Submission to the Independent Scientific Panel Inquiry into Hydraulic Fracture Stimulation in Western Australia 2017

March 2018

Doctors for the Environment Australia

67 Payneham Road
College Park SA 5069
P 0422 974 857
E admin@dea.org.au
W www.dea.org.au

Healthy planet, healthy people.

This submission focusses on the potential impact of Hydraulic Fracture Stimulation (fracking) in Western Australia on the physical and mental health of individuals, and the public health of populations. The definition of health includes the Aboriginal concept of the current and future wellbeing of both the individual and the community.

Recommendations

1. There is currently insufficient documentation of toxicity related to chemicals both used and produced, leakage and contamination of air and water and human exposure to know if or how well regulatory measures can ensure safety. Comprehensive safety data should therefore be obtained and provided for all chemicals prior to commencement of extraction, including relevant toxicological assessment for endocrine disruptor chemicals and carcinogens.

2. Baseline monitoring should be established prior to unconventional gas development and continue throughout development to completion, including biological markers of exposure in local populations and ecosystems. Otherwise it will not be possible to determine if these activities were responsible for subsequent adverse health effects.

3. Social impacts resulting from the large-scale surface activities should be assessed as part of a health risk assessment, including anxiety in local populations and effects on indigenous populations due to their close connection to land.

4. The greenhouse emissions from developing this resource (from both combustion of the gas and fugitive emissions) must be assessed and accounted for as part of Australia's commitment to the Paris agreement.

Doctors for the Environment Australia

Doctors for the Environment Australia (DEA) is an independent, self-funded, non-government organisation of medical doctors in all Australian States and Territories. Our members work across all specialties in community, hospital and private practices. We are supported by a Nobel laureate, recipients of the Australian of the Year award and many other distinguished health professionals. We are committed to bringing health risks from climate change and pollution to the frontline of attention, to minimise public health impacts and to address the diseases local, national and global caused by damage to our natural environment.[2]

Air pollution and human health

Air pollution is recognised as an important public health risk factor. Acute exposures increase asthma exacerbations[3] and the risks of acute myocardial infarction[4]. Chronic (or long term) exposure even at levels below current Australian guidelines is implicated as a causal risk factor for heart disease, stroke, lung disease, preterm births and lung cancers. This is a major consideration for Indigenous health, as mortality from respiratory disease in this group is about double that of non-Indigenous people[5].

Fracking, and its attendant surface activities, are associated with the release of particulate matter ($PM_{2.5/10}$), volatile organic compounds (notably benzene, toluene, ethylene and xylene), nitrogen oxides, hydrogen sulphide, formaldehyde and diesel exhaust[6]. Many of these air pollutants are the same as, or similar in nature and composition to other petrochemical-origin air pollution for which there is now inconvertible evidence of harm. In addition, there are also some novel compounds for which there is little health safety data.

In view of this it is not surprising that there is emerging evidence of increased respiratory disease in places where fracking is undertaken. For example, in a study of 400,000 people in Pennsylvania, living near fracking sites was associated with a significant increased risk of exacerbation of asthma[7]. People living near low production wells had a 28% increased risk, while those near high production wells had a 440% increased risk. Whilst causality is not proven, the observation of a dose response effect is consistent with fracking being responsible.

Acute health effects are generally more easily identified because they occur soon after exposure, in contrast chronic effects of low dose exposure can appear in communities years or decades later. As well as the lag time in presentation it also means the connection between exposure and illness is less obvious and, as with smoking, lead and diesel exhaust, can take much longer to recognise. The implication is that it may take more than a decade with good monitoring and reporting to confirm safety.

In a large US cohort study of the developmental health impacts in communities living near unconventional gas projects, an association between density and proximity of gas wells to maternal residence and the prevalence of congenital heart disease (and possibly neural tube defects) has been demonstrated[8]. In another example, the incidence of acute lymphocytic leukaemia in under 24-year olds was found to be elevated with proximity to unconventional gas wells[9]. These studies are not conclusive, but they do demonstrate that health risks to local populations are likely, and most importantly, that reassurance of safety cannot be given at this time.

