Northern Territory Fracking Inquiry

Submission from Frack Free Darwin

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Frack Free Darwin Written Submission

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As a group, Frack Free Darwin, banded together in March 2016. We have a core group of over 200 members and we meet fortnightly to discuss issues regarding the fracking industry in the Northern Territory. We also run community stalls where we engage with the public and hear their concerns, have conversations, answer questions and help to educate them about fracking in the Northern Territory.

Our submission is based on some of the community concerns that present to us on these stalls and in our meetings.

As Frack Free Darwin stall holders, we endeavour to answer any questions that are asked by the general public, in accordance with scientific evidence based on what is happening in Qld with CSG and in America with the shale gas industry.

For this submission, we have used information from the Concerned Health Professionals of New York & Physicians for Social Responsibility (2017, Nov 27) “Compendium of Scientific, Medical and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction) “(4th Ed.).
http://concernedhealthny.org/compendium/

We also provide detailed up to date maps, which can be found on the Northern Territory Government website.
Reference: https://1drv.ms/b/s!AovNzcCgqwW5gRkawjuubIAYEda6

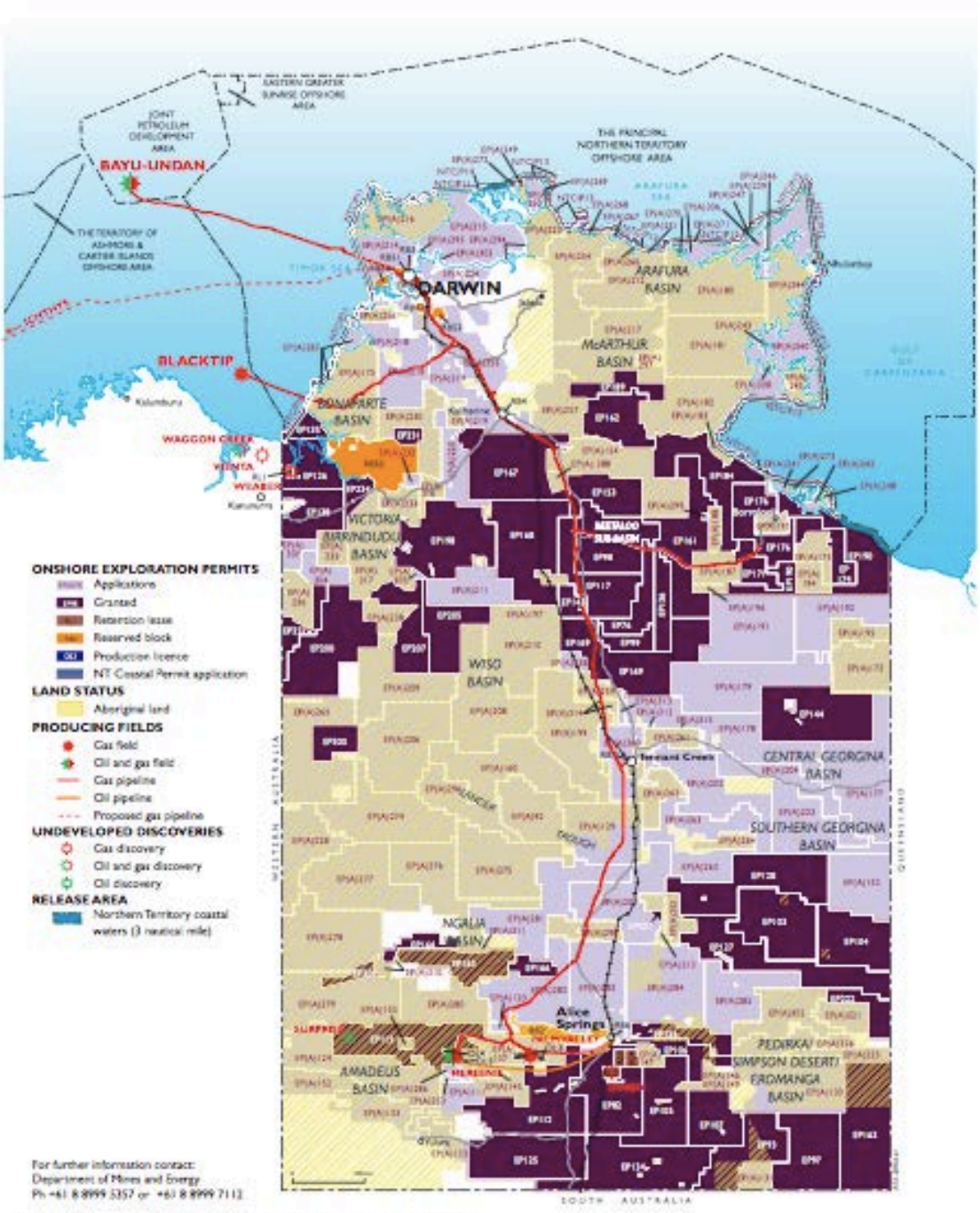

Figure 3. Petroleum operations and development in 2013.

Environmental Impacts

Long term environmental impacts are of great concern to local Territorians especially considering the NT has some of the worst examples of legacy mines. None to date have been fully remediated.
Currently the estimated level of legacy mining liabilities for the Northern Territory is in excess of $1 billion.

Reference: International Summit on Derelict Mines – Singleton NSW
Dec 2016 Managing Mining Legacies in the Northern Territory.
Mike Fawcett. Manager Mining Remediation.

Environmental Impacts Evidence

March 3, 2015 – A research team from Duquesne University reviewed the evidence for environmental impacts to air and water from activities related to shale gas extraction in Pennsylvania and explored potential mechanisms for contamination of air and water related to the drilling and fracking process itself. Among them: deformations of the shale bedrock caused by the injection of large volumes of fluid result in “pressure bulbs” that are translated through rock layers and can impact faults and fissures, so affecting groundwater.

