LOCK THE GATE **ALLIANCE**

AUSTRALIANS WORKING TOGETHER TO PROTECT OUR LAND, WATER, AND FUTURE

Submission to the Standing Committee on the Environment and Public Affairs Inquiry into the Implications for Western Australia of Hydraulic Fracturing for Unconventional gas.

Lock the Gate Alliance is a national grassroots organisation made up of thousands of individuals and over 160 local groups who are concerned about inappropriate mining. The mission of the Lock the Gate Alliance is to protect Australia's natural, environmental, cultural and agricultural resources from inappropriate mining and to educate and empower all Australians to demand sustainable solutions to food and energy production. Lock the Gate Alliance is committed to advocating that environmental health, community health, local industry health and individual health should take priority over the development of an unconventional gas industry in Australia.

Lock the Gate Alliance welcomes the opportunity to make a submission to this Inquiry. However, the Alliance notes that the designated Terms of Reference for the Inquiry fall a long way short of a thorough investigation into the range of issues surrounding the unconventional gas industry in general and the process of hydraulic fracturing in particular. The Terms of Reference of this Inquiry should be broadened so as to include a thorough investigation of the full range of risks inherent in the hydraulic fracturing process including:

- Risks of contamination and depletion of ground and surface water resources
- Risks to human health from hazardous air pollutants and water contamination
- Social impacts of gas field development
- Impacts on biodiversity and natural areas
- Lack of existing baseline data by which to measure impacts
- Cumulative impacts of gas field development

After two and a half decades of rapid development and large-scale expansion in the unconventional industry (UG) in the United States, there is a now a growing body of literature worldwide on the negative impacts of the processes and practices involved in the exploration and production of unconventional gas, particularly the process of hydraulic fracturing (fracking). The Australian Council of Learned Academies[1] notes: "Because of the manner in which shale gas is produced it has the potential to impact on the landscape, on ecosystems, on surface and groundwater, on the atmosphere, on communities, and rarely may result in minor induced seismicity." A number of comprehensive investigative reports by various European authorities and expert bodies also identify and document a wide range of issues with UG development and fracking that present a high risk for people and the environment. These studies include:

[1] Engineering Energy: Unconventional Gas Production, ACOLA

1. *Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe, European Commission: DG Environment (August 2012).*[2]

2. *Hydrofracking Risk Assessment, Study concerning the safety and environmental compatibility of hydrofracking for natural gas production from unconventional reservoirs, Panel of experts.*[3]

3. Impacts of Shale Gas and Shale Oil on the Environment and Human Health, Directorate General for the Internal Policies, Policy Department: Economic and Scientific Policy, European Parliament. [4]

Given the range and number of risks identified in these and other reports, Lock the Gate recommends that the WA Parliament instigate a comprehensive, rigorous and independent scientific investigation of the potential impacts of UG development on the land, water and communities of Western Australia. These studies should include impacts on health, water resources, land use, air quality and fugitive emissions. Further to this, the Alliance strongly urges the parliament of Western Australia to implement a moratorium on the expansion of this industry until such time as this scientific investigation is undertaken and the risks are fully quantified and a proper risk based assessment is undertaken in deciding whether the industry should proceed, and if so, in what areas. The Alliance also recommends that the WA government implement standards for mandatory baseline monitoring of health impacts, water resources, air quality, soil quality and fugitive emissions prior to any further development of the UG industry in the state.

Terms of Reference:

a) how hydraulic fracturing may impact on current and future uses of land;

Lock the Gate Alliance maintains that hydraulic fracturing, and more broadly, UG extraction, has a range of negative impacts on current and future land uses. UG development requires very large - often tens of thousands- numbers of clustered multi-well pads, plus connecting roads and pipelines as well as additional gas processing infrastructure and wastewater storage and treatment facilities. The spatial intensity and heavy industrial nature of UG development and the horizontal drilling and hydraulic fracturing processes involved means that a very large surface area of land is impacted, and impacted heavily- far larger areas and greater impacts than in conventional gas operations.

