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Standing Committee on Environment and Public Affairs
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Parliament House, Perth

Inquiry into the Implications for Western Australia of Hydraulic Fracturing for Unconventional Gas

Submission from Judith Blyth

Introduction

I am grateful for the opportunity to participate in this Inquiry as hydraulic fracturing (henceforth referred to as fracking) for unconventional gas(methane) is of extremely high concern to me.

In drafting this submission, I have depended on much 'borrowed' scientific material to support my case – that this industry is potentially an extremely harmful one – and we should take great care that if it is to proceed, it does so only under stringent conditions. Before WA becomes any more committed to allowing this new extractive technology to make further intrusions into WA's rural landscapes and communities, I am certain that *all* aspects of the industry's impact should be taken into account – that is a cost-benefit analysis of how its long term risks and benefits stack up against each other.. As well as examining its impact on the health of the environment, we need to define what health effects it could have on the human communities throughout the vast areas of WA that cover shale gas deposits. Its potential impacts will be similar to what South Australia, Queensland and NSW are already experiencing with the rampant coal seam gas industry in those states. We can learn by observing those impacts – which have called forth the Lock the Gate Alliance demonstrating the unhappiness of farmers whose land has been intruded upon by the industry. They are worried about their water supplies, their soils and air quality, noting that overseas experiences with fracking have left a legacy of harm to water, soil and air. They also have concerns to their own health. It is my hope that we in WA will not repeat the same mistakes here.

The Inquiry's Terms of Reference

Term of Reference 1 - How hydraulic fracturing may impact on current and future uses of land:

Term of Reference 2 - The regulation of chemicals used in the hydraulic fracturing process:

Term of Reference 3 - The use of groundwater in the hydraulic fracturing process and the potential for recycling of groundwater:

Term of Reference 4 - The reclamation (rehabilitation) of land that has been hydraulically fractured:

The **Terms of Reference** for this Parliamentary Inquiry seem to include little on the impacts on groundwater – except regarding its actual use in the fracking process and how that water might be recycled. This is a distressing oversight and I can only hope it is unintentional. It is essential that this critically important aspect be addressed more comprehensively through this Inquiry.

This situation reminds me of what happened in Queensland during a clearly shonky, fast-tracked approvals process a couple of years ago. Early this year, Four Corners looked at its history. Two major frack companies had applied to develop coal seam gas operations on a sizeable hunk of Queensland's south east. They failed to supply enough basic data for properly processing their application – but a great deal of pressure was put onto a senior bureaucrat Simone Marsh to approve it – and to do so at speed. The companies' lengthy EIS documents had failed to mention impact on water, one of the highest concerns about the fracking industry. This 'oversight' was glaring. Ms Marsh said *"It was quite frightening that they would consider approving such a project without the basic information that a normal mining project would have been asked to submit, given that this was like six hundred times the size of your standard, large mine."*

Her stress level grew to the point where she felt she could no longer work for the government and she packed up her office and left. Subsequently, a Four Corners programme (last April) exposed her painful journey through which she had found how the bureaucracy and the state government had abandoned the best interests of protecting water resources and community health in favour of giving the green light to these two companies. The case could have parallels in WA where a similar pro-industry, blow-long-term-environmental-and-health-outcomes mindset exists in our currently re-elected state government.

Another big area of concern is about how fracking relates to global warming. That must be comprehensively addressed, but the Inquiry's Terms of Reference also fail to include this.

The Terms of Reference should encompass assessment of fracking's impact on:

Global warming/Air pollution

Groundwater, including impact of multiple frack wells

Human Health/Communities

Natural ecosystems

... and should also address **Regulation of a shale gas industry in WA** beyond simply looking into what chemicals should be permitted.

I am not at all belittling the importance of the Inquiry's four Terms of Reference– but there is a larger picture that we need to consider.

Now I will try to reply to those four Terms of Reference – after which I shall respond to the extra aspects that I would have liked to see included in this Inquiry.

<u>Term of Reference 1</u> refers to "How hydraulic fracturing may impact on current and future uses of land".

I applaud this forward projection on impacts of the fracking industry on land. Its legacy will last for an extremely long time. Our opportunity to minimise its harmful effects exists now and we must not squander this chance.

The First People have fought for a long time for their native title rights. If Aboriginal people are to be forced to enter access 'agreements' imposed on them by inflexible legal instruments giving frackers the 'right' to operate their gas wells on native title land, that would be another extension on the injustices dealt to them since this continent was Europeanised. Indigenous connectedness to country should be recognised and respected. We should be able to improve on our past record in this 21st century by paying genuine homage to the thousands of years of indigenous law behind Aboriginal commitment to look after country. Our laws should be helping them to do so, not undermining their ability to fulfil this deeply held belief in their responsibilities to their ancient homelands.

All life depends on water. Over allocation of groundwater could result in serious decreases to the availability of the water supply for drinking and farming. See Wood Ruth, Gilbert Paul, Sharmina Maria, Anderson Kevin, Footit Anthony, Glynn Steven, Nicholls Fiona.Shale Gas : a provisional assessment of climate change and environmental impacts. Tyndall Center for Climate Change Research, 2011. Available on http://www.karooplaces.com/wp-content/uploads/2011/06/coop_shale_gas_report_final_200111.pdf

Fracking is projected to occur in WA's agricultural and pastoral lands, around places of high tourism activities – so there is potential for short- and long-term impacts on food production and the tourism industry. In the US, good farmland has been polluted and ruined. Let us protect our primary food producers and their land better than this – and preserve our landscapes that attract tourists to WA.

