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To: info@frackinginquiry.wa.gov.au
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Subject: Submission : WA Scientific Inquiry into Hydraulic Fracture Stimulation in WA 2017

Name: Maria Atkinson

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Date: 14th March 2018

My name is Maria Atkinson. I am a retired teacher. My husband, Brian, and I have been following the debate about the exploration and extraction of unconventional gas around the world, in Australia and in particular here in WA.

We have grave concerns about the safety of this industry, as there is more and more overwhelming information demonstrating the risks and harm associated with it.

I was compelled to write this submission after watching the 4 Corners report (5/3/18) about the changing climate in Australia, which pointed out that here in Perth we already have shortage of water and rely on desalination.

Where is the vast amount of water needed for fracking going to come from?

The use of highly toxic chemicals used in the process have been found to contaminate ground drinking water around the world in spite of " best practice " promised by industry.

Can we take the risk of gas wells polluting the Leederville Mound and the Yarragadee aquifer?

"Substantial evidence shows that drilling and fracking activities, and associated water disposal practices, inherently threaten groundwater and have polluted drinking water sources, as confirmed by the US Environmental Protection Agency's 2016 final report on the impact of fracking on the nation's drinking water. Repudiating industry claims of risk-free fracking."

(Concerned Health Professionals of New York, 2018)

A survey in 2014 of more than 41000 gas wells in USA showed that more than 6 percent lost integrity and were leaking methane into the atmosphere. Abandoned wells in Pennsylvania all had integrity failures and leaked

methane. It is estimated that these leakages contribute 13 percent of Pennsylvania 's methane emissions from human activity.(Jackson 2014)
Can the health and lives of our people living in areas designated for fracking here in WA, be so easily abandoned?

A New Climate Analytics report, released today (14.3.18),states regarding the fracking for shale gas in the Canning Basin :

" In addition to environmental impacts associated with fracking these resources contain much more energy and carbon than conventional resources and using them would enlarge carbon emissions. Additionally, because shale gas and other unconventional resources are so much more difficult to extract, they also have a substantially higher risk of leakage and loss of methane - a powerful greenhouse gas released during the extraction process."

As the report also states, it is important to note that methane has 25 times the warming potential of carbon dioxide.

By signing the Paris Agreement, Australia promised to reduce greenhouse gases, but by fracking in the Canning Basin, we are going to vastly increase our greenhouse gases pollution.

The report also states: " ...Western Australia is uniquely placed to take advantage of the economic opportunity....as the world transitions to a low carbon future. Not only is it rich in minerals needed to make the global low carbon transformation possible, but it also has enormous and easily accessible solar, wind and geothermal renewable energy sources."(Climate Analytics report. (14/3/18)

Can our planet cope with the large increase in WA's carbon footprint brought on by fracking in the Canning Basin ? Should we not do our best to move away from damaging our planet and move toward clean renewable energy?

Why is it that banks refuse to give loans against the value of land near gas wells? (Commonwealth Bank in 2016)

Why do land owners in Queensland find it hard to get insurance when there is gas production near their property?

Why were farmers in north west NSW refused insurance cover for risks and contamination associated with unconventional gas extraction?(Caskey,2015)

Could it be that the unconventional gas industry puts an unacceptable risk onto land owners, devaluing their land, possibly cause personal injury, property damage and contamination?

Our daughter lives in Bullsbrook and we are very concerned that were fracking to commence in that area, people who live there would be similarly effected as the land owners in Queensland and NSW.

As areal photographs of the Queensland gas fields show, the environment has been totally destroyed.

Do we want this to happen to our beautiful Swan Valley, that we all enjoy and which is such a tourist attraction, and to our farms that feed us and bring in export dollars?

Conclusion

It appears from the evidence that the gas industry does not achieve the high standards in practice that it claims, or those, which the regulations require. There is a history of failure of government regulation to protect the public and the environment from this hazardous industry.(Davey, 2014; European Environment Agency 2001)

There is a growing volume of evidence that Hydraulic Fracturing poses an unacceptable risk and harm to people 's health, wellbeing, way of life and financial security. It risks causing irreparable damage to our air, water, land and the environment.

