

FOLLOW UP SUBMISSION TO THE SCIENTIFIC INQUIRY INTO HYDRAULIC FRACTURING IN THE NORTHERN TERRITORY (Initial comments on the interim report)

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GENERAL COMMENT

This is named a Scientific Inquiry, by which one would assume that the findings would be evidence based. One would assume on any topic within the inquiry it would be clear what the evidence is for risk/harm, the evidence for safety/benefit, and critically, the extent and significance of knowledge gaps.

COMMENTS ON TERMS OF REFERENCE

Aboriginal communities are to be put at increased health risk but the Inquiry is not considering that risk in their terms of reference.

The panel notes that

- most of the proposed area for shale gas development are remote (page 82)
- Aboriginal persons and communities as a group are especially vulnerable and disadvantaged (page 132)
- the petroleum industry has expressed an intention to deliberately invest in providing local training, jobs and business support. (page 99)
- There are likely to be higher health risks for workers as a result of their proximity to the construction, drilling and gas extraction activities. (page 81)
- The terms of reference of the inquiry specifically exclude health impacts on workers (as the WA inquiry also did) (page 81)

So the inquiry will be asked to consider the potential positives to this community (work), but are not to investigate or consider the health harms to the remote, vulnerable potential workers who are the community.

COMMENTS ON INTERIM REPORT

With regards to the Interim Report Chapter 10 Public health the content and tone were deficient with random sentences unsupported by any evidence.

1. Page 81 regarding concerns re BETX
“this data may not be relevant to shale deposits that are the subject of the inquiry.”

What is the evidence that BETX may not be relevant?

Particularly since on page 30

“In the Northern Territory disclosure of composition of flowback is not mandated”

BETX is always relevant to health.

This lack of disclosure exposes a major knowledge gap.

2. Page 81 regarding the Queensland health effects.

The relevance of these findings... is questionable due to the difference between the two processes.

What are the differences/ similarities in the two processes?

DIFFERENCES

- Depth
CSG is generally shallower, Shale is generally deeper, but the fact is the industry will go where the shale is, and where they are permitted to go.

For example in the Lough Allen Basin in Ireland, Tamboran’s target for shale exploitation lies between 600 and 1200 metres (with an aquifer immediately above the shale layer and a major beneficial aquifer immediately below)

- Single well pads / multi well pads.
In Queensland CSG wells tend to be placed at a distance of approximately 750 metres, with secondary infill at approx. 350 metres.
Multi well shale pads with extended laterals may be 3-4km distant from each other.

However both CSG and Shale are mined on a grid pattern, necessarily covering extensive areas, since in both cases the methane must be mined molecule by molecule from the source rock.

- Initial stimulation
Shale is always fracked.
The initial stimulation for CSG is dewatering the aquifer: then it is fracked when flow declines.

SIMILARITIES

- I. Industrialisation on a massive scale with the pollution to go with it.

In both CSG and Shale there is widespread land disturbance for

- Well pads
- Access roads
- Pipelines

- Gathering lines / high point vents/low point drains
- Compressor stations
- Ponds
- Processing plants
- Pumping stations
- Power plants (to power the infrastructure)
- Etc

Air pollution results from the land disturbance itself /construction activities/ associated truck movements.

Air pollution results from emissions intrinsically associated with the processes, and potentially from all of the equipment. (fugitive/planned/accidental /deliberate) (drilling/ fracking/ leaks/ spills/evaporation/venting/ flaring)

II. Use of water /contamination of water

Production of massive volumes of contaminated waste for which there is no solution (hydrocarbons, radioactive, unknown mixtures, brine, salts heavy metals)

What is the evidence that the differences between the processes makes the relevance of the Queensland health findings questionable?

3. Statements on page 82 misrepresented what Werner said.

“Werner et al have commented that the strength of the epidemiological evidence of health impacts associated with UGE remains tenuous, with many studies of health outcomes lacking methodological rigour. However, they also point out that while the evidence is somewhat weak and is focussed more on acute health effects, rather than chronic ones, it is not possible to entirely rule out a relationship between hydraulic fracturing and adverse health impacts.”

What Werner actually said was:

“Articles spanned several relevant topics, but most focussed on impacts on typical environmental media, such as water and air, with much of the health impacts inferred rather than evidenced. Additionally, the majority of studies focussed on short-term, rather than long-term, health impacts, which is expected considering the timeframe of UNGD; therefore, very few studies examined health outcomes with longer latencies such as cancer or developmental outcomes. Current scientific evidence for UNGD that demonstrates associations between adverse health outcomes directly with environmental health hazards resulting from UNGD activities generally lacks methodological rigour. Importantly, however, there is also no evidence to rule out such health impacts. While the current evidence in

the scientific research reporting leaves questions unanswered about the actual environmental health impacts, public health concerns remain intense. This is a clear gap in the scientific knowledge that requires urgent attention.”