Landowners in WA cannot prevent fracking on their land. Also WA law allows shale gas fracking to occur in our nature reserves and other areas of our conservation estate. The Petroleum Geothermal Energy Resources Act 1967 (PGER Act) which covers the petroleum industry allocating it a separate tenement regime for exploration and production, likewise applies to fracking, gifting that industry too with special treatment. Examples are paying low royalties, benefiting by more than $100 million in unconventional gas exploration subsidies, freedom to pollute water with impunity ... and not cleaning up once gas extraction is finished. The industry itself should certainly attend to whatever rehabilitation is possible and pay the bills for it!

The PGER Act gives limited rights to farmers and private landowners. To the Minister for Mines and Petroleum it gives the legal right to grant exploration, and to retain and develop titles over 'private land'. There is no requirement that landowners be notified or consulted if gas exploration has been granted over their land. Landowners may have no rights of objection to the development of a gas field on their land. If a formal notice from an exploration company is issued to a landowner, the landowner has 3 months in which to reach a compensation agreement – or the matter will go to the Magistrate's Court for determination. Hence there is little to stop the March of the Frackers onto 'private land'.

In future, we will need the food that could be produced on these gasfields far more than we will need the energy derived from the gas (what we don't export, that is). WA has abundant free energy fuels of sun, wind and wave, to generate electricity. If the government encouraged renewable energy technologies to establish in WA in favour of the fossil fuel industries, including fracking, healthier farmers would be able to continue to work their lands, our aquifers would not be so depleted by our energy needs, and we would have more of our precious conservation estate intact. We would be winners.

Despite the fact that fracking was already operating in the Perth Artesian Basin in June last year, the information shadow that the farmers were in was not to be dispersed by the then Minister for Mines, Norman Moore. Doctors for the Environment Australia (DEA), a voluntary organisation of medical doctors working to prevent ill health caused by environmental damage, was invited by the farmers via the National Party to address some public meetings in the region to explain environmental and health issues involved. Dr George Crisp of the DEA (WA Branch) was set to respond, but clearly Minister Moore wanted only representatives from the Dept. of Petroleum and Mines and industry speakers to address these meetings. He prevented Dr Crisp from presenting at them. In the DEA's media release, Dr Kingsley Faulkner, Chair of DEA said, *"Affected communities have a right to information about the potential health effects of this technology. For the minister to obstruct this process undermines democracy and suggests there is something to hide."* ...and *"There are clearly inherent risks to human health from exposure to toxic and untested chemicals that may be spilt at the surface or leak into subsurface water"* and *"The decision to exclude environmental and health assessment and input from this process ignores real risks and is at odds with overseas experience."*

Quoting again from the DEA's media release, had the Mid West communities been able to hear Dr Crisp speak, they would have found out about *"potentially serious health risks to the community ... which may arise from industrial scale water consumption, water contamination; air pollution, particularly by volatile organic compounds (VOCs) and methane, seismic effects, and the production and management of large quantities of toxic liquid waste, as well as long-term and cumulative impacts on freshwater aquifers."* ... and further, that the *"DEA considers the current level of assessment, monitoring and regulation of unconventional gas exploration and mining to be inadequate. DEA supports a precautionary approach in this setting and recommends a moratorium on unconventional gas extraction until safety has been established by thorough, transparent and impartial analysis."*

Small wonder that Minister Moore was keen for only one side of the fracking industry to be presented. The farming community might have become "difficult" had they been better informed of the risks they will be exposed to from fracking.

Late last year, WA Farmers President Dale Park expressed further concerns of farmers over the impacts of shale gas fracking on their water supplies. (See ***Farmers fear water risk in gas search*** by Kate Emery, in The West Australian, 2012.12.28). They wanted to know more about the risks, especially given the immense size of the resource. Mr Park expressed his wish to see an impact study or something similar. It is an indictment on the present WA government that there was a need to ask this question. Why is this controversial but as yet infant industry even allowed to start up at all before such a basic study is done? Dr Crisp referred to the US EPA's decision to conduct a comprehensive study into the potential adverse effects of fracking on water quality and public health. This Inquiry is a chance for us

to look hard at the fracking industry here too... but the Inquiry's Terms of Reference need to be broadened.

The present WA government's haste to see fracking well-established here on a large scale is exemplified by inducements it offers - like half-price royalties to fracking companies, and the avoidance of due process such as having environmental assessments done. The then Mines Minister Norman Moore insisted last December that existing regulations *were "more than adequate"* and he brushed off the idea of impact studies. See: Farmers fear water risk in gas search, The West Australian, 2012.12.28. Perhaps Mr Moore meant "more than adequate for the fracking industry to go ahead unimpeded" – though he did make reference to companies being required to disclose what chemicals they put into the ground – but not to any chemicals that would be excluded due to their potential for harm to water supply, environment and health.

A CSIRO report late last year found that some Mid West farmers wanted more information about how the fracking industry would affect their communities and lifestyle. Water is a basic necessity for food production – Could their immediate and long-term water supplies become contaminated by fracking?