This is the reason why we call upon this inquiry and upon the West Australian government to enact a permanent ban onshore hydraulic fracturing for gas , and for all exploration, production and associated activities of onshore unconventional gas production in Western Australia.

We appreciate the chance to express our concerns and hope they will add some weight to your deliberations

Maria and Brian Atkinson

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I include our daughter 's submission

Sent from my iPad

**Submission to:
WA Scientific Inquiry into Hydraulic Fracture Stimulation in WA 2017**

Introduction

My name is Judith (Jody) Atkinson. I am a land owner, living in Bullsbrook. I am a university graduate and spent many years working as an academic librarian and so have a thorough understanding of how to read and assess research material and how to judge the authority and value of information sources. I have been following the debate around the planned development of onshore unconventional gas exploration and extraction in Western Australia with growing concern. I have read a large amount of the available scientific research, much of it peer reviewed, as well as reports from governments and investigative news reports. I have also read many claims and reports from industry. The overwhelming and growing body of scientific research (more than 1200 peer reviewed papers to date) demonstrating the risks and harms of the onshore unconventional gas industry leads me to conclude that the onshore unconventional gas industry poses serious and unacceptable risks to the West Australian people, economy and environment. These risks cannot be effectively regulated to an acceptable level due to the inherent nature of the processes involved. The industry has demonstrated repeatedly in Australia and internationally that it does not and will not play by the rules, even if sufficient regulation could possibly sufficiently reduce risk.

My personal concern as a land owner is over the serious health effects I would suffer should this industry operate on my land or in my community. I suffer from respiratory disease and live in a semi rural area primarily for the good air quality. If our community changed from a rural residential area to an industrial gas field, the increases in fumes, dusts, methane, VOCs and other air pollutants would leave me chronically sick or force me out of my own home.

My other major personal concern is the seriously financial losses my family would suffer due to loss of value of our home and land, which is our only major asset. It has been amply demonstrated that the presence of onshore gas developments on private land or in the surrounding community seriously devalues land if not renders it unsaleable at any price. If the lease holder in our area is permitted to turn our community into a gas field, we would not financially be in a position to relocate and so would be stuck in an environment that would leave me chronically sick. We would lose not only our home but a valuable asset that we need to part fund our retirement.

There are many, many issues of concern regarding the onshore unconventional gas industry, including pollution of air, water and soil, radioactive pollution from elements naturally occurring in shale that are brought to the surface by gas operations, climate change impacts both from continued burning of fossil fuels and from large quantities of leaked methane gas, increased seismic activity, water use and waste water disposal, health impacts, both physical and psychological, property rights for landholders, impacts on the surrounding community, lack of credibility of the gas industry, lack of social licence to operate - the list goes on. There is a vast and growing body of evidence demonstrating that onshore unconventional gas is not safe and the risks cannot be managed by regulation.

Scientific literature involving more than 700 studies on the impacts of unconventional gas development show:

- 84% of public health studies indicate risks to public health
- 69% of water studies show actual or potential water contamination
- 87% of air quality studies indicate elevated air pollution.

(Hays, 2016).

Another metanalysis of 156 papers (Saunders, 2016) found multiple potential hazards to human health from exposures to harmful air and water pollutants associated with unconventional gas mining.

The Concerned Health Professionals of New York's Compendium of Scientific, Medical and Media Findings Demonstrating the Risks and Harms of Fracking (Unconventional Gas and Oil Extraction) draws from more than 1300 sources, including more than 1200 peer reviewed academic papers proving that the

unconventional gas can and does cause harm at every stage of the process and cannot and has not been effectively regulated to mitigate these harms.

I will not attempt to replicate the work of these major reviews of the literature, rather have chosen 3 topics to focus my efforts on. These are not the only issues that concern me, however the limited time offered for public comment has meant there just was not time to do justice to more.

