversity data.

As for other key issues, the Panel appears to have considered habitat loss and fragmentation in isolation without recognition of its cumulative interactions with changed fire regimes, grazing, weed spread and importantly, climate change. Fragmentation can reduce dispersal, foraging and mating success, thereby increasing a species' risk of extinction (Souther *et al.* 2014), thereby potentially affecting ecosystem function. It can create significant barriers across corridors which may be crucial in maintaining the resilience of populations exposed to climate change. Together with cumulative impacts, this may result in medium and long-term impacts on species (i.e. high risk).

Where possible the Panel has chosen to consider the impacts of habitat loss separately to fragmentation (Section 8.2, 8.3.5) which is not practicable or realistic from an ecological perspective. For example, habitat loss was estimated on the basis of a range of well pad densities ranging from 1 well pad per 1 km², 9 km² and 25 km². This represents a very broad range of densities that may range from high (i.e. 1 well pad/km²) to low-medium (i.e. 1 well pad/25 km²).

Mitigation measures recommended are nothing new and have had very little success in halting or even slowing biodiversity loss Australia-wide (Australia SOE 2016).

In my opinion, another risk is that NT will follow the path of NSW where less and less effort is spent minimising and/or mitigating impacts. Rather emphasis is placed on offsetting on the basis that it is simpler, faster, and less expensive for developers and may simply take the form of a cash payment in lieu of compensatory habitat or, in the case of mining, considering rehabilitation as an offset. Most of the offsetting protocols do not even require like-for-like replacement which means that cleared vegetation communities are not replaced. This would be of concern for shale basins where biodiversity values are not well-represented in the current reserve system. Furthermore, there is no evidence that offset schemes have improved or maintained biodiversity in the states or nationally, within Australia or overseas.

While the EPBC Offsets Scheme is more robust than many of the statewide schemes, it applies only to MNES species. The calculation of suitable offsets that "must be of a size and scale proportionate to the residual impacts on the protected matter" is not likely to take into account ecosystem function at a landscape scale, and is more likely to provide isolated refuges in a sea of development/agriculture.

Moreover, while mitigation measures recommended (i.e. minimising clearing, rehabilitation, offsetting) may go some way towards reducing habitat loss, they will do little to mitigate the impacts of fragmentation. Fragmentation is considered a primary threat to global biodiversity (Franklin *et al.* 2002).

Furthermore it typically occurs at “rates dramatically faster than long-lived organisms are capable of adapting, thus disrupting life history cycles and ecological processes” (Duchamp and Swihart 2008). Half of all species listed on the EPBC Act are considered to be at risk from fragmentation (Australia SOE 2016). Most of the National Parks and conservation reserves are located outside shale basins. Without the implementation of ‘no go’ areas pre-approval, there is the real risk that these vast areas will be carved up in their entirety.

In my opinion, due to the lack of available data and ineffective mitigation, the Panel should take a precautionary approach by lifting the risk (of consequences and likelihood) to high or unknown (i.e. subject to further data being collected). Furthermore, I strongly suggest that, if the Panel recommends proceeding with strategic bioregional assessments and/or bioregional surveys, that all of these be completed prior to exploration licenses being granted. I understand that this may be dependent on significant regulatory reform, but believe that it is essential to achieving long-term conservation goals.

Section 8.3.6 Inappropriate location of infrastructure within a development area

I agree with the Panel that the consequences and likelihood of inappropriate location of infrastructure within a development area is ‘medium’ due to the high level of flexibility for infrastructure location. However, I would stipulate that we should not rely on ‘industry practice’ to protect sensitive and culturally important sites but that this conduct should be enshrined in legislation and that these sites should be declared ‘no go zones’.

Section 8.3.7 Chemical spills

I agree with the Panel that the likelihood of significant wildlife poisoning and/or soil contamination from chemical spills is ‘medium’. I find it very unconvincing that a very localised and relatively uncommon ‘event’ like a chemical spill would be given the same risk level as habitat loss and fragmentation over thousands of km² of what is currently largely contiguous native vegetation.