In addition to the risks associated with air pollution, there are occupational hazards related to fine crystalline silica used in the fracking processes[10], which can result in an increased risk of silicosis[11]. There may also be a higher exposure to harmful volatile compounds.

Fracking fluid, toxic exposures and water quality

Fracking fluids are comprised of complex mixtures of silicates, acids, surfactants and other chemicals. Between 5 and 40 million litres of water, sand and chemicals are injected under high pressure per frack. The majority returns to the surface as 'produced water' which contains a range of organic and inorganic toxic compounds and naturally occurring radioactive materials (NORMs). These include compounds known to be neurotoxic, carcinogenic and endocrine disruptors[12]. Whilst some additives that can be assessed for safety, many of the products of fracking have not been qualitatively or quantitatively assessed making their safety uncertain.

Produced water is generally stored in open surface ponds from which volatile compounds evaporate into the local airshed, providing a pathway for human exposure. Surface storage is prone to leakage from a variety of mechanisms and consequently may enter ground water supplies. Disposal is also problematic as waste facilities are generally not designed or equipped to deal with this type of waste.

Heavy metals may be mobilised by the low pH of fracking fluid[13]. These include:

a. mercury, which can cause peripheral neuropathy and kidney damage[14, 15, 16]
b. arsenic, lead, and cadmium which are nephrotoxic[16];
c. manganese, which may increase the risk of Parkinson's Disease.

These toxic heavy metals are persistent and accumulative water pollutants. The recycling of effluent is possible but is expensive and increases the concentration of toxins. There is a high degree of consensus that surface water contamination due to fracking waste water is common[17].

'Best practice' has been touted as a solution to surface and groundwater contamination, but whilst reducing potential risk, it is highly likely that leakage and spills will still occur due to human error and technical failure. The leakage of produced water from Buru's Yalleroo 4 well in 2014[18] is a real example. Because this process is still relatively new, and it has not been undertaken in the Western Australian setting, there is a higher probability of unforeseen and potentially hazardous events.

Indigenous Australians living in remote regions with insecure ground water supplies[19], are a particularly vulnerable group as they already are at higher risk of neuropathy and nephropathy (due primarily to diabetes); adding to this risk with a man-made environmental hazard would be unconscionable.

Chemical toxicity and exposure

There is a large range of chemical additives that have been used in the various processes associated with extraction. The agreement to disclose these in the WA setting is welcome. However, it is still the case that many of these chemicals have not undergone safety testing and/or have not been assessed in the context of their use in hydraulic fracturing. Furthermore, the process itself yields numerous toxic products. These include hydrocarbons, heavy metals and NORM (naturally occurring radioactive materials).

Some of these chemicals, particularly polyaromatic hydrocarbons and heavy metals, are toxic at very low concentrations, and there is no safe threshold for exposure. US and UK researchers have separately reviewed chemicals used in hydraulic fracturing and found that a significant proportion have reported toxicity[20, 21]. In particular some are established or suspected carcinogens. Some are 'Endocrine Disruptor Chemicals' (EDCs) which are hormonally active chemicals and can have reproductive or developmental effects at exceedingly low exposures and can exhibit non-monotonic dose responses. Conventional toxicological assessments that relies on high exposure effects and extrapolation of safe exposure thresholds are therefore not adequate in assessing health risks related to some of these toxins such as EDCs or carcinogens. For this reason, an endocrine-centric component should be included in health risk assessments[20].

Psychosocial impact and risks to mental health

To date, research into the mental health consequences of fracking has been predominantly qualitative, and from North America. There is evidence (even amongst local proponents of fracking) of increased stress, anxiety and sleep disturbance[22]. Impaired quality of life and disruption of long term community stability due to fracking is pervasive. For Indigenous people the unwelcome intrusion and damage to their traditional land has also been reported[23]. As with many other forms of mining, locations targeted for fracking are often in rural or remote regions. People and communities in such regions in Western Australia are already at increased risk of mental health problems[24]. This is a particular problem for Indigenous people and communities. Although the extant research is limited, the consistency of reported adverse psychological and existential effects of fracking must not be ignored.