A small group of Jurien Bay citizens organised another meeting about fracking to which representatives from Doctors for the Environment Australia and the Environmental Defenders Office as well as the Conservation Council of WA were invited to speak – as well as a well-informed respected local farmer. Concern was expressed about how a fracking company could have been issued an exploration permit which included Beekeepers Nature Reserve, part of Lesueur and Drover's Cave National Parks, part of Leda Nature Reserve, all of Nambung National Park and also Wanagarren and Nilgen Nature Reserves.

The **Petroleum Geothermal Energy Resources Act 1967** with its special treatment of shale gas fracking companies would have allowed this travesty to occur. Likewise, such companies would probably be granted permits over surrounding farmlands if they had applied.

The regulation of the fracking industry is unjust to farmers and extremely disrespectful to our conservation estate, impacting on groundwater quality, polluting the air with methane (and sometimes radon gas) emissions, and by its 'footprint' of a network of roads and well pads, taking a considerable amount of land out of production for food. We must consider these impacts on the land and its communities, not simply by one gas well at a time, but the impact of many thousands of such wells with their deep underground spider networks of horizontal shafts radiating from each vertical well, and the cumulative impact of the explosive fracking to free the gas from the shale.

We have so many warnings about the impact of fracking (whether of CSG or gas-bearing shales, the effects are largely the same). Experiences from overseas or here in Australia should make us wiser about how we should generate power. Last April, a Four Corners programme gave us more insight into the impacts on our farmlands as the reporter talked with farmers and footage was gathered showing methane bubbling through rivers, and found bores polluted with fracking chemicals. Reserves of groundwater had dropped, presumably due at least in part to the thirst of the fracking process. This 'thirst' will place the frackers in conflict with the farmers.

Term of Reference 2 - The regulation of chemicals used in the hydraulic fracturing process:

Frack chemicals have been found in bore water in eastern Australia where fracking is practised. In the US, people's health and their livelihoods have been damaged by the fugitive fracking chemicals in their water. We need stringent, well-enforced regulations in WA to ensure 'best practice' in the fracking industry here if it is to go further ahead, so that human and environmental health and agricultural production is protected from frack-chemical pollution.

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This following section about chemicals used in fracking is more or less 'borrowed' to strengthen my appeal for the need for much improved regulation of fracking in WA. References are listed at end of section :

Chemicals used in gas fracking processes include toxic, allergenic, mutagenic and carcinogenic substances[iii], which even in minute quantities can make water toxic and potentially dangerous.

The primary sources of risk come from:

- **Fracking Fluid ('slickwater')** - the fluids used in fracking comprise a mix of water and sand (98%), combined with around 2% additional chemical additives (such substances are also known as 'slickwater'). The chemicals used in fracking fluids include known toxic, allergenic, mutagenic and, carcinogenic substances.[iv]
- **Toxic particulates released from the shale itself** - released from the source rock after fracking, and returning to the surface as 'flow-back fluid', usually kept in open-air, on-site ponds. This new mixture can contain harmful substances such as heavy metals, naturally occurring radioactive materials (NORMs - including Radium, Thorium and Uranium), high concentrations of salts, oils and other contaminants, including arsenic, benzene and mercury[v].

The European Commission's 2012 report found an overall high risk of surface water contamination by dangerous substances and chemicals from unconventional gas fracking activities[vi]. Lakes, wetlands, rivers are therefore also likely to be harmed by fracking.

This water pollution would impact on environmental and human health and agricultural production. **It is of supreme importance that we ensure our food security.** We should move environmental impact assessment processes to the EPA rather than the conflicted DMP – and insist on assessment addressing multiple wells (including their drilled horizontal reaches) in whole gasfields rather than the well-by-well strategy favoured by our current WA government. All activity at each well must then be subject to stringent regulations over fracking. Such regulation is yet to be drafted and legislated.

Contamination of groundwater occurs when wells fail during production, or in the longer term through corrosion, or by pollutants migrating through faults, or by surface water migrating into aquifers. Sadly, such contamination of WA aquifers could be irreversible.

We know that such failures happen from the study in Pennsylvania where it was found that 6-7% of new wells failed in the past three years, and that these statistics will worsen as wells age, crack and corrode. The fracking process itself is known to cause shallow local seismic activity – which increases the likelihood of damage to the vertical and horizontal frack wells and their geological surroundings – and therefore increasing the risk of spreading chemically contaminated water and fugitive gases.

Surface water can become contaminated with waste slick-water containing fracking chemicals (15-80% of the fracking fluid is returned to the surface) [ix], and flow-back fluid (containing additional substances freed from shale rock during blasting) [x]. This waste water, after being brought to the surface, is left in open air ponds (vulnerable to flooding – or to tears in their lining) or taken to another site by heavy transport. Total truck movements for a single well pad are estimated at 7,000 to 11,000 - producing not only the pollution which comes with heavy traffic, but also exponentially increasing the risk of a spill of wastewater or fracking fluid on transport lines. Both settling ponds and transportation therefore can result in accidental spills involving dangerous chemicals entering surface water – lakes, rivers and wetlands.