Reference: Lampe, D. J. & Stolz, J. F. (2015). Current perspectives on unconventional shale gas extraction in the Appalachian Basin. *Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering*, *50*(5), 434-446. doi: 10.1080/10934529.2015.992653

December 17, 2014 – As part of a lengthy review that became the foundation for New York State’s ban on high volume hydraulic fracturing, the New York State Department of Health (NYSDOH) identified environmental problems associated with fracking that could contribute to adverse public health impacts. Among them: air pollution (particulate matter, ozone, diesel exhaust, and volatile organic compounds) that could affect respiratory health; drinking

water contamination from underground migration of methane and/or fracking chemicals associated with faulty well construction or seismic activity; drinking water contamination from inadequate water treatment of fracking waste or from surface spills of fracking chemicals or wastewater; earthquakes and the creation of fissures; increased vehicle traffic; increased noise; increased demand for housing and medical care; and public health problems related to climate change impacts from methane and other greenhouse gas emissions into the atmosphere. The NYSDOH Public Health Review also discussed findings from surveys of health symptoms among residents living near high volume hydraulic fracturing activities. These included skin rash, nausea or vomiting, abdominal pain, breathing difficulties, cough, nosebleed, anxiety, stress, headache, dizziness, eye irritation, and throat irritation in populations living near drilling and fracking operations. The NYSDOH Public Health Review noted that ongoing studies by both government agencies and several academic institutions were exploring the public health risks and impacts of fracking but that many of these studies were years from completion. The review concludes:

... significant gaps exist in the knowledge of potential public health impacts from [high volume hydraulic fracturing].... The existing science investigating associations between [high volume hydraulic fracturing] activities and observable adverse health outcomes is very sparse and the studies that have been published have significant scientific limitations. Nevertheless, studies are suggestive of potential public health risks related to [high volume hydraulic fracturing] activity that warrant further careful evaluation.