[2] http://ec.europa.eu/environment/integration/energy/pdf/fracking%20study.pdf

[3] http://dialog-erdgasundfrac.de/sites/dialog-erdgasundfrac.de/files/Ex_HydrofrackingRiskAssessment_120611.pdf

[4] http://www.europarl.europa.eu/document/activities/cont/201107/20110715ATT24183/20110715ATT24183EN.pdf

In general fracking and UG development lead to:

- Industrialization of rural regions with roads, pipelines, and infrastructure.
- Destruction of the visual amenity of rural areas.
- Reduced quality of life of rural residents due to massive increases in truck movements and impacts of continual noise and lights during drilling and fracking activities.

Farmland

The more particular impacts of these developments vary according to the type of land on which the activities are being carried out, and the current uses of that land. When gas development takes place on agricultural lands there are a variety of impacts including:

- Loss of productive farming land due to the large surface area required for UG development.
- Reduced viability of farming operations due to UG industry operations and infrastructure and negative impacts on water resources relied upon by existing industries (as detailed below).
- Competition for scarce water resources between UG operators and existing land users due to the large water use in hydraulic fracturing processes (Approximately *7.7* -38 megalitres per fracture with multiple fractures usually needed for each well[5]).

Water impacts

The impacts of UG development on water resources will negatively impact the current and future use of land due to the likely reduction in the quantity and quality of water available for other land uses. This is particularly relevant to the West Australian context where groundwater supplies two thirds of the state's water needs[6] and where the areas currently targeted for UG extraction coincide with important ground water resources, such as in the Perth Basin where the Yarragadee and Parmelia aquifers occur and are vital to south west WA's water supplies. The incidence of well failure and the spatial intensity of UG operations (i.e. number of well heads required) means that there is a high likelihood that fracking and UG development will have a significant impact on water resources relied upon by rural industries and populations.

These impacts include:

- Contamination of groundwater from well flowback fluids which contain hydraulic fracturing chemicals as well as substances released from target geological zones e.g methane, BTEX (benzene, toluene, ethylbenzene, xylene), polycyclic aromatic hydrocarbons (PAHs), naturally occurring radioactive materials (NORMs), heavy

[5] **NTN**: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources
[6] http://www.ga.gov.au/groundwater/basics/groundwater-use.html

metals and other volatile organic compounds (VOCs)[7]. Such aquifer cross-contamination with introduced or naturally occurring toxic substances may occur through migration of fluids via natural pathways in underground geologies, via pathways created by the fracking process or as a result of well blow outs and well casing failings (which industry documents show occur in a significant number of wells[8]). [9] Contamination of shallow aquifers may also occur from surface leaching of polluted water.

- The large volumes (tens of thousands of litres per well) of hazardous flow back fluid (15 - 80% of the hydraulic fluid mixture that returns to the surface[10]) must be stored and disposed of after fracking at each well. Contamination of surface water may occur from release of insufficiently treated or untreated wastewater onto land surfaces or directly into waterways and as a result of leakage from storage facilities. Surface water contamination may also occur from accidental spills of fracking fluids or solids at the surface and via surface well blow outs.[11] [12]
- Depletion of ground and surface water resources due to the large amount of water required in fracking processes, the many times wells are fracked, and the massive number of wells needed to develop unconventional resources.