I call upon this Inquiry to do the right thing by the people of Western Australia and recommend a ban on all onshore unconventional gas activities in Western Australia.

Summary of key points

In my submission I have chosen to focus on 3 issues :

- The issue of well integrity. Much of the gas industry's case for their claim the industry is safe depends on the infrastructure maintaining integrity and not leaking fluids into the environment. They assert that with "best practice" contaminants will be kept contained, preventing environmental pollution and harms to health. A large and growing body of evidence proves that despite best practice and despite stringent regulation, well integrity failure is an ongoing and unresolved issue for the oil and gas industry
- The issue of water. Despite industry claims to the contrary, there is a large and growing body of evidence that pollution of water resources can and does occur via many routes. Regulation does not and has not prevented this from happening at levels that are harmful.
- The rights of landholders. As an owner of land now subject to a gas lease, myself and my family stand to personally suffer a range of substantial negative impacts through a development we do not want and have no control over. We have no rights to prevent actions that will harm our health, our financial security, our community and our peace of mind.

Well Integrity and failure

The gas industry claims that risks associated with onshore unconventional gas are low and can be managed with "best practice" and regulation. However a growing body of research shows that this claim cannot be substantiated, indeed well casing integrity is an ongoing and unresolved issue in the industry, and that in some areas it can be shown that the structural integrity of well casings is not only not improving, newer wells are failing sooner and at higher rates than older wells. Research shows that a significant percentage of wells suffer structural issues resulting in leakage of gases and liquids during their productive life as well as after abandonment and potential or actual leakage of contaminants into water resources and air.

"Studies show that many oil and gas wells leak, allowing for the migration of natural gas and potentially other substances into groundwater and/or the atmosphere. According to Schlumberger, one of the world's largest companies specializing in fracking, about five percent of wells leak immediately, 50 percent leak after 15 years, and 60 percent leak after 30 years. Recent research suggests that the act of fracking itself creates pathways for leaks. The problem of leaking wells, identified by industry, has no known solution. Data from Pennsylvania's Department of Environmental Protection (DEP) agree, showing over nine percent of shale gas wells drilled in the state's northeastern counties leaking within the first five years. Leaks pose serious risks, including potential loss of life or property from explosions and migration of gas and other harmful chemicals into drinking water supplies. Methane leaking into aquifers, can under some conditions, be transformed by bacteria into hydrogen sulfide and other poisonous byproducts. Microbes from deep shale formations can likewise generate sulfides contributing, over time, to corrosion of pipes and casings.

Leaks also allow methane to escape into the atmosphere, where it acts as a more powerful greenhouse gas than carbon dioxide. There is no evidence to suggest that the problem of cement and well casing impairment is abating. Indeed, analysis of more than 75,000

compliance reports for more than 41,000 wells in Pennsylvania found that newer wells have higher leakage rates than older ones and that unconventional shale gas wells leak more than conventional wells drilled within the same time period. Industry has no solution for rectifying the chronic problem of well casing/cement failures and resulting leakage." (Concerned Health Professionals of New York, 2018)

Jackson (2014) shows in a survey of more than 41 000 gas wells in the USA that more than 6% of shale gas wells drilled between 2000 and 2012 had lost structural integrity and were leaking methane by 2014. In addition they showed that while older wells would be expected to leak more than newer wells due to older practices and aging of materials, in many areas the opposite was true with closer to 12% of newer wells (wells drilled 2009-2012) were leaking when they were no more than 4 years old. He notes that since 2005, the state of Pennsylvania has confirmed more than 100 cases of groundwater contamination due to "failure to prevent migrations to fresh groundwater". Other studies have similar findings (Ingraffea, 2014)

An analysis of industry literature showed:

- In 340,000 oil and gas well in Canada, 15-16% of conventional wells leak and 65% of modern deviated (unconventional) wells leak.
- 35% of 1.8 million global wells leak – 5% in young wells and 35% in old wells.