In an accompanying letter to the New York State Department of Environmental Conservation, Health Commissioner Howard Zucker, MD, concluded, ... the overall weight of the evidence from the cumulative body of information contained in this Public Health Review demonstrates that there are significant uncertainties about the kinds of adverse health outcomes that may be associated with [high volume hydraulic fracturing], the likelihood of the occurrence of adverse health outcomes and the effectiveness of some of the mitigation measures in reducing or preventing environmental impacts which could adversely affect public health. Until the science provides sufficient information to determine the level of risk to public health from [fracking] to all New Yorkers and whether the risks can be adequately

managed, DOH recommends that high volume hydraulic fracturing should not proceed in NYS.

Reference: New York State Department of Health. (2014, December 17). A public health review of high volume hydraulic fracturing for shale gas development. Retrieved from http://www.health.ny.gov/press/reports/docs/high_volume_hydraulic_fracturing.pdf

June 26, 2015 – A decade-long USGS study of 11,000 public drinking water wells in California—nearly all the groundwater used for public supply—found high levels of potentially toxic contaminants in about 20 percent of the wells, affecting about 18 percent of the state's population. Although the study did not specifically investigate contaminants from oil and gas extraction, it does provide evidence for farm irrigation draining into groundwater, raising questions about the possible contamination of drinking water aquifers from the reuse of fracking wastewater for crop irrigation.

Reference: Knickmeyer E., & Smith, S. (2015, July 15). Study finds contaminants in California public-water supplies. *Associated Press.* Retrieved from

Well Failure

Contamination of waterways/aquifers due to well failure is also a common concern with the general public.

Well Failure Evidence

A 2014 analysis of more than 75,000 compliance reports for more than 41,000 wells in Pennsylvania found that newer wells have higher leakage rates 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 leakage.

July 9, 2015 – As part of a larger examination of the potential health and environmental impacts of fracking in California, the California Council on Science and Technology (CCST) documented cases of well failures triggered by underground movements that caused well casings to shear. Sheared well casings can allow gas and fluids from the fracking zone to migrate to overlying aquifers. The CCST team identified several mechanisms by which casing shears can occur in California as oil wells age: surface subsidence, heaving, reservoir compaction, and earthquakes. Prolonged drought can also damage the integrity of well casings: as groundwater levels fall, landforms can sink and contribute to casing shear.

Reference: Stringfellow, W. T., Cooley H., Varadharajan, C., Heberger, M., Reagan, M. T., Domen, J.K., Sandelin, W. ... Houseworth, J. E. (2015, July 9). Volume II, Chapter 2: Impacts of well stimulation on water resources. In: *An Independent Scientific Assessment of Well Stimulation in California.* California Council on Science and Technology, Sacramento, CA. Retrieved from http://ccst.us/publications/2015/vol-II-chapter-2.pdf

January 8, 2013 – According to state inspections of all 6,000 wells drilled in Pennsylvania's Marcellus Shale before 2013, six to ten per cent of them leaked natural gas, with the rate of leakage increasing over time. The rate was six per cent in 2010 (97 well failures out of 1,609 wells drilled); 7.1 per cent in 2011 (140 well failures out of 1,972 wells drilled); and 8.9 percent in 2012 (120 well failures out of 1,346 wells drilled).

Reference: Ingraffea, A. R. (2013). Some scientific failings within high volume hydraulic fracturing proposed regulations. Retrieved from http://www.psehealthyenergy.org/data/NYS_DEC_Proposed_REGS_comments_Ingraffea_Jan_2013.pdf

July 11, 2016 – An interdisciplinary team led by University of Colorado researchers found methane in 42 water wells in the intensely drilled Denver-

Julesburg Basin where high volume, horizontal fracking operations began in 2010. By examining isotopes and gas molecular ratios, the researchers determined that the gas contaminating these wells was thermogenic in origin, rather than microbial, and therefore had migrated up into the groundwater from underlying oil- and gas-containing shale. The steady rate of well contamination over time—two cases per year from 2001 to 2014—suggests that well failures, rather than the process of hydraulic fracturing itself, was the mechanism that created migration pathways for the stray gas to reach drinking water sources. Of the 42 affected wells, 11 had already been identified by state regulators as suffering from “barrier failures.”