The European Report, *"Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe"*, states that there is a moderate-high risk of both ground and surface water contamination from both single frack operations and cumulative fracking operations, and a high risk to water resources from cumulative fracking operations[13]. For multiple examples of water contamination and depletion from hydraulic fracturing processes see: *"Brief Review of Threats to Canada's Groundwater from the Oil and Gas Industries' Methane Migration and Hydraulic Fracturing"*, Ernst Environmental Services.[14]

Natural areas

When UG development takes place in natural vegetated areas such as the wildflower region of the Mid West, the Ningaloo hinterland region and the Fitzroy River region in the West

[7] NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources
[8] http://www1.rollingstone.com/extras/theskyispink_annotdoc-gasl4final.pdf
[9] NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources
[10] http://www.karooplaces.com/wp-content/uploads/2011/06/coop_shale_gas_report_final_200111.pdf
[11] NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources; http://www.karooplaces.com/wp-content/uploads/2011/06/coop_shale_gas_report_final_200111.pdf
[12] Fracking: a serious concern for surface water as well as groundwater: http://ec.europa.eu/environment/integration/research/newsalert/pdf/275na3.pdf
[13] http://ec.europa.eu/environment/integration/energy/pdf/fracking%20study.pdf
[14] http://www.ernstversusencana.ca/wp-content/uploads/2013/06/Brief-review-of-threats-to-Canadas-groundwater-from-oil-gas-industrys-methane-migration-and-hydraulic-fracturing-v4.pdf

Kimberley where UG operations are proposed, there are likely to be very significant impacts on native vegetation, wildlife habitat and biodiversity. These impacts include[15] [16]:

- Destruction and fragmentation of critical wildlife habitat and food resources for construction of roads, pipelines and well pads.
- Wildlife deaths from large numbers of heavy traffic movements and exposure to wastewater via leaks spills or in holding ponds.
- Depletion and contamination of ground and water supplies represent a major threat to the vegetation, natural ecosystems, wildlife, groundwater dependent organisms, and wetland areas that rely on those water resources.
- Invasion by noxious weeds as well as feral pests and predators.
- Increased bushfire risk due to increases in ignition sources and flammable fuel for fires.
- Fouling of natural waterways from vegetation clearing and sediment run off from pads, pipelines and roads as well as wastewater releases into waterways.
- Disruption to wildlife by machinery, traffic and drilling noise and emissions.

Given these impacts on the integrity and biodiversity of natural areas, Lock the Gate maintains that it is entirely inappropriate for UG development and fracking to take place on Western Australia's conservation estate.

Community impacts

The impacts of fracking on current and future uses of land cannot be considered in isolation from the communities that live in the rural regions of Western Australia where fracking operations are proposed and who undertake the land use activities and rural industries that currently exist in those regions and would be impacted by the UG industry. There are a number of very significant impacts on communities facing and experiencing the rapid industrialization of their region from UG development. These impacts are outlined in the following paragraphs.

- Exposure to toxic fracking chemicals and byproducts of the fracking process via air pollution and water contamination pose a serious threat to human health. Exposure to hazardous air pollutants is a serious health hazard for those living adjacent to or surrounded by UG fields. A recent report[17] from the US based Centre for Environmental Health states that "all around the country people are finding that hydraulic fracturing [ ] is dangerous, destructive, and harmful to human health. Contaminated water and harmful air pollution are just a few of the all-too-real side effects associated with unconventional oil and natural gas development. Pregnant women, mothers, and their babies are at particular risk from toxic chemical exposures that can lead to infertility,

[15] Engineering Energy: Unconventional Gas Production, ACOLA

[16] *Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe, European Commission: DG Environment (August 2012)*

[17] *Toxic and Dirty Secrets: The Truth About Fracking and Your Family's Health*,

miscarriage, impaired learning and intellectual development, birth defects, respiratory problems, heart disease, and cancer."

Hazardous air pollutants are released as part of fracking operations from the burning of diesel in machinery, generators and vehicles, off-gassing from wastewater ponds, flaring and venting at wellheads, plus leaks and emissions from wells, pipelines and compressor stations.[18] A 2012 study detected 44 hazardous air pollutants at gas drilling sites and several other US studies highlight the health symptoms experienced by those living near drilling operations[19]. Exposure to harmful substances can also occur through direct skin contact with the chemicals or wastes; drinking or bathing in contaminated water and through contaminated dust particulates[20].