And:

“Overall, there was very limited systematically gathered, scientific evidence of health effects directly caused by UNGD activity. Notably, this review identified only seven studies as ‘highly relevant’, demonstrating the lack of research on direct health impacts associated with UNGD. More importantly, while evidence of the environmental cause of adverse health impact was lacking, several scholars and experts voiced concerns about the potential for adverse health outcomes. These concerns were based on credible evidence of detrimental environmental impact and strongly suggest that the lack of evidence of health impact does not dismiss claims of health impact. The available evidence, or lack thereof, is not sufficient cause to rule in or rule out significant or specific, future, or cumulative health impacts of UNGD activities.

It is probable that the lack of evidence on direct causal links between environmental hazards and health outcomes is a result of the rapid expansion of this industry in a short period of time — leaving evidence-based research activities with very little time to respond. Additionally, there is the potential for environmental health outcomes with longer latencies for which effects may not yet be seen.”

4. On page 86 (impacts on social cohesiveness, mental health and well being) the 2015 CSIRO/ GISERA report is mentioned. The panel notes that some of the submissions from industry suggested more positive effects on wellbeing, while failing to note that what that report actually found was that of the 390 residents from the Chinchilla region surveyed 48.5% felt their community was “only just coping”, “not coping” or “resisting” the industry and only 11.4% saw the change as “into something different but better”.

5. There are striking omissions

Despite Dr Werner’s paper on *‘All-age hospitalization rates in coal seam gas areas in Queensland, Australia 1995-2011’* being the solidary significant peer reviewed piece of primary research into physical health in Queensland’s gasfields it was not mentioned. Werner’s finding was that hospitalization rates for blood/immune disorders and cancer increased more quickly in the CSG area than in the other study areas.

Despite Dr Methuen Morgan’s paper *‘Fracked: Coal seam gas extraction and farmers’ mental health’* being the single significant peer reviewed piece of primary research into mental health in Queensland’s gasfields it was not mentioned either. Dr Morgan’s finding was that “Farmers in the

CSG stressed and globally stressed profiles exhibited clinically significant levels of psychological morbidity.” “stress associated with CSG impacts both on-farm (operations, profitability, and personal privacy) and off-farm (health, community and environmental) were assessed as severe.”

The paper by Rasmussen et al “*Association Between Unconventional Natural Gas Development in the Marcellus Shale and Asthma Exacerbations*” (June 2016) which is noted for its strong methodology failed to rate a mention. Its finding was that residential UNGD activity metrics were statistically associated with increased risk of mild (new oral corticosteroid medication order), moderate (emergency department encounter), and severe (hospitalization), asthma exacerbations.

6. Page 82 “The panel notes that where adequate toxicological information is available HFF chemicals appear to have low toxicity” obfuscates and avoids the evidence that adequate toxicological information is not available.
 - There is no information on mixtures of chemicals
 - There is no information on endocrine disrupting chemicals. Dilution is not the solution to pollution. If endocrine disrupting chemicals are diluted throughout an aquifer, the aquifer is polluted.
 - There are no drinking water standards for the chemicals in frack fluids. Page 83
 - WA HHRA was hampered by the lack of local measured/reported data on the concentrations of chemicals identified in HFF and produced water
 - Page 30. In the Northern Territory disclosure of flow back is not mandated.

7. On Page 56 the statement “The Panel notes that public disclosure of *“specific information regarding chemicals”* used in hydraulic fracturing is required in the Northern Territory” begs the question, who is overseeing that process? Disclosure must be an absolute requirement, but would be totally inadequate if it is part of a box ticking exercise and that having disclosed the chemicals, the company proceeds regardless of the risks or outcome.
 - Has there been full disclosure regarding chemicals to the inquiry? (see generic “under the kitchen sink” listing of chemicals on page 9 background and issues paper) Has “commercial in confidence” been claimed for any compound? Have material safety data sheets been provided to the panel for all products? Have accurate details been given to the committee on the volumes of chemicals to be used in each well for drilling /fracking and all other purposes? If not, why not?
 - What does the entity receiving the information on chemicals do with the information? Incredible though it is, the Senate Committeeⁱ inquiring into the re-identification of Coal Workers’

Pneumoconiosis in Queensland found that the “**Health Surveillance Unit**” (part of DNRM) was literally a storage unit.