Reference: Sherwood, O. A., Rogers, J. D., Lackey, G., Burke, T. L., Osborn, S. G. & Ryan, J. N. (2016). Groundwater methane in relation to oil and gas development and shallow coal seams in the Denver-Julesburg Basin of Colorado. *Proceedings of the National Academy of Sciences 113*(30). doi: 10.1073/pnas.1523267113

May 22, 2014 – In a 69-page report, University of Waterloo researchers warned that natural gas seeping from 500,000 wellbores in Canada represents “a threat to environment and public safety“ due to groundwater contamination, greenhouse gas emissions, and explosion risks wherever methane collects in unvented buildings and spaces. The report found that 10 percent of all active and suspended gas wells in British Columbia now leak methane. Additionally, the report found that some hydraulically fractured shale gas wells in that province have become “super methane emitters” that spew as much as 2,000 kilograms of methane a year.

Reference: Dusseault, M. B., Jackson, R. E., & MacDonal, D. (2014, May 22). *Towards a road map for mitigating the rates and occurrences of long-term wellbore leakage*. Geofirma. Retrieved from http://geofirma.com/wp-content/uploads/2015/05/lwp-final-report_compressed.pdf

Reference: Nikiforuk, A. (2014, June 5). Canada's 500,000 leaky energy wells: 'Threat to public' *The Tyee*. Retrieved from http://www.thetyee.ca/News/2014/06/05/Canada-Leaky-Energy-Wells/

May 1, 2014 – Following a comprehensive review of evidence, the Council of Canadian Academies identified inherent problems with well integrity as one of its top concerns about unconventional drilling and fracking. According to one expert panel, “the greatest threat to groundwater is gas leakage from wells from which even existing best practices cannot assure long-term prevention.”

Regarding their concerns related to well integrity and cement issues, the panel wrote:

Two issues of particular concern to panel members are water resources, especially groundwater, and GHG emissions. Both related to well integrity.... Natural gas leakage from improperly formed, damaged, or deteriorated cement seals is a long- recognized yet unresolved problem. Leaky wells due to improperly placed cement seals, damage from repeated fracturing treatments, or cement deterioration over time, have the potential to create pathways for contamination of groundwater resources and to increase GHG emissions.

They further explain:

Cement may crack, shrink, or become deformed over time, thereby reducing the tightness of the seal around the well and allowing the fluids and gases ... to escape into the annulus between casing and rock and thus to the surface.... The challenge of ensuring a tight cement seal [will] be greater for shale gas wells that are subjected to repeated pulses of high pressure during the hydraulic fracturing process than for conventional gas wells. This pressure stresses the casing and therefore the cement that isolates the well from surrounding formations repeatedly.

Reference: Council of Canadian Academies. (2014, May 1). *Environmental Impacts of Shale Gas Extraction in Canada: the Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction.* Retrieved from http://bit.ly/1nNicuf

June 30, 2015 – According to the New York State Department of Environmental Conservation (NYS DEC) Findings Statement, “there is a risk that well integrity can fail, especially over time, and questions have arisen

about whether high-volume hydraulic fracturing can cause seismic changes which could potentially result in fracturing fluid migration through abandoned wells or existing fissures and faults. Thus, high-volume hydraulic fracturing could result in significant adverse impacts to water resources from well construction and fracturing fluid migration."

Reference: New York State Department of Environmental Conservation. (2015, June 30). Final supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program: regulatory program for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus Shale and other low-permeability gas reservoirs, findings statement. Retrieved from http://www.dec.ny.gov/docs/materials_minerals_pdf/findingstatehvhf62015.pdf

Chemicals in Fracking Fluid

One of the many concerns about Shale Gas Hydraulic Fracturing that presents to us in conversations with the public is the use of harmful chemicals in the fracturing process, and the lack of transparency on the part of the gas companies. There seems to be considerable disparity between the components of frack fluid talked about by the gas companies when they make their presentations to the public, and those chemicals listed as common frack fluid additives in peer-reviewed research.