- The social stressors associated with the heavy industrial activities that accompany UG development also take a heavy toll on the mental and emotional health of rural families and communities impacted by UG development. "Fracking has also been found to detrimentally impact the immediate and nearby communities. Fracking increases traffic and creates industrial noise, which is correlated with hypertension, sleep disturbance, cardiovascular disease and stroke. Because of the many health problems associated with fracking, the process also strains the communities' health care resources."[21] Doctors for the Environment Australia (DEA) has written extensively on the issues of unconventional gas and health. DEA's "Gas as a replacement fuel: Discussion paper on the health aspects of gas" can be found at: http://dea.org.au/images/general/Gas_and_Health_Report_01.

  The DEA states: "Large scale coal seam gas development poses poorly assessed, yet potentially serious health risks to the community. There is the potential for public health to be affected directly and indirectly by CSG operations through contamination of water, air and soil, as well as long-term impacts on rural communities. Current assessment, regulation and monitoring of CSG impacts on the environment, public health and vulnerable communities is insufficient to provide confidence of adequate safeguards."[22] Where is occurs in areas of human habitation, the health and community impacts of the proposed shale and tight gas industry in WA are likely to be similar to those of the rapidly expanding east coast CSG industry as the majority of the processes and practices involved in CSG development are mirrored in other forms of UG development- in particular the scale and level of intensity of the heavy industrial operations involved. DEA also note that "Water and air pollution, water shortages, permanent degradation of

[18] NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources
[19] NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources
[20] NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources
[21] *Toxic and Dirty Secrets: The Truth About Fracking and Your Family's Health*,
[22] http://dea.org.au/images/general/viewpoint_issue_8_CSG.pdf

productive agricultural land and loss of livelihood and landscape...all have mental health consequences for communities living in a gas field."[23]

- In discussing the broader social impacts of UG development, DEA note: "Informed consent of landholders is often lacking in the contract process when mining companies first approach landholders about unconventional gas extraction.... The injustice and powerlessness that this engenders contributes to solastalgia and poorer mental health outcomes." The lack of a veto right for landholders in relation to UG development, the stress involved in dealing with UG companies (often against their will), the lack of full information and disclosure on the realities of UG development, and the often underhanded tactics employed by companies contributes to a sense of powerlessness, betrayal and frustration amongst landholders and affected communities. According to DEA, in eastern Australia, "The stress and disruption caused to farmers has already been shown to force some of them to leave a CSG drilling area, allowing once productive lands to lapse into disuse," whilst in the US "long time residents are moving, unable to bear the changes the gas industry has wrought on their landscape and community."

  The health and social impacts of UG development will necessarily have a flow on negative impact on the overall wellbeing of rural communities as well as the functionality of the industries in which rural residents are engaged. This impact will be magnified due to the fact that farming and rural communities are the very same communities who are already at most risk from the adverse health effects of drought, climate change and the degradation and depletion of Australia's river systems and groundwater resources.[24]

- Lock the Gate members and local community groups report a range of impacts from proposed and actual UG development on their mental and emotional wellbeing. These include:

  -A sense of injustice that they do not have the right to refuse access to companies for UG activities and that this industry is being forced on an unwilling population.

  -Fear and anxiety about the impacts of the UG industry on their family's health and the quality of the air and water they rely upon.

  -Concern about the impact of UG development on the economic viability of their farms and property values.

[23] DEA, Submission to the Inquiry into Coal Seam Gas, 16/09/2011
[24] DEA, Submission to the Inquiry into Coal Seam Gas, 16/09/2011

-A sense of anger and betrayal that governments are supporting industry rather than communities in the development of the UG industry.

-A sense of anger that the industry is being pushed ahead rapidly without proper consideration of the impacts and before proper scientific studies have been done and baseline data collected.

The East Coast experience has shown that when this industry is forced upon communities against their wishes there is potential for significant conflict and social upheaval and disruption as a result.