- NICNAS was charged with assessing the risks from fracking chemicals in 2012. As discussed in my original submission, 5 years after being commissioned despite thousands of wells having been drilled and many fracked, NICNAS’s desk-top study (with very limited terms of references) has still not appeared. I note on page 86 the panel is relying on NICAS to outline suitable HHRA methodologies. Good luck with that. It seems to me that our National Industrial Chemicals Notification and Assessment Scheme is toothless, what with more than 20,000 chemicals having been grandfathered in with no assessment of human health safety at all, and now the 2017 “streamlining” relieving NICAS of function and responsibility.

8. Page 82

“The [opinion](#) consistently expressed in industry submissions is that such risks are manageable, and that contamination of aquifers from the process of hydraulic fracturing is [improbable](#) because of the spatial separation between the deep shale deposits and the beneficial use aquifers that are typically much closer to the surface.”

In this Scientific Inquiry why are evidence bases and methodological rigour not required to back industry “opinion”?

- How ‘improbable’ is contamination of the aquifers?
- What is the risk? -One in how many wells drilled?
- What are the unknowns?
- What is the extent of knowledge/lack of knowledge about the aquifers themselves? Have they been mapped in detail both over this massive remote area, and at local level where each well would intersect? What is the degree of connectivity between aquifers?
- What is the level of drawdown on the aquifers historically through wet and dry seasons?
- Where is the connectivity of the aquifers with surface water?
- What about the faults? Where exactly are the faults? Have they been mapped? With what degree of accuracy have they been mapped at regional level and local level- if at all? How do the fault lines interact with the shale, the aquifers and the proposed fracking zone?

At the bottom of the diagram on page 84 is a statement: *‘the fracture zone may extend to a maximum of 1km from the horizontal well’*. This statement is frankly unsupported. What evidence is that 1km is the **maximum** fracture zone? In 2012 to great fanfare from the industry and politicians world-wide Davies decreed that the maximum induced fracture was calculated to be 588m, so 600 metres was deemed to be safe. However within 3 months of Davies’ paper Geiser et al **measured** a fracture at 1000m.

The question is what is the actual evidence gathered since 2012?
Thousands of wells have been drilled and fracked. Are there any papers?
If not, why not?

The December 2016 update of the US EPA confirms that: *“cases of impact were identified at all stages of the hydraulic fracturing water cycle.”*

A point that must be noted is that before wells are fracked, they must be first drilled. Aquifers are also placed at great risk during initial drilling. Drilling is through the unprotected aquifers. A wide range and large volume of chemicals are used in routine drilling of exploratory wells and significantly more when there are losses during drilling (uncontrolled losses into the formation).

9. Quote from WA report.

“The HRA has found that, under the right conditions, hydraulic fracturing of shale gas reserves in WA can be successfully undertaken without compromising drinking water sources.”

Where is the evidence? Where is the working model, even one actual place where shale gas reserves have been successfully undertaken without compromising drinking water sources?

Where is the evidence from baseline studies, and follow up studies and what specifically have been the “right” conditions of regulation/monitoring and enforcement in this elusive utopia?

What happens under the wrong conditions?

10. What is the evidence that the Northern Territory will be different to anywhere else?

(same industry/same players).

Where is the **proof of intent** from Industry that the Northern Territory will be different?

It is acknowledged by everyone that baselines are crucial.

To my knowledge Tamboran has been in the Northern Territory since 2011. They have drilled a well almost 4km deep. Santos has long been associated with Tamboran.

What evidence has the industry provided to the Inquiry regarding baseline testing in the NT?

The question of baselines and the necessity to have baseline data did not start today. It is not an issue that started with this inquiry.

If the intent of the industry was to conduct themselves in a manner different to how they behaved in Queensland and elsewhere, their proof of intent at this point would be full and open disclosure of comprehensive baseline testing that they had already collected (over the many seasons they have had opportunity to) in the Northern Territory.

If industry has not gathered baseline data---why not?

11. Where is the evidence that the Industry in the NT will behave differently in the NT to how they have operated in Queensland?

Please watch this video (link below)

It is a graphic account by Queensland farmer Wayne Walker of the absolutely appalling way he was treated by Origin.