During my attendance at one of the Public Information Sessions held by representatives of the gas industry in Darwin last year I witnessed the panel telling its audience that 'salt water' was used to fracture the shale rock. When questioned about the use of fresh water the panellist assured the audience that only water identified as unsuitable for drinking or agriculture was used. When questioned about the mixing of chemicals with that water, the panellist assured the audience that only a small amount of 'polymers' was added to the water. The panel then went on to assert that the frack waste fluid that was generated in the fracking process was minimal in quantity and easily disposed of.

In actual fact there is a large body of evidence suggesting that these claims are incorrect, some of which can be found in the fourth edition of the Compendium referenced below. Given the importance of a social license in undertaking fracking operations, it is essential that the public are provided with accurate information, facilitated by transparency and full disclosure by the gas companies.

Non-Disclosure of Fracking Chemicals Evidence

August 13, 2014 – A team from Lawrence Berkeley National Laboratory reported that scientific efforts to understand the hazards of fracking continue to be hampered by industry secrecy. A comprehensive examination of the chemical formulations of fracking fluid—whose precise ingredients are protected as proprietary business information— revealed that no publicly available toxicity or physical chemical information was available for one-third of all the fracking chemicals surveyed. Another ten percent of chemicals, including biocides and corrosion inhibitors, were known to be toxic to mammals.

Reference: Stringfellow, W. T., Domen, J. K., Carmarillo, M. K., Sandelin, W. L., Tinnacher, R., Jordan, P., . . . Birkholzer, J. (August 13, 2014). Characterizing compounds used in hydraulic fracturing: a necessary step for understanding environmental impacts. Presentation before the American Chemical Society conference, San Francisco. Abstract retrieved from http://abstracts.acs.org/chem/248nm/program/view.php?obj_id=262051&terms=

Reference: Robinson, P. (2014, August 19). Fracking fluid survey shows missing information. *Scientific American.* Retrieved from http://www.scientificamerican.com/article/fracking-fluid-survey-shows-missing-information/

Further evidence: Concerned Health Professionals of New York & Physicians for Social Responsibility (2017, Nov 27) “Compendium of Scientific, Medical and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction) “(4th Ed.). http://concernedhealthny.org/compendium/

A study entitled "Environmental Public Health Dimensions of Shale and Tight Gas Development" is an American report which has far reaching implications for the Northern Territory we are also contemplating shale gas extraction here. It says “Shale gas development uses fracturing fluid that contain organic and inorganic chemicals known to be health damaging…Fracturing fluids can move through the environment and come into contact with humans in a number of ways including surface leaks, spills, releases from holding tanks, poor well construction, leaks and accidents during transportation of fluids, flow back and produced water to and from the well pad, and run of during blowouts, storms, and flooding events. Further, the mixing of these compounds under conditions of high pressure may synergistically create additional potentially toxic compounds. Compounds found in these mixtures may pose risks to the environment and to public health through numerous environmental pathways including water, air, and soil.

It goes on to say that because of the limited information that is available about the chemicals used in frack fluids, researchers have sought to acquire more information on the chemical makeup of fracturing fluids through other means. In this instance, the Colborn et al., used material safety data sheets. And doing so, identified 353 of 632 chemicals contained in 944 products used for natural gas operations in Colorado. They found that at certain concentrations or doses, more than 75% of the chemicals they identified are known to negatively impact the skin, eyes, and other sensory organs, as well as the respiratory system, the gastrointestinal system, and the liver. They also found that 52% of the chemicals have the potential to negatively affect the nervous system, and 37% are candidate EDC's or Endocrine Disruptive Chemicals.

The report also cited a study by Kassotis et al., that indicated that EDC's are a potential health concern in natural gas operations and that chemicals used in the process should be disclosed, and should be screened for EDC activity.

Reference: Shonkoff, Hays, Finkel (2014,Aug) Environmental Public Health Dimensions of Shale and Tight Gas Development. Journal of Environmental Health Perspectives

http://dx.doi.org/10.1289/ehp.1307866.