Climate change

There is international consensus that climate change threatens human health, through direct effects of heat and extreme weather, and secondary effects related to food and water insecurity, changing patterns of infectious and vector-borne diseases (e.g. malaria), and displacement from sea level rise and regional conflict[25]. This has major adverse health consequences - particularly for the world's most vulnerable people.

Natural gas has been promoted as being part of the solution (as a 'transition fuel') to reducing greenhouse gas emissions as it has about half of the CO_2 emissions as coal at the point of combustion. However, natural gas is about 90% methane, which is 80 times more potent as a greenhouse gas than CO_2 over a 20-year timeframe. As a result, small amounts (as little as 3%) of fugitive emissions, negate any advantage that gas has over existing coal plants[26]. Studies indicate that leakage, from the extraction to processing and distribution stages, is significant and likely higher than 2%.

Even if fugitive emissions could be avoided altogether, natural gas combustion generates significant greenhouse emissions. Emissions factors for gas are around 51 Kg-CO_2 e/GJ (compared to 90 Kg-CO_2 e/GJ for coal). Despite this apparent advantage over coal, gas is still a carbon-intensive method of generation and does not provide a near term path to decarbonisation[27].

The overall implications of global unconventional gas development have been contested. A 2014 study published in Nature found that a global abundance of natural gas would not significantly reduce, and may increase, climate forcing[28]. It is therefore not an effective mitigation strategy. Furthermore, investment and development of new sources of fossil fuel compete for funding and can therefore delay or impede deployment of renewable energy. Expanding unconventional gas production in Western Australia will therefore inevitably jeopardise national and international greenhouse gas emission targets.

General comments/conclusions

There are major uncertainties about the short and long-term health impacts of fracking. The oil and gas industry will argue that the health problems listed here, are not proven[29] to be caused by fracking. The position of industry on this matter must be considered conflicted. The magnitude of the potential risk is too great to warrant going ahead with fracking in Western Australia. As the world has seen with smoking – waiting for a causal relationship between an exposure and adverse outcomes to be proven leads to irreparable harm. With the rapid and potentially poorly regulated expansion of fracking in the US, a large amount of research into the health consequences will be undertaken and reported. This will provide an opportunity for Australia to learn from the experience in the US before any irrevocable steps are taken.

Extraction of unconventional gas clearly poses potential risk to human and animal health[30]. Many of the chemical products used and produced are known to be toxic and there are multiple potential pathways which can lead to exposure in workers and people living near gas wells and infrastructure. Due to the nature of the industry and above ground activities there is also potential for negative social impacts and significant greenhouse gas emissions.

Whilst some of these risks may be minimised with 'best practice' there is still significant uncertainty about many aspects including toxicity and dispersion of some chemical products, fugitive emissions, long term well integrity as well as indirect effects through impacts on infrastructure, biodiversity and seismic activity.

Studies are now appearing in the medical literature that implicate unconventional gas and oil development in causing illness in local communities. Although these do not conclusively prove causation, they are sufficient to determine that it is not possible to give reassurance of safety.

References

[1] https://frackinginquiry.wa.gov.au/have-your-say

[2] https://www.dea.org.au/

[3] Guarnieri M, Blames JR. Outdoor air pollution and asthma. Lancet. 2014;383:1581-92.

[4] Nawrot TS, Perez L, Künzli N, Munters E, Nemery B. Public health importance of triggers of myocardial infarction: a comparative risk assessment. Lancet. 2011;377:732-40.

[5] Department of Prime Minister and Cabinet. Aboriginal and Torres Straight Islander Health Performance Framework. 2013. https://www.pmc.gov.au/sites/default/files/publications/indigenous/Health-Performance-Framework-2014/tier-1-health-status-and-outcomes/104-respiratory-disease.html.

[6] Litovitz A, Curtright A, Abramzon S, et al. estimation of regional air quality damage from Marcellas shale natural gas extraction in Pennsylvania. Environ Res Lett. 2013;doi:10.1088/1748-9326/8/1/014017.

[7] Rasmussen SG, Ogburn EL, McCormack M, et al. Association between unconventional natural gas development in the Marcellus Shale and asthma exacerbations. JAMA Int Med. 2016;176:1334-43.