<https://www.facebook.com/100015336371626/videos/vb.100015336371626/166438060544072/?type=2&theater>

KNOWLEDGE GAPS

12. In the interim report, the very significant and well documented human health impacts of noise are not considered at all.
What consideration has been given to the impacts of noise on the well being of birds and other animals?
13. In the Interim report, there is almost no mention of the burden on health of air pollutionⁱⁱ, ⁱⁱⁱin general, and the recognized air toxins that are acknowledged to result from these industrial processes. There is no acknowledgment of the vast body of medical research directly attributing causation of impaired health to air pollution and air toxics exposure.

There has been no attempt to collate primary air toxics data (particulate PM10/ PM2.5, Oxides of nitrogen, Carbon monoxide, volatile organic compounds, Ozone, formaldehyde, etc) known to be emitted by this industry. Data available through the National Pollutant Inventory^{iv}, is limited by the number of toxins mandated for reporting and by the fact it is self assessed, self calculated and self reported by the industry. However it provides some indicators of the mechanisms and cumulative risks to health.

For example in Queensland QGC reported air emissions from Ruby Jo – Kumbarilla commencing in 2010/11. In the years before, local residents were exposed to **zero** air toxins from that particular facility.

In 2010/11 QGC reported 59kg of PM10 and 57kg of PM2.5.

In 2014/15 they reported 1,900,000kg PM 10 and 2,700kg of PM2.5

In 2010/11 39,000kg Carbon monoxide,

In 2014/15 1,500,000kg carbon monoxide

In 2010/11 11,000kg oxides of nitrogen,
In 2014/15 940,000 kg oxides of nitrogen and so on.

In 2014/15 there was 28,000 kg or 28 tonnes of formaldehyde emitted from this facility.

Primary air toxics data from NPI could give at least some indication of the scale of cumulative air pollution if extrapolated to the facilities proposed in the northern territory.

I have already discussed the health impacts of air pollution in my original submission and I would urge the panel to follow the references that I have included. (for example the comprehensive “Review of evidence on health impacts of air pollution REVIHAAP project, WHO 2013”)

In short air toxins which are subject to mandatory reporting to the NPI are recognised causes of cancer, cardio/respiratory illness, (including heart attacks, stroke and asthma), and are implicated in neurodevelopmental abnormalities and a range of other health harms including endocrine disruption.

There are multiple low volume highly toxic pollutants (including from the flares) for which reporting to the NPI unfortunately is not mandated.

14. Evidence entirely missing for review by the panel is data on the peak and chronic exposures of gas field residents. The work of Brown et al is alluded to on page 85 and should be noted. Notice must be taken of this massive information gap, because peak exposures and resultant health impacts do not correlate well with ambient air modeled on a regional scale.

Health impacts on humans in Queensland’s gas field have already been reported (and ignored). (see Symptomatology of a gasfield 2013).^v
Please also refer to the evidence given by Ms Helen Bender regarding impacts on livestock.

15. Page 86

“Knowledge gaps that will need to be addressed to better inform the risk assessments to public health include:

- further information on proposed sites for wellhead development, so that the proximity of human ‘receptors’ in residential communities can be factored into the CSMs needed to inform a detailed HHRA for these specific sites”.*

Further information is in fact required on all associated infrastructure (pipelines, vents, drains, flares, ponds, pits, pumping stations, compressor stations, processing plants, water treatment plants, reinjections wells, waste dumps, etc etc.)

16. Can the industry be regulated into safety?

Attempts can be made in optimum circumstances to regulate the inspection, maintenance and repair of plant and equipment. But one cannot regulate the underlying inevitable decomposition and degeneration of components whose function is critical.

It is not possible to regulate the degeneration of cement. Everywhere in our daily lives there is widespread visual and tactile evidence of how cement cracks, crumbles and inevitably degenerates over time. There is evidence of how it is sensitive to movement/ heat/cold/ pressure etc

In the purported protection of the aquifers the critical layer in the gas well is the 2-3cm+- of cement between the steel pipe and the formation through which it has been drilled (it is still cement no matter how many additives are claimed, and to protect the aquifer this cement must **forever** form a tight seal between the steel and the formation).

- How can one regulate that cement shall not crack, crumble, become dislodged from the steel, become dislodged from the formation? The more wells, the more risks.
- How can one regulate that the seismicity which fractures shale will not also fracture/weaken the cement on the fracked well or any other well in the grid?
- This is a short-term industry. Even if one could regulate and enforce repeated inspection and repeated repair while the industry is operating, what happens when the gas runs out?