An analysis of 75,000 inspection reports in Pennsylvania between 2000-2013 showed:

- Leakage in old wells pre 2009 of 13% for conventional wells and 20% for unconventional wells.
- Leakage in modern wells post 2009 were better, but still 12% in unconventional wells.

(Ingraffea, 2016)

Well casing failures have also been documented where underground movements have caused them to shear (Stringfellow 2015). This is concerning as fracking is now known to cause earthquakes (Atkinson, 2016), increasing the likelihood of well casing failure. Changes in ground water such as extended periods of drought can also cause ground movement leading to well casing failure. (Stringfellow, 2015). This is particularly relevant to Western Australia as the frequency and duration of drought events is predicted to increase due to climate change.

Jackson (2014) says that little monitoring or research has been conducted on integrity failure in abandoned wells, however a random sample of 19 abandoned wells in Pennsylvania showed that all leaked methane. Leakages from gas wells are estimated to contribute approximately 13% of that states methane emissions from human activity.

Evidence that well integrity is increasingly likely to fail over time and that well casing materials are not stable in a subsurface environment over the long term (Vogwill, 2017) strongly suggests we cannot expect abandoned wells to remain sound, but that abandoned wells will need monitoring and maintenance regularly for an indefinite future at an ongoing cost and burden on the West Australian people. Little research has been done on the long term (50+ years) integrity of well casings however it has been shown that the casing of wells drilled in Perdika/Great Artesian Basin in NT in the 1960s. completely corroded, costing the NT and federal government more than \$500 000 to plug, as the company responsible was insolvent, and evidence from the US suggests both the likelihood of this occurrence and the cost of remediation are common.

This demonstrates that well integrity failure is an expected and unavoidable part of oil and gas extraction. It occurs at demonstrably higher rates in unconventional vs conventional hydrocarbon extraction and rates also increase with the length of the horizontal shaft and with volumes and pressures of injected fluids. This is of particular relevance to proposed shale gas developments in WA, as the volumes of water estimated per frack places operations in the Mid West at the high end of shaft length and fluid volume, so at the high end of risk of failure.

Well integrity failure is not something that can be prevented with regulation, occurs at unacceptably high levels even in new wells observing "best practice" and is inevitable over the long term. "Best practice" cannot prevent it and has not prevented it anywhere ever. High densities of wells over vital groundwater

sources, productive farmland and in populated areas cannot be allowed under any circumstances as the risk to people and the environment cannot be mitigated to an acceptable level.

Effects on Water

As demonstrated above, gas wells fail to maintain integrity and leak at unacceptably high levels at all stages of their lifecycle, despite continued industry denials. And despite continuing industry denial, there is a concrete and growing body of evidence that water resources both surface and groundwater sources can be and are being contaminated by the onshore oil and gas industry.

In addition to water pollution from well integrity failure, water sources can also be demonstrated to have been contaminated from legal release of "treated" waste water, illegal dumping of waste waters into rivers and sewers, rock formations fracturing contrary to prediction, spills and leaks from holding ponds, pipelines and tankers in normal operations and spills due to uncommon but expected flood events. Research and monitoring are hampered by industry secrecy and compliance issues. Regulation and "best practice" has not prevented these harms.

"Substantial evidence shows that drilling and fracking activities, and associated wastewater disposal practices, inherently threaten groundwater and have polluted drinking water sources, as confirmed by the U.S. Environmental Protection Agency's 2016 final report on the impacts of fracking on the nation's drinking water. Repudiating industry claims of risk-free fracking, studies from across the United States present irrefutable evidence that groundwater contamination occurs as a result of fracking activities and is more likely to occur close to well pads" (Concerned Health Professionals of New York, 2018).