References for the above section are:

[iii] Colborn Theo, Kwiatkowski Carol, Schultz Kim, Bachran Mary, Natural Gas Operations from a Public Health Perspective, int the Inernational Journal of Human and Ecological Rosk Assessment, 2010. Available on :
http://www.endocrinedisruption.com/files/Oct2011HERA10-48forweb3-3-11.pdf

[iv] Ibid.

[v] Ibid.

[vi] Ibid.

[vii] Ibid.

[viii] Broomfield Mark, Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe. AEA Technology, 2012, available on
http://ec.europa.eu/environment/integration/energy/pdf/fracking%20study.pdf

[ix] [ix] Wood Ruth, Gilbert Paul, Sharmina Maria, Anderson Kevin, Footit Anthony, Glynn Steven, Nicholls Fiona. Shale Gas : a provisional assessment of climate change and environmental impacts. Tyndall Center for Climate Change Research, 2011. Available on
http://www.karooplaces.com/wp-content/uploads/2011/06/coop_shale_gas_report_final_200111.pdf

[x] LechtenBöhmer Stephan, Altmann Mathias, Capito Sofia, Motra Zsoltz, Weindrofr Werner, Zitell Werner, Impacts of Shale gas and shale oil extraction on the environment and on human health. European Oarliament, directoret general for internal policies, policy department, A : Economic and Scientific policy. 2011, available on :
http://www.europarl.europa.eu/document/activities/cont/201107/20110715ATT24183/20110715ATT24183EN.pdf

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It is simply not possible for the fracking industry here to execute its business perfectly for each well's duration. Of the many thousands of frack wells proposed for WA, only one needs to critically fail, enabling chemical leakage which could wreck the water quality of an aquifer.

While the industry tries to reassure that fracking here in WA will be more carefully executed compared to the US, we already have evidence that this is not so. (eg. Leakage at Corybas well near Dongara.) Given the so-far inadequate regulations over the incipient industry in WA, it is difficult to have faith that the companies' immediate or long-term behaviour will adequately protect our groundwater from chemical contamination. The 'cocktail of chemicals' injected under high pressure to fracture shales deep underground in order to free trapped gas will be combinations of any of the 500+ chemicals used by the fracking industry. Each combination will be refined to deal with the particular geology of each frack well. They could include benzene, mercury, arsenic, and radon which are all toxic to humans, livestock and wildlife.

In Pennsylvania in the US, 6-7 per cent of new shale fracking wells have leaked such pollutants into groundwater for the past three years. Leakage is likely to increase as wells age and more cracks appear. The social consequences to farming families becoming unable to use such polluted water for showering, cooking etc have been severe. Their land values have collapsed so they are unable to sell and move on.

We must ensure that WA does not follow this course – and this means being far more wary of the fracking industry than we are now. The encouragement by the current government through incentives (half price royalties) via the Royalties for Regions funding is absolutely back-to-front. **The first step should have been more research to assemble relevant data, and trustworthy environmental and human health assessment of fracking in WA. .. after which the regulations regarding allowable chemicals and operating practices should be refined. Can we hope that will come out retrospectively after this Inquiry is completed?**

In the meantime, the projections are that the industry wants to drill 100,000 wells in the Kimberley over the Canning Basin, and 30,000 in the Midwest, including on farms, nature reserves, in wildflower country and in drinking water catchments at Jurien Bay and Eneabba.

Some projects in WA are up and running – and already leaking chemicals and gas.

Fracking has made people sick in Queensland and in the United States. It has spoiled good agricultural land through pollution of water, soil and air. It has disrupted farmlands and communities. Do we really want it WA? It has been going on regardless of this question being answered by the people – and regardless of the fact that its environmental, health and social impacts have not been properly assessed. Nonetheless the Barnett government has given the fracking industry enormous financial encouragement here. **That's why a Federal line of defence of our health and environment is so necessary.**

Now we have an Abbott Federal Government – and our new Prime Minister has not looked kindly on the Commonwealth Environment and Biodiversity Act in the past. If this results in

renouncing this legislation, protection of our natural history estate will depend on state and territory law only. **If this comes to pass, then WA must ensure that any fracking activity in this state must operate only under a rigorous and transparent regulatory regime. We must protect our groundwater and surface water, our soils and air.**

Term of Reference 3 - The use of ground water in the hydraulic fracturing process and the potential for recycling of ground water:

Water is a basic need for life and for food security. In the south western part of WA, water is becoming an increasingly scarce resource as climate change bites. This is demonstrated in the dwindling rain records from this region since the 1970s.

Fracking is a water-intensive industry. Each shale gas frack requires between 9 million and 29 million litres of water - that's for a single well. Imagine that figure multiplied by 130,000 – That's how much water would be required if the fracking industry in WA is not to be stopped. How can we justify using our precious groundwater reserves at that level? Of course thoughts are turning to recycling of this groundwater – but how? Firstly, decontaminating it would have to occur on a very large scale before it could be pumped down into the aquifers again. If that could be done at all, it would add to the costs of running each fracking operation – making it less economic. Secondly, how possible is it anyway to decontaminate slick-water and flow-back fluid?