[8] McKenzie LM, Guo R, Witter RZ, Savitz DA, Newman LS, Adgate JL. Birth Outcomes and Maternal Residential Proximity to Natural Gas Development in Rural Colorado. Environ Health Perspect. 2014;122:412-7.

[9] McKenzie LM, Allshouse WB, Byers TE, et al. Childhood hematologic cancer and residential proximity to oil and gas development. PlosONE. 2017; https://doi.org/10.1371/journal.pone.0170423

[10] McCawley M. Air contaminants associated with potential respiratory effects from unconventional resource development activities. Crit Care Med. 2015;36:379-87.

[11] Centers for Disease Control and Prevention. https://www.cdc.gov/niosh/topics/silica/. 2017.

[12] Colborn T, Kwiatkowski C, Schultz K, Bachran M. Natural gas operations from a public health perspective. Human Ecological Risk Assessment. 2011;17(5):1039-56.

[13] Wang L, Burns S, Giammar DE, Fortner JD. Element mobilization from Balkan Shales as a function of water chemistry. Chemosphere. 2016;149:286-93.

[14] Latove N, Kumar G, Vo ML, et al. Elevated blood mercury levels in idiopathic axonal neuropathy. JAMA Neurol. 2015;72:474-5.

[15] Grant CJ, Lutz AK, Kulig AD, Stanton MR. Fracked ecology: response of aquatic trophic structure and mercury biomagnification dynamics in the Marcellus Shale Formation. Ecotoxicology. 2016;25:1739-50.

[16] Orr SE, Bridges CC. Chronic kidney disease and exposure to nephrotoxic metals. Int J Molec Sci. 2017;18:1039.

[17] Costa D, Jesus J, Branco D, Danko A, Fiuza A. Extensive review of shale gas environmental impacts from the scientific literature. Environ Sci Pollut Res. 2017;24:14579-94.

[18] ABC http://www.abc.net.au/local/stories/2014/08/08/4063892.htm. 2014.

[19] Clifford H, Pearson G, Franklin P, et al. Environmental health challenges in remote Australian Aboriginal communities: clean air, clean water and safe housing. Aust Indig Health Bull. 2015;15(2):1-2.

[20] Kassotis CD, Tillitt DE, Lin C-L, et al. Endocrine-Disrupting Chemicals and oil and natural Gas Operations: Potential Environmental Contamination and Recommendations to Assess complex environmental mixtures. Environ Health Perspect 2016;124: doi:10.1289/ehp.1409535

[21] Tydall Centre for Climate Change Research. 2011 http://www.gegen-gasbohren.de/wp-content/uploads/2011/01/tyndall-coop_shale_gas_report_final.pdf

[22] Hirsch JK, Bryant Smalley K, Selby-Nelson EM, et al. Psychosocial impact of fracking: a review of the literature on the mental health consequences of hydraulic fracking. Int J Mental Health Addiction. 2017;doi 10.1007/s11469-017-9792-5.

[23] Sangaramoorthy T, Jamison AM, Boyle MD, et al. Place-based perceptions of the impacts of fracking along the Marcellus shale. Soc Sci Med. 2016;151:27-37.

[24] Australian Institute of Family Studies. Mental health in rural and remote communities. https://aifs.gov.au/cfca/2017/06/06/report-mental-health-rural-and-remote-communities. 2017.

[25] World Health Organization. http://www.who.int/mediacentre/factsheets/fs266/en/. 2014.

[26] Wigley TML. Coal to gas: the influence of methane leakage. Climate Change. 2011; https://doi.org/10.1007/s10584-011-0217-3.

[27] Australian Government Department of the Environment and Energy. 2017. https://www.environment.gov.au/system/files/resources/5a169bfb-f417-4b00-9b70-6ba328ea8671/files/national-greenhouse-accounts-factors-july-2017.pdf.

[28] McJeon H, Edmonds J, Bauer N et al. Limited impact on decadal-scale climate change from increased use of natural gas. Nature 2014; 428: doi:10.1038/nature13837.

[29] https://energyindepth.org/national/fracking-and-health-headlines-vs-reality/

[30] Bamberger M, Oswald R. The real cost of Fracking. Beacon Press; 2015.