In their COMPENDIUM OF SCIENTIFIC, MEDICAL, AND MEDIA FINDINGS DEMONSTRATING RISKS AND HARMS OF FRACKING (UNCONVENTIONAL GAS AND OIL EXTRACTION, The Concerned Health Professionals of New York using more than 1300 sources including peer reviewed academic research papers, government reports and investigative media reports, document the many hundreds of incidents of ground water contamination from fracking operations. They have demonstrated that water contamination occurs at every stage of the process, that spills and leakages whether accidental or illegal are frequent and that regulation cannot and has not prevented this from happening.

A small sample of the documented evidence includes:

- groundwater depletion in Texas (Collins, 2017),
- illegal disposal into rivers and streams including those that feed drinking water sources for communities and cities (Liberatore, 2017; Hopey, 2014),
- "clear evidence of direct water contamination from fracking" in North Dakota from accidental spills affecting streams and soils where inorganic pollutants remain at persistently high levels after more than 4 years (Nicholas School of the Environment, Duke University, 2016)
- a regulatory "mixup" that allowed toxic fracking wastewater to be injected into drinking water sources in California (Sommer, 2017),
- High levels of "fracking-related chemicals that include radium, barium, strontium, and chloride, as well as endocrine-disrupting and carcinogenic compounds" in river sediments where "treated" fracking wastewater had been legally released, (Burgos, 2017; Johnston, 2017),
- fracking related contaminants (including methane, benzene, toluene, salts, organic chemicals and arsenic) in many drinking water sources near fracking operations in the US often in levels "high enough to affect human health" (McMahon, 2017; Hill, 2017; U.S. Agency for Toxic Substances and Disease Registry, 2016; Banerjee, 2016; Jordan, 2016; CBS/AP 2013),
- unacceptably high rates of surface spills of up to 16% of wells in any 1 year and approximately 5% of all fracking waste water (Patterson, 2017; Kuznetz, 2017; Konkel, 2016),
- plumes of fracking chemicals and wastewaters from overturned tanks, inundated wells and swamped waste ponds entering rivers and streams during flood events in Texas (Schladen, 2016)
- A study of more than 44 000 gas wells in the US found vertical fractures extend upwards to a much greater extent than assumed (more than 2000 feet) posing a much greater risk to

- groundwater aquifers than industry assumptions. (Jackson, 2015)
- 20% of 11,000 public drinking water wells in California are contaminated with toxic contaminants affecting 18% of the state's population. The contaminants were those commonly used in fracking. The study did not examine whether the contaminants came directly from oil and gas extraction or from the fracking waste water used to irrigate agricultural crops although farm irrigation was demonstrated to leach into groundwater.
 - Widespread drinking water contamination in Northern Texas from fracking the Barnett Shale region including 19 hydrocarbons, including benzene (carcinogen) and toluene (reproductive toxicant) and "strikingly high" levels of ten metals (Hildenbrand, 2015; Fontenot, 2013)
 - Investigations over the last decade in the US by the Environmental Integrity Project have found that prohibited additives continue to be used in fracking operations, despite denials from industry. Suppliers, including Halliburton continue to market and supply prohibited additives to gas companies for use in fracking (Greene, 2015)
 - An international team of researchers have found that treatment of fracking waste water can actually make it more toxic as chemicals used to "treat" the water (eg. chlorine and bromine) react with carbon-based compounds creating highly toxic byproducts. (European Commission, 2015). Other studies concur (Parker 2014).
 - Numerous studies note that research into the area of water risk is hampered by industry secrecy whereby chemical formulations of fracking fluids are protected as proprietary business information. The range of possible additives is large so non-disclosure seriously impedes independent monitoring or research and makes proof of responsibility for harm almost impossible. (Stringfellow, 2014; Robinson, 2014; Sadasivam, 2014; US Government Accountability Office, 2014).
 - Industry secrecy also hampers research as many landowners who claim their water has been damaged by fracking are offered out of court cash settlements or property buyouts which come with non-disclosure agreements preventing the landowners from reporting or commenting on the contamination and allowing the industry to continue to claim that no harm has been caused. (Efstathiou, 2013; Environmental Protection Agency, 1987)
 - A Stanford University research team working in the Pavillion gas basin in Wyoming documented that fracking in shallow layers of bedrock, including those that serve as drinking water aquifers, is not uncommon. This finding overturns the industry claim that oil and gas deposits targeted by fracking operations are located at much greater depths than underground drinking water sources and are isolated from them by hundreds of feet of impermeable rock. (Banerjee, 2014)
 - At least half of known fracking related spills in Pennsylvania were not reported by the companies despite state law requiring them to proactively seek and report them. The inquiry concluded it is likely a large percentage of actual spills remain unreported. (Hamill, 2014)
 - fracking fluid and fracking wastewater can mobilize previously deposited chemical contaminants in soil particles in ways that could potentially exacerbate the impacts of fracking fluid spills or leaks. The Cornell University research team concluded that, by interfering with the ability of soil to bond to and sequester pollutants such as heavy metals, fracking fluids may release from soils an additional repository of contaminants that could migrate into groundwater. (Sang, 2014)
 - The Pennsylvania Department of Environmental Protection determined that fracking wastewater that had leaked from a storage pit contaminated groundwater and rendered a natural spring used for drinking water in Greene County undrinkable. (Niedbala, 2018)
 - In Arkansas, researchers found that water withdrawals for fracking operations can deplete streams, threaten drinking water supplies, damage aquatic life, and impact recreation. (American Chemical Society, 2018; Enterkin, 2018)