Over-allocation of the aquifer could result in serious decreases to the availability of the water supply for drinking and farming. See Wood Ruth, Gilbert Paul, Sharmina Maria, Anderson Kevin, Footit Anthony, Glynn Steven, Nicholls Fiona.Shale Gas : a provisional assessment of climate change and environmental impacts. Tyndall Center for Climate Change Research, 2011. Available on http://www.karooplaces.com/wp-content/uploads/2011/06/coop_shale_gas_report_final_200111.pdf

Fracking uses a wide variety of chemicals, some of which are toxic or carcinogenic. There are over 500 chemicals known to be used in this process, and each "chemical cocktail" is presumably adjusted to the particular subterranean environment in which each frack well is to occur. This process contaminates the water it uses and presents a dangerous risk of pollution by escapee slick-water – as well as challenging any attempts to recycle the water. The contamination of water may well be irreversible and permanent.

Also leakages from frack wells and holding ponds allow contamination to spread into surrounding water, soil and rock. An independent study by Cornell University found that 6-7% of fracked wells were leaking into aquifers within a year of drilling.

It is crucial that fracking not be given precedence over food production needs. As shale gas in WA usually occurs below the artesian water basin, the many thousands of gas wells (130,000+) that might be drilled, must usually pass through that groundwater to reach the gas stratum. Unless well installation and the fracking process is perfect every the time, it is likely that we will be experiencing fugitive methane and other gas emissions in groundwater – as well as in soil and air.

Of course the industry here will tell us that their practices are safe. However, already frack wells have started leaking pollutants in WA. I refer to the Corybas well to the south of Dongara. Gas started to bubble up through the well. It is just one of around 130,000 wells we might eventually have in WA – but you only need one leak to contaminate an aquifer forever. The statistical likelihood of other wells leaking has to be accepted. This is a risky, imperfect technology being practised in remote areas with little oversight.

Rather than protecting our rural landscape, farmlands and communities from the dangers of fracking, our current WA government offers this industry enthusiastic encouragement at every step - Generously halving royalty arrangements for exploration, offering the incentive of over $100million in unconventional gas exploration subsidies and avoidance of regulation that would see each project assessed by the Environmental Protection Authority. (That process should not be handled by the conflicted DMP – as is the case at present.)

With encouragement like this, fracking could soon be pockmarking the landscapes we love. Western Australia has the fifth largest reserve of shale gas in the world concentrated in the Canning Super Basin that underlies a large part of the Kimberley. Then there's the farming districts and wildflower country in the Midwest which are considered excellent prospective gasfields in WA. The North Perth Basin is WA's gas field closest to production, and contains twice the gas reserves of all the coal seam gas fields on the east coast combined. Shale gas extraction could be a gigantic industry in WA – but should it be developed at all? Its impact on water resources through depletion and pollution, is one strong reason why it should not.

Overseas experiences with fracking confirms that leaks happen from holding ponds (contaminating surface water) and from deep injection wells, contaminating groundwater with chemical pollution.

Please refer to the Proceedings of the National Acdemy of Sciences's paper which addresses the impact of horizontal drilling and fracking in the Appalachian Plateaus region of north eastern Pennsylvania: ***Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction,*** by scientists, Robert B. Jackson, Avner Vengosh, Thomas H. Darrah, Nathaniel R. Warner, Adrian Down, Robert J. Poreda, Stephen G. Osborne, Kaiguang Zhao, and Jonathan D. Karr. These studies found that 82% of drinking water samples contained methane. Average concentrations were 6 times higher in homes <1km from a gas well. Ethane was 23% higher in homes <1 km from a gas well. Propane was detected in 10 water wells all within c. a km distance from a gas well. The Marcellus study of environmental and health consequences of fracking has led to fracking being banned in France and Belgium, and in towns of Pittsburg and New Jersey in the US.

We have to ask how the change of federal government in Australia will affect past efforts for legal measures to protect water resources from contaminating coal seam gas fracking and other forms of fracking that we have in WA. Former Independent MP Tony Windsor's **Environment Protection and Biodiversity Conservation Amendment Bill 2013** would have allowed the Federal Environment Minister to consider the impact on water of coal seam gas and coal mining. However to include WA's case where gas occurs in shale, the Bill needed wider scope. In June, WA Senator Scott Ludlam tried to bring that about by moving an amendment to the Bill to include shale gas, tight gas and underground coal gasification. The Senator's experience in the 2009 inquiry into the impact of mining in the Murray Darling Basin had made him well aware of the grave consequences of permanently ruining the

hydrogeology of the Liverpool Plains, and the consequences of filtering inland Australia's drinking water through a pair of active coalmines.

In the Perth Basin, a major unconventional gas resource occurs – and if the fracking industry is permitted to exploit it, it could in time be responsible for contaminating Perth's water supply. Around 40 % of Perth's drinking water is sourced from groundwater.

Fracking is a very water-intensive industry, and yet is being actively (and I think recklessly) encouraged by the present WA government. As global warming advances, rainfall in the south west of WA will progressively diminish and this is already evident. Where will we get our water from – if fracking is permitted to diminish our groundwater resource? We could have more expensive desal plants (which already supply 50% of Perth's water) – but should the state and taxpayers have to take that expensive course – which would be in part due to the high water use of the fracking industry? 9 – 29 million litres per well.

WA's Canning Basin is assessed by US Department of Energy experts to have 229 trillion cubic feet of recoverable gas. That's around five times bigger than Chevron's Gorgon field. How irresistible this must seem to the Mr Oncelers of the world (Please refer to Dr Seuss's ***The Lorax***)! – but should they be allowed to extract that resource using the risky and controversial fracking methods? How will fracking affect the availability of water for the pastoral industry? Or for the towns in that region? Groundwater contamination could effectively last forever.