- DEA[25] also note that there are likely to be negative economic impacts on existing rural industries, social divisions and negative mental and physical health consequences for rural communities from the economic realities of UG development. These economic impacts include:

- The use of FIFO workers in UG operations rather than local workforces.
- Increases in rent and costs of goods and services as a result of UG industry development.
- Loss of workers is local businesses, particularly agricultural enterprises, who are unable to compete for skilled labour with the wages offered by UG companies.
- Decreased land values in proximity to gas field development.

Overall, DEA maintain that UG development can "divide previously close-knit rural communities, increasing tension and disharmony."

b) the regulation of chemicals used in the hydraulic fracturing process;

The National Toxics Network[26] identifies a range of issues in relation to the chemicals used in fracking and their regulation. These include:

- Many chemicals used in fracking operations in Australia have not been assessed for their toxicity to the environment and humans. "The mixtures used in drilling and fracking fluids are also not assessed for toxicity or persistence and can form new compounds when exposed to sunlight, water, air, radioactive elements or other natural chemical catalysts."[27]
- Large numbers of hazardous products were identified in US fracking operations.
- There is a reliance on industry reporting of fracking chemicals in the US, with many potentially toxic chemicals not being reported as they are classed as 'trade secrets'.

[25] DEA, Submission to the Inquiry into Coal Seam Gas, 16/09/2011

[26] NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources
[27] NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

Doctors for the Environment (DEA)[28] note that it is "not possible to undertake adequate health risk assessments of [fracking] operations as insufficient information has been gathered on the nature and doses of chemicals entering water and air and the exposures of people to these chemicals." DEA are concerned that many of the chemicals used in fracking are known to be hazardous to health through release into water and/or air and include endocrine-disrupting and cancer causing agents. They maintain that disclosure of the chemicals used in fracking and assessment of their impacts over time are inadequate.

A US study, *Natural Gas Operations from a Public Health Perspective,*[29] notes that fracking "relies on undisclosed types and amounts of toxic chemicals" and that "many chemicals used during the fracturing and drilling stages of gas operations may have long-term health effects that are not immediately expressed". The authors recommend that full disclosure of the contents of all products, extensive air and water monitoring, coordinated environmental/human health studies, and regulation of fracturing under drinking water legislation is vital to protecting human health from harm from the chemicals used in fracking.

c) the use of ground water in the hydraulic fracturing process and the potential for recycling of produced water

Groundwater use

As noted above the amount of water used in fracking operations is very significant- approximately *7.7* -38 megalitres per fracture with multiple fractures (up to 30) usually needed for each well. When you multiply these amounts by the hundreds, thousands or tens of thousands of wells in a gas field the total water use if extremely high. This will place significant stress on groundwater systems, particularly if they are already utilized by existing industries. This demand on groundwater for supplying fracking operations will be magnified in semi-arid regions and under circumstances where the sole or principal source of water is from underground aquifers, as well as during extended drought periods and during periods of reduced rainfall which are likely to be more frequent as a result of climate change. The water consumption by the UG industry in WA is of great concern, particularly in dry regions like the Mid-west and Gascoyne where significant development is proposed.

In relation to water use the European Commission report[30] on fracking notes: "The hydraulic fracturing process is water-intensive and therefore the risk of significant effects due to water abstraction could be high where there are multiple installations. A proportion of the water used

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[28] DEA, Submission to the Inquiry into Coal Seam Gas, 16/09/2011

[29] http://cce.cornell.edu/EnergyClimateChange/NaturalGasDev/Documents/PDFs/fracking%20chemicals%20from%20a%20public%20health%20perspective.pdf

[30] *Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe, European Commission: DG Environment (August 2012)*

is not recovered. If water usage is excessive, this can result in a decrease in the availability of public water supply; adverse effects on aquatic habitats and ecosystems from water degradation, reduced water quantity and quality; changes to water temperature; and erosion. Areas already experiencing water scarcity may be affected especially if the longer term climate change impacts of water supply and demand are taken into account. Reduced water levels may also lead to chemical changes in the water aquifer resulting in bacterial growth causing taste and odour problems with drinking water. The underlying geology may also become destabilized due to upwelling of lower quality water or other substances."