There are many ways water can and is being contaminated by onshore gas operations. Regulation can not and has not prevented this. I call upon the WA state government to do the right thing by the people of Western Australia and protect our precious water resources by permanently banning onshore unconventional gas operations in our state.

Rights of Land Owners

The development of the onshore unconventional gas industry puts unacceptable burden and risk onto land owners. We face grave risks to our health and financial security and disruption to our lives, businesses and community.

Onshore unconventional gas devalues land and can make it unsaleable at any price. This has been demonstrated in Australia (Rabobank, 2011; Robertson, 2016,) as well as internationally (Radow, 2014; Daily Real Estate News, 2013; Conlin, 2013; Downing, 2013). It has been demonstrated in banks refusal to loan against the value of land, due to the presence of gas wells (Commonwealth Bank in 2016) and in the many personal accounts of landowners in Australia and the United States. The fact that banks are reluctant to loan due to uncertainty or devaluation of gas field affected land impacts not just farmers needing crop loans, as was the case with Commonwealth Bank in 2016, but anyone wanting to sell land affected by proximity to gas wells - most buyers will need a loan where the value of the land is the collateral (Radow, 2014; Peters, 2013). In the US at least 8 local and national banks (as of 2011) will no longer issue mortgages on property subject to a gas lease. (Urbina, 2011).

Land owners of gas field affected properties in Queensland are finding their ability to get insurance is affected by gas production on or close to their properties. Insurance companies have refused to insure against risks associated with unconventional gas extraction, both in Australia and in the USA. In the USA, homeowners can be confronted with uninsurable property damage for activities that they cannot control (New York State Bar Association Journal, 2011; Radow 2014).

In the north west of NSW, farmers have been refused insurance cover for risks and contamination associated with unconventional gas extraction (Caskey, 2015).

Landholders are concerned they may be liable for any negative impacts caused by hydraulic fracturing. In 2014, the NSW Chief Scientist released a report, which concluded that the CSG industry was markedly under-insured and that landholders were likely to bear a substantial risk as a result (NSW Chief Scientist and Engineer, 2014).

Meat and Livestock Australia has advised there is a genuine risk that landholders may ultimately be responsible for liabilities arising from unconventional gas activities if they lead to personal injury, property damage, or contamination (Meat and Livestock Australia, 2014).