I am very critical that our state government has dedicated around $27 million from the Royalties for Regions funds for drilling for gas in WA; also of great concern is the close relationship of the Department of Mining & Petroleum and APPEA representatives – who co-present at public meetings, effectively pushing the case for this private industry to be accepted in outback communities. Such government bias must be questioned. **Surely we should have a moratorium on fracking in WA, to remain in place until proper regulations are established to guarantee that WA's water resources will not be placed at risk by this industry.**

We must remember that the European Commission's report in September 2012 found a high risk of groundwater and surface water contamination, and also a high risk of air pollution.

If pumping used groundwater back down into the aquifer is what the Term of Reference means by "recycling of groundwater", I am sure it should not be permitted.

<u>Term of Reference 4</u> - The reclamation (rehabilitation) of land that has been hydraulically fractured:

Rehabilitation of fracked landscapes should be the responsibility of the fracking companies – and not the WA taxpayers. Current lax law only obliges frack companies to monitor their abandoned wells for two years – after which they can leave. How then can they 'fix' the chemical pollution of groundwater if that has occurred? Or mend the land, lakes, wetlands, creeks and rivers if chemically contaminated should a widespread flood spread the damage far and wide?

The wells could continue as pollution threats forever as they crack and corrode with age, severely contaminating groundwater and land. The health consequences of such a disaster

must be taken into account – before this 'infant industry' really cranks up in WA. Sadly, because it is such an unnecessary risk we are taking, it has already progressed far too far. **I say "unnecessary" because WA is so blessed with proven renewable energy sources that do not endanger our water, soil and air – We should instead be harnessing the sun, wind and wave power that we have in abundance. Our government should be steering us away from fossil fuels and transitioning to renewable sources (which have the additional benefit of being free).** The funds that have been so eagerly applied to the fracking industry could have been so much more beneficially employed if directed to the solar Goldfields concept or to Carnegie wave power development by Garden Island, or to more wind farms around the coastline of WA.

If this had been the government's strategy, there would be no need for this question of liability for rehabilitating polluted fracked landscapes.

Additional to the Terms of Reference:

I strongly urge the impact of following be included:

1. **Global warming/Air pollution**

Fugitive gas is released from gasfields during fracking. A study by scientists from Southern Cross University found that coal seam gas fields on Queensland's Darling Downs were leaking at a greater rate than thought. The findings were revealed in March this year after the Lismore-based scientists had found radioactive radon gas near wells near Tara were three times higher than the surrounding area. Douglas Tait, one of the researchers, explained that this study was the first of its kind – and that clearly more needs to be done in terms of monitoring stations in the gasfields collecting baseline data on the patterns of radon emissions – and to do so over a longer term. Dr Tait said *"Basically what it suggests is that there is alternative pathways for emissions from the coal seam gas industry, so rather than emissions just coming from infrastructure, what this suggests is emissions might be diffusing through the soil over a much larger scale."*

Associate Professor Isaac Santos said more research needs to be done, but the findings indicate emissions are concentrated around CSG wells. Is this the case because of the fracking process – or have the wells concentrated in areas that are more naturally highly gassy? This is just an example of how little is known about this industry's impacts – while it has been encouraged to gallop ahead in the eastern states.

The fracking industry presents itself as clean – at least in comparison with coal-fired power generation (but veers away from comparisons with renewable energy sources.) Gaslands, the film put together by young US film-maker Josh Fox, had much footage of methane gas bubbling up through water on farmlands, farmers lighting the gas-permeated water that came through taps in their homes, (and also the chemical contamination of bore water) – all manifestations of the harm apparently related to fracking, a juggernaut of an industry that was dividing communities as it grew to mammoth proportions. The fugitive gas issue is a serious one as methane is a powerful greenhouse gas (GHG) 30 times more harmful than CO2.

This same problem exists to a growing degree in Australia as was demonstrated through the Four Corners programme last April. Reporter Matthew Carney interviewed farmers in the eastern states where fracking is rife. Footage again showed methane gas bubbling up through rivers. **The programme looked at the latest research that suggested the CSG industry is a much bigger GHG emitter than previously thought.** To the gas directly emitted from the fracking process should be added the pollution from the plethora of heavy trucks traversing the gasfields constantly. As any aerial view of a gasfield will show, there is a network of new roads between the proliferation of well heads. I ask decision-makers to please keep in mind that **total truck movements for a single well pad are estimated at 7,000 to 11,000, producing air pollution which comes with heavy traffic,** (while also increasing the likelihood of accidental spills of contaminated frack water being removed from well heads.)

Whenever contemplating fracking, we should keep firmly in mind the **European Commission's report (Sept 2012) which found a high risk of air pollution associated with that industry.** While we can learn much from this study, the need for Australia-specific research into fracking's impacts given our various different geological circumstances where unconventional gas occurs. These data should be collected before fracking commences.