[The above reference is provided in direct response to Professor Brian Priestly's request.]

Chemicals in Fracking Fluids Evidence

May 24, 2016 – The U.S. Agency for Toxic Substances and Disease Registry (ATSDR) conducted a public health evaluation using groundwater data gathered in 2012 by the U.S. Environmental Protection Agency (EPA) from 64 private drinking water wells in Dimock, Pennsylvania where natural gas drilling and fracking activities began in 2008 and where residents began reporting problems with their water shortly thereafter. The agency found that water samples collected from 27 Dimock wells contained contaminants "at levels high enough to affect human health." These included methane, salts, organic chemicals, and arsenic.

Reference: U.S. Environmental Protection Agency. (2012, July 25). EPA completes drinking water sampling in Dimock, Pa. [news release]. Retrieved from https://yosemite.epa.gov/opa/admpress.nsf/0/1A6E49D193E1007585257A46005B61AD

February 22, 2016 – Relying on voluntary disclosures reported to the FracFocus registry and a list compiled by the U.S. Congress, a German team surveyed the physiochemical properties of chemicals used in hydraulic fracturing fluid to evaluate their environmental fate and potential toxicity. Common ingredients included those known to contaminant groundwater, such as solvents, as well as those known to react strongly with other chemicals, such as biocides and strong oxidants, indicating that almost certainly, new chemical products are formed during the process of fracking and its aftermath. Hence, non-toxic additives could potentially react with other substances to create harmful byproducts. The authors conclude that a comprehensive assessment of risks would require an unabridged list of the chemical additives used for fracking, and they call for full disclosure.

Reference: Elsner, M. & Hoelzer, K. (2016). Quantitative survey and structural classification of hydraulic fracturing chemicals reported in unconventional gas production. Environmental Science & Technology, 50(7). doi:10.1021/acs.est.5b02818

Reference: Phys.Org. (9 March 2016). How to get a handle on potential risks posed by fracking fluids. Retrieved from http://phys.org/news/2016-03-potential-posed-fracking-fluids.html

January 6, 2016 – Yale School of Public Health researchers analyzed more than 1,021 chemicals either used in fracking fluid or created during the process of hydraulic fracturing. They found that 781 of these chemicals lacked basic toxicity data. Of the 240 that remained, 157 were reproductive or developmental toxicants. These included arsenic, benzene, cadmium, formaldehyde, lead, and mercury. Commenting on this study, lead author Nicole Deziel said, “This evaluation is a first step to prioritize the vast array of potential environmental contaminants from hydraulic fracturing for future exposure and health studies. Quantification of the potential exposure to these chemicals, such as by monitoring drinking water in people’s homes, is vital for understanding the public health impact of hydraulic fracturing.”

Reference: Elliot, E. G., Ettinger, A. S., Leaderer, B. P., Bracken, M. B., Deziel, N. (2016). A systematic evaluation of chemicals in hydraulic-fracturing fluids and wastewater for reproductive and developmental toxicity. Advance online publication. Journal of Exposure Science & Environmental Epidemiology. doi: 10.1038/jes.2015.81

Reference: Greenwood, M. (2016, January 6). Toxins found in fracturing fluid and wastewater, study shows. Yale News. Retrieved from: http://news.yale.edu/2016/01/06/toxins-found-fracking-fluids-and-wastewater-study-shows

February 1, 2015 – An investigation of the chemical make-up of fracking fluid found that the compositions of these mixtures vary widely according to region and company, making the process of identifying individual compounds difficult. Classes of hydrocarbon-based chemicals include solvents, gels, biocides, scale inhibitors, friction reducers, and surfactants. Chemical analysis identified around 25 percent of the organic compounds that are believed to be present in fracking fluid and that are necessary to test for in identifying groundwater and drinking water contamination. Dr. Imma Ferrer, lead author, explained in a Science Daily article about her research that "[b]efore we can assess the environmental impact of the fluid, we have to know what to look for."