The Rural Industries Research and Development Corporation cite a case study in Queensland where a landowner was advised by their supply chain partners that they would be liable for any contamination caused by coal seam gas activities. Neither the CSG company nor the insurer would agree to indemnify the landholder against that risk (Clarke, M, 2013). Legal advice indicated:

- Gas companies are refusing to include provisions in access agreements to accept liability for any contamination that may occur.
- Gas companies in Australia are under-insured and do not have adequate insurance to cover the types of risks that CSG activities bring.
- Some graziers have reported that insurers have examined the risk to them of unconventional gas contamination and found it too high to offer insurance.

While all the examples so far have pertained to farm businesses, the issue of insurance is also of grave concern to residential land owners, as a large number of small acreage residential properties in City of Swan and Shires of Chittering and Gingin are covered by gas leases. We are personally concerned that the presence of gas wells in our area will greatly increase our risk from bushfire both the potential of flaring well heads to start fires and the likelihood that firefighters will be unable to or have reduced ability to safely defend our property due to the presence of gas infrastructure (which vents methane by design, and regularly leaks methane as shown above) which not only puts us at increased personal risk but will affect our ability to insure our property or may allow our insurer to fail to honour a claim.

We would also be at increased risk of uninsurable damage from contaminated water affecting our land or home in the event of spills, leaks or storms. Onshore unconventional gas works produce large amounts of contaminated waste water which is usually stored in holding ponds at the well site. In the 7 years we have

lived in our home, we have had 3 "hundred year" storm events directly impact our property where intense rain in our immediate area overwhelmed the storm water drains causing large amounts of water to flow over the land and into homes. Our damage was limited to fences (insurable), damage to land and pasture (not insurable) and a great deal of sludge, debris and mess to clean up (not insurable). Cleaning up was messy and exhausting but mud and organic debris is not particularly hazardous. It would have been a completely different story had the storm water been contaminated with spill from fracking operations. We currently can not insure for the cleanup that would be required in and around our house or decontamination of our pasture, orchards and food gardens (if effective decontamination is even possible). The cost of paying someone to undertake cleaning up contaminated debris would be crippling and too hazardous for untrained householders to undertake themselves. To put us and all other affected land owners at risk of large costs for activities that we cannot control and that cannot be insured for is outrageous and completely unacceptable.

As a landholder I also have grave concerns about the responsibility for long term management of abandoned gas wells. There is substantial evidence as documented above that a large percentage of gas wells start leaking during their productive life, and that leakage and failure become increasingly likely over time. Once production ceases, once the wells are decommissioned and capped, who is then responsible for the monitoring and maintenance of this abandoned infrastructure? Casing materials are not stable in subsurface conditions in the long term (Vogwill, 2017) and existing older oil and gas wells can be shown to have completely corroded casings (eg Perdika/Great Artesian Basin in NT) demonstrating that as could be expected, steel and concrete degrade over time and abandoned wells can and do leak. Unmonitored abandoned wells pose a health and safety threat, and some have even exploded (Zoffos, 2018). Who is responsible for this in the long term? If the current behaviour of mining companies operating in our state is typical, it apparently won't be them.

Evidence given to a Senate Inquiry held in Perth in March 2018 demonstrated that despite regulation requiring it, and despite regulation requiring money be set aside by mining companies to rehabilitate mining sites, this is not happening. Mining Industry representatives were unable to supply a single instance where rehabilitation had occurred to the required standard. The Inquiry heard evidence that it is common practice for companies to avoid paying for any rehabilitation by making use of a legal loophole that absolves them of any responsibility by going insolvent, leaving the West Australian taxpayer to pick up the bill. (Young, 2018). The current minister for Mining and Petroleum, Bill Johnston, is quoted as saying this is a problem limited to "rogue operators" who put the costs onto "the rest of the industry" (Young, 2017) demonstrating that the current government is in denial of the extent of this problem, and is misrepresenting who ultimately pays the cost - the taxpayer.