CONCLUSION

As stated on page 1 of the Interim Report, the purpose of the Inquiry is to, “based on the most current and best available scientific data and literature, assess the environmental, social, cultural and economic risks associated with hydraulic fracturing for shale gas in the Northern Territory”.

My understanding of the Panel’s findings in relation to terrestrial ecology is that, even though there have been scientific studies on shale gas impacts undertaken in the northern hemisphere, there are significant knowledge gaps regarding the distribution of flora and fauna in the NT and the potential development of the shale gas industry in Australia. Given these uncertainties, it is my opinion that the Panel has not applied a sufficiently precautionary approach in assessing risks.

No scientific evidence has been provided to support the conclusion that noise, light, roads and pipelines as barriers and corridors and the drinking of wastewater represent low risks without the need for mitigation. In fact, Section 8.2 describes some significant ecological risks and the scientific papers cited in this section recommend mitigation in order to minimise medium- to long-term impacts associated with shale gas development. In my opinion it is highly unusual to have a situation where mitigation measures are specifically not recommended, especially where these are readily available, routinely applied and reasonably effective.

Based on the scientific evidence available, I agree with the Panel that the consequences of impacts to landscape amenity, inappropriate development due to inadequate knowledge of biodiversity, the spread of weeds and changed fire regimes as a result of shale gas development are high. However the Panel has assessed the likelihood of significant impacts to landscape amenity as being medium, provided that 'no go zones' are implemented and minimum acceptable well pad spacing/densities are specified. In my opinion, this risk rating does not take a precautionary approach.

Even if existing National Parks, conservation reserves and areas of high ecological significance are declared as 'no go zones', this represents only a very small proportion of the NT's landscape amenity values. Given that 85% of the NT is covered in permit applications or exploration leases and that the current regulatory framework has significant weaknesses, there is no guarantee that iconic outback landscapes will be protected from over-industrialisation once development is approved. Furthermore, based on industry submissions, density forecasts for well pads vary widely at this stage. I would suggest that, in order to protect ecosystem function and landscape amenity, the minimum well pad spacing/density should have ecological criteria as a major consideration. Based on these uncertainties, the risk of impacts to landscape amenity should be assessed as unknown pending further information becoming available or the establishment of a comprehensive and representative network of 'no go zones' prior to development approval.

The Panel assessed the likelihood of shale gas development significantly altering fire regimes as being medium, even though increased human activity is highly likely to result in increased ignitions. In my opinion, it has failed to adequately consider the scientific evidence relating to the cumulative effects of fire, grazing, weed spread and predation that has been implicated in the decline of biodiversity throughout the NT. I am particularly concerned that the risk assessment does not appear to have taken into account expected changes to the frequency, intensity and distribution of fires as a result of climate change or increases in the frequency and extent of high-intensity fires related to the ignition of introduced grasses. On the basis of available information, the risk level should be assessed as unknown.

Of most concern to me is the Panel's assessment that the risk associated with the likelihood of habitat loss and fragmentation for biodiversity and ecosystem function, due to shale gas development at the regional scale, is medium. This is not supported by the scientific literature that overwhelmingly cites habitat loss and fragmentation as a primary driver of biodiversity loss and ecosystem degradation around the world. The consequences of habitat loss and fragmentation due to shale gas development should therefore be assessed as high.

Given the uncertainties relating to NT biodiversity and potential well pad spacing/densities, together with the weaknesses of the existing regulatory framework, it is my opinion that it is not currently possible to predict the likelihood of significant impacts at the regional or landscape levels. The mitigation measures recommended (i.e. minimising clearing, rehabilitation, offsetting) have had little or no success in slowing or halting biodiversity decline in Australia. Although they may mitigate habitat loss to some extent, they would have a negligible effect on fragmentation impacts associated with linear infrastructure. The SEA process recommended by the Panel has serious limitations in that it only considers MNES, fails to assess cumulative impacts at a landscape level and precludes future EIAs.

Given acknowledged data gaps, the likelihood of habitat loss and fragmentation resulting in significant impacts on biodiversity and ecosystem function should be assessed as unknown pending further information becoming available, or the establishment of a comprehensive and representative network of 'no go zones' prior to development approval.

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