Reference: Ferrer, I. & Thurman, E.M. (2015), Chemical constituents and analytical approaches for hydraulic fracturing waters. Trends in Environmental Analytical Chemistry, 5, 18-25, doi: 10.1016/j.teac.2015.01.003

Reference: Elsevier. (2015 April 8). Fracking fluids contain potentially harmful compounds if leaked into groundwater. *ScienceDaily*. Retrieved from http://www.sciencedaily.com/releases/2015/04/150408090323.htm?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+sciencedaily%2Fearth_climate%2Frecycling_and_waste+%28Recycling+and+Waste+N ews+--

So we need the gas companies to be transparent about the chemicals that they are intending to use. What are the names of those chemicals? What are their effects? How are they going to keep us safe from them? Then, what are the gas companies going to do with the thousands of tonnes of frack fluid waste containing those chemicals, as well as the radioactive material and compounds generated underground?

There is talk of re-injection of the frack fluid into other aquifers here in the Territory. Who oversees that? What regulations are in place to

ensure it is done correctly and safely? Who makes sure that those regulations are adhered to? What happens when mistakes are made, like accidentally re injecting waste into a clean aquifer as happened in California where fracking waste chemicals were being disposed of into drinking water. How do we ensure that that never happens here and if it does happen, what is our recourse? Can that contaminated water be rehabilitated?

Wastewater Reinjection into Drinking Water Aquifers Evidence

July 9, 2015 – A multi-volume report from the California Council of Science and Technology (CCST) found threats to groundwater in California from several parts of the fracking lifecycle, most notably from toxic wastewater. First, wastewater from California fracking operations is sometimes used for crop irrigation, in which case contaminants may seep from the surface of agricultural areas into groundwater. Second, nearly 60 percent of fracking wastewater in California is disposed of in unlined, open-air pits, a practice that is banned in almost all other states. There are 900 such waste disposal pits in the state, most of which are located in Kern County. Third, for many years, fracking wastewater in California has been mistakenly sent, via injection wells, directly into protected aquifers containing clean freshwater. [1] California's Division of Oil, Gas and Geothermal Resources allowed fracking wastes to be injected into aquifers that it believed were exempt from the U.S. Safe Drinking Water Act. Conceding this mistake, the agency has shut down 23 injection wells for fracking waste disposal and established a two-year timetable for phasing out other wells injecting waste into aquifers that should have been protected.[2] Fracking also threatens California's groundwater resources through water consumption, according to the CCST study. While this volume of water represents a small percentage of overall annual water consumption in California, fracking-related water use is, the study noted, disproportionately concentrated in areas of the state already suffering from water shortages. Further drawdowns of these aquifers may interfere with agricultural and municipal water needs.[3] In addition, because the oil containing rock layers in California are located closer to the surface than in other states, the state's groundwater is potentially vulnerable to chemical contamination

through vertical faults and fissures and via old and abandoned wells. The absence of evidence for direct contamination of groundwater by fracking, the study concluded, reflects absence of investigation rather than evidence of safety. [4]

Reference [1]: Shonkoff, S. B. C., Jordan, P., Hays, J., Stringfellow, W. T., Wettstein, Z. S., Harrison, R., Sandelin, W., & McKone, T. E. (2015, July 9). Volume II, Chapter 6: Potential impacts of well stimulation on human health in California. In: An Independent Scientific Assessment of Well Stimulation in California. California Council on Science and Technology, Sacramento, CA. Retrieved from http://ccst.us/publications/2015/vol-II-chapter-6.pdf

Reference [2]: Baker, D. R. (2015, July 16). U.S. likely to bar oil-waste dumping into 10 California aquifers. San Francisco Chronicle. Retrieved from http://www.sfchronicle.com/business/article/U-S-likely-to-bar-oil-waste-dumping-into- 10-6389677.php