The current and previous governments of Western Australia are not, and have not created sufficient and appropriate regulation to ensure the rehabilitation of mining sites is achieved or that the mining companies pay for it. There is no reason to believe that anything will change. It is bad enough for this to happen on publicly owned land. The onshore unconventional gas industry has leases over large areas of privately owned land, and there is nothing to protect the land owners from being left with the legacy of abandoned infrastructure.

To leave the responsibility for the cost of managing the aging and failing infrastructure, leaking wells and crumbling, polluted waste ponds to the people of Western Australia is unacceptable. To leave it to the individual landowner who had gas wells forced upon them against their will, received no benefit from the development and already suffered significant loss through devalued land is completely outrageous and can not be allowed to occur.

Onshore unconventional gas developments on or close to private land pose a range of substantial risks to the land owner. To force land owners and communities to bear these risks for developments they do not want, actively reject, but have forced upon them is completely unacceptable in any civilised society. The government must act to protect the rights of private individuals to protect themselves and their property from risks and harms that they have no control over and cannot insure against. The WA government must enact law to allow private landholders and communities to refuse access to lease holders. To do anything other is a grave violation of the human rights and property ownership rights of the land owner.

Conclusions and recommendations

There is a growing body of evidence that the gas industry cannot and does not in real world practice achieve the standards it claims and that regulating bodies require and has not so anywhere. This failure of regulation to protect the public and environment from hazardous industry has a long history whereby industry routinely overstates it's ability to control it's processes, governments repeatedly fail to consider the gap between theoretical, ideal practices and actual real world practice when assessing the ability of regulation to mitigate harms, and when harms occur, dismiss complaints too easily and act far too slowly allowing harms to be exacerbated. We do not learn from past mistakes. (Davey, 2014; European Environment Agency, 2001).

I would love to have been able to write more. There is so much evidence in so many other areas

- of methane leaks (fugitive emissions) being up to 170 times higher than current government models predict on top of the large amounts of methane gas wells vent as a normal part of their operation with massive implications for global warming. A report released on March 14 2018 has revealed that if developed, the domestic onshore unconventional gas footprint for WA would be more the three times the entire energy sectors emissions budget for the whole of Australia under the Paris Agreement (Hare, 2018).
- of measurable health impacts to local communities that are concrete, replicable and dose dependant, and can be demonstrated in populations even several miles from well sites
- of air quality in rural areas where fracking occurs going from being pristine to being "worse than LA on it's worst days" (Gruver, 2011)
- to greatly overestimated benefits such as expected numbers of jobs being overestimated typically by a factor of 10
- of measurable harms to surrounding ecosystems
- of high costs born by state and local authorities, and ultimately tax and rate payers eg 1.5-2 Billion dollars a year in road damage costs from heavy vehicles used in fracking in Texas alone (Concerned Health Professionals of New York, 2018) and so much more.

As stated in my introduction, this inquiry only allowed a very short time for public comment. Unlike the gas industry, comment from the public has to be done on top of our normal work and home activities, rather than in paid work time. It was not enough.

I can only conclude by saying that it is undeniable in 2018 that onshore unconventional gas as a whole and hydraulic fracturing as a process is unacceptably risky and harmful to people, health, air, water, land, environment and the economy. It imposes high costs on state and local authorities that are ultimately born by those communities. It blows our Paris Agreement commitments out of the water and puts WA at high risk of significant financial losses through increased health costs, impacts on other industries of polluted or depleted water and polluted agricultural land and the massive costs of stranded assets if we invest in infrastructure that has a limited future as the costs of cleaner energy technologies price gas out of the energy market. The evidence is clear. The volume of evidence is substantial and growing. The only sane conclusion is that onshore unconventional gas poses unacceptable risk to the environment, people and economy of Western Australia, and regulation cannot mitigate this risk to an acceptable level.

I call upon this inquiry and upon the West Australian government to enact a permanent ban on hydraulic fracturing for onshore unconventional gas for the entire state of Western Australia. I further call upon this inquiry and the West Australian government to enact a permanent ban on all exploration, production and associated activities of onshore unconventional gas for the entire state of Western Australia.

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