2. Groundwater and surface water, including impact of multiple frack wells in shales and tight gas areas

The current WA government prefers assessment of only ONE well at a time, and I suspect with good reason. Because frack operations will drill many wells per gasfield and those wells will pass through the groundwater layer before reaching the gas-bearing shale, there is the possibility of escaped chemicals passing through cracks in the well and through fissures in the rock and entering the aquifer allowing the pollutants to spread. The high number of wells per gasfield increases the chances of linkage to pollution from other wells in the vicinity, thus hastening the spread and interactivity of these sometimes toxic chemicals. In this way, the aquifer could become seriously contaminated permanently. Multiple wells dotted about a single gasfield will do exacerbate the risks of water, soil and air pollution. Rehabilitation of such a dangerous mess would be very difficult, if not impossible..

Each shale gas frack requires between 9 million and 29 million litres of water – If we extrapolate that to the 130,000 wells projected to be drilled in WA, it represents an awesome amount of water. It also puts the fracking industry on a collision course with the agricultural and pastoral industries – and any other reasonable use of this water. The immense scale of water usage for fracking suggests very strongly how interaction from well to well, each with its horizontally drilled 'spokes' could take place, allowing the subterranean spread of polluted water. See http://www.ga.gov.au/groundwater/basics/groundwater-use.html

Fracking is not deep enough under Earth's surface to cause large-scale destructive earthquakes. However the pumping under high pressure of fluids into the ground does cause local shallow seismic activity, enough in some cases to feel it on the surface, and sometimes causing ground collapse. This would open up fissures for the migration of escaped slick-water and flow-back fluids, again risking contamination of groundwater. This is another reason to be very wary of gas fracking – and should be further researched by geologists.

There are many aspects of fracking begging for further scientific research to provide better understanding of the actual and likely impacts of this industry. Instead, a blind single-minded rush rules the day with short-term financial gains eclipsing every other consideration.

Climate change is happening now – We see it in the increasing melting of polar ice, in the increasing occurrences of extreme weather causing floods and major wildfires around the globe, in the thawing of the permafrost and tundra releasing advancing quantities of methane and so on. Governments everywhere should be urgently guiding us away from burning fossil fuels for power generation, and towards existing renewable energy technologies and also providing incentives for developing new ways to capture these free energy sources. Instead, the present WA government is tragically stuck in the past, plunging our state's financial resources into restoring Muja A&B coal-fired stations in Collie – and pushing forward with the fracking industry widely around the state. All this before proper research has been undertaken and before a rigorous, transparent, trustworthy and effective regulatory regime is in place. Perhaps since WA has recently lost its Triple A-rating, the government might pull in its belt and at least not be so generous in its financial encouragement of the fracking industry here.

While the WA's EPA has delayed studies of effects on drinking water by fracking, recent academic research reveals that people who live near natural gas wells in Pennsylvania are drinking the same gases that the frackers are pumping out from the shale beneath their feet.

I want to refer again to that PNAS-published study which concludes that levels of the gas were far higher in drinking water wells located close to fracking operations than in other areas. It should sound warning bells in the heads of any decision-makers about whether fracking is a good idea or not. I would be most relieved if the EPA would take it to heart.

Researchers from Duke University, the University of Rochester, and California State Polytechnic University found dissolved methane, which is the main ingredient in natural gas, in water pumped from 82 percent of drinking water wells sampled in northeastern Pennsylvania. The researchers theorise that this gas in drinking water is due to sloppy safety practices on the part of the fracking industry. They reported that the two simplest explanations for the higher dissolved gas concentrations that they observed in drinking water were (i) faulty or inadequate steel casings, which are designed to keep the gas and any water inside the well from leaking into the environment, and (ii) imperfections in the cement sealing of the annulus or gaps between casings and rock that keep fluids from moving up the outside of the well.

In 2010, the Pennsylvania Department of Environmental Protection (DEP) issued 90 violations for faulty casing and cementing on 64 Marcellus shale gas wells; 119 similar violations were issued in 2011.

Methane is highly damaging to our atmosphere – but the fracking industry around the globe is emitting that climate-changing gas in significant quantities at a time when it is so critical that globally we reduce GHGs.

WA does not have to go down this track!

Ground Level Ozone

Ground Level Ozone is created when VOCs combine with nitrogen monoxide, heat and sunlight. Chronic exposure to heightened level of ozone is correlated with higher rates of asthma and chronic obstructive pulmonary disease[vi]. Combined with Particulate Matter, ozone creates smog[vii].

There are high stakes here. Air pollution can have dire consequences on public health. The European Commission report found there is a cumulatively ***high risk*** of air pollution[viii], and as such, the gas fracking industry should have to prove to the community that what they are doing is safe. Until they have done so, they should not be allowed to gamble with the public's health.

For more information on public health risks, see :

[i] Broomfield Mark, *Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe*. AEA Technology, 2012, available on http://ec.europa.eu/environment/integration/energy/pdf/fracking%20study.pdf

[ii] Colborn Theo, Kwiatkowski Carol, Schultz Kim, Bachran Mary, *Natural Gas Operations from a Public Health Perspective*, in the International Journal of Human and Ecological Rosk Assessment, 2010. Available on : http://www.endocrinedisruption.com/files/Oct2011HERA10-48forweb3-3-11.pdf

[iii] LechtenBöhmer Stephan, Altmann Mathias, Capito Sofia, Motra Zsoltz, Weindrofr Werner, Zitell Werner, Impacts of Shale gas and shale oil extraction on the environment and on human health. European Oarliament, directoret general for internal policies, policy department, A : Economic and Scientific policy. 2011, available on : http://www.europarl.europa.eu/document/activities/cont/201107/20110715ATT24183/20110715ATT24183EN.pdf

[iv] http://www.epa.gov/iaq/voc2.html#definition

[v] Mc Kenzie M. Liza, Witter Z. Roxana, Newman S. Lee, Adgate L. John, *Human health risk assessment of air emissions from development of unconvetional natural gas ressources*. In the Science of Total Environment, 2012.