Reference [3]: Stringfellow, W. T., Cooley H., Varadharajan, C., Heberger, M., Reagan, M. T., Domen, J.K., . . . Houseworth, J. E. (2015, July 9). Volume II, Chapter 2: Impacts of well stimulation on water resources. In: An Independent Scientific Assessment of Well Stimulation in California. California Council on Science and Technology, Sacramento, CA. Retrieved from http://ccst.us/publications/2015/vol-II-chapter-2.pdf

Reference [4]: Long, J. C. S, Birkholzer, J. T., & Feinstein, L. C. (2015, July 9). Summary report. In: An Independent Scientific Assessment of Well Stimulation in California. California Council on Science and Technology, Sacramento, CA. Retrieved from: http://ccst.us/publications/2015/2015SB4summary.pdf

The issue of earthquakes caused by reinjecting these frack fluids into empty aquifers is also of concern.

Earthquakes Resulting from Frack Fluid Reinjection Evidence

February 1, 2016 – An article in the *Texas Journal of Oil, Gas, and Energy Law* exhaustively reviewed the literature on earthquake activity in areas of six states (Arkansas, Colorado, Kansas, Ohio, Oklahoma, and Texas) where fracking takes place or drilling wastes are disposed underground and concluded that courts should impose strict liability for earthquake damage caused either by fracking itself or by the underground injection of fracking fluids. “Earthquakes sometimes occur when subsurface formations are properly fractured. Likewise, the risk of earthquake damage is not substantially mitigated by the exercise of due care when frack fluids are injected into the ground.”

Reference: Watson, B. A. (2016). Fracking and cracking: strict liability for earthquake damage due to wastewater injection and hydraulic fracturing. *Texas Journal of Oil, Gas and Energy Law, 11*(1). Retrieved from http://ssrn.com/abstract=2735862

October 29, 2015 – The Kansas Corporation Commission extended limits on the injection of wastewater from fracking operations after a drop in the frequency of earthquakes that followed more than 200 earthquakes. Before that, the average rate was one earthquake every two years.

Reference: Kansas Corporation Commission. (2015, October 29). Kansas Corporation Commission approves order extending wastewater injection limits. [Press release.] Retrieved from http://www.kcc.state.ks.us/pi/press/15-13.htpFracking Background and Issues Paper

Suggested addition of three risks not currently listed in paper

On Page 15, under the risk theme of Social Impacts: and separate to the subheading of Housing and Rent, may we suggest that "Property or Land Value" be added as a subheading. We make that suggestion

due to the potential for a reduction in property values due to proximity to a shale gas fracking operation, and its infrastructure (well pad/processing plant/flare) and the impacts that may have on the air, water and soil quality of that property. There are instances of previously suitable land no longer being fit to raise cattle. These landowners face the challenge of having banks refuse to lend to them and insurance companies refusing to insure them. Further, when they find themselves needing to sell and move elsewhere, the gas companies won't buy their properties at market value.

Secondly, under the heading Public Health: and subheading "Mental health and Wellbeing" there is a need to consider the mental health effects of such a reduction in property values due to fracking operations. Many farmers and those raising cattle on their property don't have superannuation. Their land is their security, and the value of that land decreasing due to fracking operations would cause enormous stress, anxiety and uncertainty about their future.

Thirdly, under the heading Social Impacts: Employment, it needs to be recognised that Fracking operations in an area can result in a REDUCTION in employment due to the negative effects on other industries, including tourism, agriculture and the raising of cattle. There is a CSIRO report commissioned by the QLD government in 2015 that found that for every 10 jobs created by the fracking industry, 18 jobs are lost in agriculture. Any assessment of the economic impacts of fracking in the NT needs to acknowledge this finding by the CSIRO.

Reference: https://industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/coal-seam-gas/Socioeconomic-impacts-of-coal-seam-gas-in-Queensland.pdf (Table 3 page 26 and page 29)

Recommendation: Frack Free Darwin recommend all panel members access the Compendium as it is a fully referenced compilation of the evidence outlining the risks and harms of fracking. It brings together findings from the scientific and medical literature, government and industry reports and journalistic investigation.

Melissa Bury, Belinda Quinlivian, Chris Naden.

Frack Free Darwin.