Recycling of produced water

The issue of how to deal with produced water from UG operations is a significant one for the industry. This water is produced for the lifetime of the well and typically contains 'heavy metals, NORMs, fracking or drilling chemicals, volatile and semi volatile organic compounds and high concentrations of salts'[31]. Produced water from UG operations is 'either reinjected into aquifer formations, used for dust suppression on roads, reused for brick making, sent to holding ponds or partially 'treated' and released into waterways'[32]. The National Toxics Network notes that the 'treatments to remove contaminants from produced water are limited by the chemicals they can remove, the energy needed and their economic costs,' and also, that 'reverse osmosis filtration has significant imitations and cannot remove many of the organic chemicals used in UG activities.' In particular, 'low molecular weight, non polar, water-soluble solutes such as the methanol and ethylene glycol are poorly rejected.'

Environmental Engineer Stuart Khan of the University of NSW has expressed serious reservations about the disposal and use of produced water[33], claiming that: "Disposing of CSG waters directly to surface waters will significantly epact the quality of those surface waters. Attempts to beneficially reuse CSG water without treatment for application's such as irrigation, poses risks to soil quality and shallow groundwater quality." And further: "poorly managed discharge of reverse osmosis waters to the environment may also pose a risk to some surface water systems by disrupting (diluting) natural mineral and nutrient compositions, essential for many aquatic ecosystems. Uncontrolled discharges to ephemeral streams will disrupt natural flow regimes with potentially significant ecological implications."

In the US water may also be filtered and reused in fracking operations, but the viability of this depends on a number of factors, including the quantity, quality and duration of the water production[34]. In Queensland the state government has developed a beneficial use approval system for coal seam gas water which details the requirements for using CSG water for

[31] NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

[32] NTN: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources

[33] Submission to the NSW Parliamentary Inquiry into Coal Seam Gas

[34] Chesapeake Energy presentation: EPA Hydraulic Fracturing Study Technical Workshop #4Water Resources Management

aquaculture, coal washing, dust suppression, industrial and manufacturing operations, irrigation and livestock watering.[35] However, Lock the Gate has concerns about the use of this water when it ends up making its way into soils and natural waterways due to the potential for substances that have not been wholly removed from the water to accumulate in, and negatively impact, natural and agricultural systems. For instance, NSW irrigators have expressed concern about the impacts of using produced water on cropping land following a trip to areas of the US where produced water is being released onto farming land[36]. "Some US farmers are finding after 10 years of irrigating with water mixed with the CSG produced water that the sodium composition of their soils has changed, altering its fertility, clay content and friability and making it more prone to deep cracking."

d) the reclamation (rehabilitation) of land that has been hydraulically fractured

In assessing the rehabilitation of land that has been hydraulically fractured, the European Commission report[37] on fracking notes: "The evidence suggests that it may not be possible fully to restore sites in sensitive areas following well completion or abandonment, particularly in areas of high agricultural, natural or cultural value. Over a wider area, with multiple installations, this could result in a significant loss or fragmentation of amenities or recreational facilities, valuable farmland or natural habitats."

Given the spatial intensity of UG fields and the number of large multi well pads and road and pipeline corridors required, there is likely to be a very significant total land area that is rendered unusable for other purposes as a result of fracking operations. The scars on the landscape from UG developments are likely to remain indefinitely, particularly in arid regions, and will permanently destroy the visual amenity of these regions. This is of particular concern in high tourism value areas such as the Kimberley and WA's Wildflower region.

[35] http://www.ehp.qld.gov.au/management/non-mining/csg-water.html

[36] http://www.weeklytimesnow.com.au/article/2013/08/27/580901_national-news.html

[37] *Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe, European Commission: DG Environment (August 2012)*