[vi] Colborn Theo, Kwiatkowski Carol, Schultz Kim, Bachran Mary, *Natural Gas Operations from a Public Health Perspective*, in the International Journal of Human and Ecological Rosk Assessment, 2010. Available on : http://www.endocrinedisruption.com/files/Oct2011HERA10-48forweb3-3-11.pdf

[viii] Broomfield Mark, *Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe*. AEA Technology, 2012, available on http://ec.europa.eu/environment/integration/energy/pdf/fracking%20study.pdf

As well as these health impacts, there will be **social impacts** with hundreds of temporary FIFO workers coming to the gasfields. Their presence we know from past experience will drive up rents making accommodation an even higher problem for long term residents (Think of Port Hedland's troubles in this regard with influx of mine workers.) . Most frack workers will be males – and this can lead to social problems as the male-female ratio becomes imbalanced. Regional ratepayers will be paying for maintenance of many roads used by the many hundreds of heavy trucks of the fracking companies.

4. Natural ecosystems

Just as fracking causes air pollution that damages human health, so it must cause health damage to wildlife.

Fracking has a large 'footprint' as it needs an expansive network of roads to service its thousands of wells each with a sizeable well pad – so the land surface used by fracking is actually immense (let alone its subterranean intrusions and the impact they are likely to have on stygofauna.) The increased traffic of heavy trucks will conflict with wildlife. It will scar our wilderness areas and farms with thousands of roads and well pads, fragmenting and degrading the landscape.

This Inquiry should also address **Regulation of a shale gas industry in WA** beyond simply looking into what chemicals should be permitted.

For instance, should it not be the EPA, and not the DMP tasked with assessing the environmental impact of the fracking industry? An integrated approach assessing human health impacts, social impacts, long term economic impacts would be wise. No more frack wells should be drilled before all these questions have been adequately addressed and assessed. Independent experts in all these fields should be brought into the process. Fracking should proceed only if all these assessments result in well-justified approvals. Then strict regulations should be applied cradle-to-grave over the process of fracking - from establishment, through operation, and finally decommissioning of plant, and decontamination and rehabilitation of the land. No frack well should be started without a guarantee from the company involved that it will properly rehabilitate the above and below landscape affected. The financial benefits are huge – and frack companies should uncritically accept this condition. Of the impact on the health of workers and communities exposed to shale gas fracking in WA, there should be reparations by the companies responsible for ill-health during and after the working period of their employees and the communities they affect. This would of course require good medical oversight and records of worker health. There should be independent oversight to see that all regulations are vigorously adhered to – and that is a fully transparent process.

WA is a long way from achieving such regulations – (but I have enjoyed writing them down!).

Under current WA law, such polluting industries have to be licensed by the Department of Parks and Wildlife (formerly Dept of Environment and Conservation) under the *Environmental Protection Act* 1986. Extraordinarily, instead of requiring an Operating Licence to control pollution as for other mining, shale gas fracking is currently EXEMPT from this condition. This allows the industry to get away with poor practices like unlined frack flow-back ponds. This is not acceptable.

The current state government's commitment to having environmental impacts of shale gas fracking regulated by the Department of Mines and Petroleum (DMP) is a clear indication of the government's priorities – Fracking trumps Environment and Health. After all, the DMP's dominating concern is to promote such industries as shale gas fracking, and giving it the responsibility to oversee the protection of WA's environmental values in regard to this same industry puts the Department into a very conflicted position. It is forced to take sides – and its natural choice is to favour the fracking industry.

How can this conflict of roles be resolved so that the environment upon which we all depend for our health can be better respected and protected? Should the role of regulator come under the aegis of DPaW? The environmental and health protections needed should at least be given equal weight by the state government compared to governmental support for the fracking industry here.

The following section is copied from another document and tells the recent history of the inadequacies of WA regulations over shale gas fracking in WA....

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In 2011, the DMP commissioned an independent expert (Dr. Tina Hunter) to review its regulatory arrangements for gas fracking in WA, which falls under the *Petroleum and Geothermal Resources Act.* In her report, Dr. Hunter concluded that ***"there are no legal provisions in the* [petroleum] *Act that specifically pertains to the management of the environment in onshore petroleum activities."***

Dr. Hunter identified DMP's requirement for proponents to develop 'Environmental Management Plans' (EMP) as a measure to manage environmental impact, however she also noted that "*under the current legislative framework the EMP is* ***legally unenforceable.***"

While some improvements have been made since this report, the fundamental failures noted by Dr. Tina Hunter have not been rectified. As a consequence the WA community cannot have confidence in the regulatory regime currently in place for shale gas fracking in WA.

Sources: Hunter, T (2011) *Regulation of Shale, Coal Seam and Tight Gas Activities in Western Australia*, Faculty of Law, Bond University

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Signed by:

19/09/2013