Page 54 *“Davies et al found from a survey of hundreds of thousands of fracturing operations that the likelihood of induced seismicity felt on the surface by hydraulic fracturing was very small”* does not address the issue of what is happening to the integrity of the cement seal underground with repeated induced seismicity. The very first well fracked by Cuadrilla in England caused distortion of the steel pipe and inevitably the cement.

- How can one regulate the degeneration, rusting and corrosion of steel?

The characteristics of steel are well known. Steel corrodes under the influence of salt/acid.

- How can one regulate the corrosion of steel underground when it will be exposed to acid from the industries' activities (acid used to clean the pipes etc)?
- How can one regulate the corrosion of steel underground when it is exposed to concentrated brine from the target formation?

- How can one regulate the maintenance of multiple joins in (almost) infinite pieces of buried infrastructure (out of sight/out of mind) in addition to the visible infrastructure?
- Does the NT have the capacity to regulate (inspect and enforce) the quality of materials used in the first place? Major delays were incurred in laying Queensland's high pressure pipelines as the quality of the imported steel was so poor the welds would not take.

All the wells drilled through aquifers will form potential, and inevitably actual, conduits between all the layers from the shale to the aquifers. It is just a matter of time before potential becomes actual. Long after the industry has gone (10, 20, 50, 150 years, even 1000 years) conduits will be there.

- What regulation (apart from preventing it happen in the first place) can prevent that?

Can one regulate permanent (ie for centuries after this industry has gone) safe disposal of massive quantities of toxic waste for which no other jurisdiction has ever found a safe answer?
(re injection wells—earth quakes) (landfill...creates toxic legacy issues, inevitable long term leakage of salt/ toxic waste/ radioactive material) (evaporation ponds)

Apparently the regulators in Queensland admit they made mistakes (in the early days).

- What were the mistakes they made (apart from not enough "communication")? To date there has been a culture of denial. If truly there was a cultural shift they would be prepared to own those mistakes publically.
- What were the consequences of those mistakes (to the people, and to country)?
- What is different now? Specifically what changes have been made?
- What evidence is there that those changes are having a measurable different outcome?

When an intrinsically hazardous activity is contained within a geographically small location (as most industrial activities are) then intense oversight, supervision, early detection and correction of human errors is possible. With personnel, activities and plant scattered over extensive areas in remote locations how can the normal human failings of inattention, apathy, blasé attitudes, or even reckless stupidity leading to errors be regulated into safety? Mental health issues are also a recognized and an extremely important extra area of concern with FIFO work.

In the offshore gas industry the intrinsic hazardous nature of the industry itself and all its processes are acknowledged, but when the same industry sets up literally in a families backyard the intrinsic hazards of the industry are not only ignored but actively denied. (see submissions from industry). To minimize risks, they must first be acknowledged and addressed.

- How can one appropriately regulate self-interest and greed?
- What steps are necessary to regulate the regulator?
- What must be done to regulate the revolving door of self-interest/ career pathways and widespread conflict of interests between industry, regulators/ bureaucracy, and politicians so evident in Queensland?

- In Queensland some cautionary tales have emerged this year from the Land Court^{vi} with the judge finding that objectors to Acland Stage 3, who for 14 years had been complaining about noise, had *'not been well served'* and had been *'treated very poorly by' 'the statutory party'* (DEHP).

- The Senate Committee^{vii} inquiring into the re-identification of Coal Workers' Pneumoconiosis in Queensland found that the Department of Natural Resources and Mines (DNRM) had failed to protect the health of coal mine workers with respect to respirable coal dust. The Senate Committee identified that the state's *'light touch regulatory model' 'has the potential to be fertile ground for regulatory capture.'*

"One of the risks associated with formal and ongoing engagement between a regulator and the industry it regulates is regulatory capture. This occurs where an officer involved in administering a regulatory regime develops a relationship with the industry and may be influenced to represent their interest in advance of the interests of the regulator.⁵⁷⁶

The influence need not be overt, but may lead to a situation where necessary compliance action is not taken, or when taken, is less severe than the circumstances warrant:

To put it simply, once captured, a regulator goes easy on the industry. The issue is one of objectivity in making decisions to carry out enforcement action.⁵⁷⁷

The Senate Committee identified that in Queensland, the state's 'light touch regulatory model' allows for close relationships between the Mines Inspectorate and the companies whose activities are being regulated – a situation that 'has the potential to be fertile ground for regulatory capture', particularly giving the influence of the mining industry in Queensland.⁵⁷⁸

- ICAC in NSW has shone significant light on corruption and misuse of power in that state.

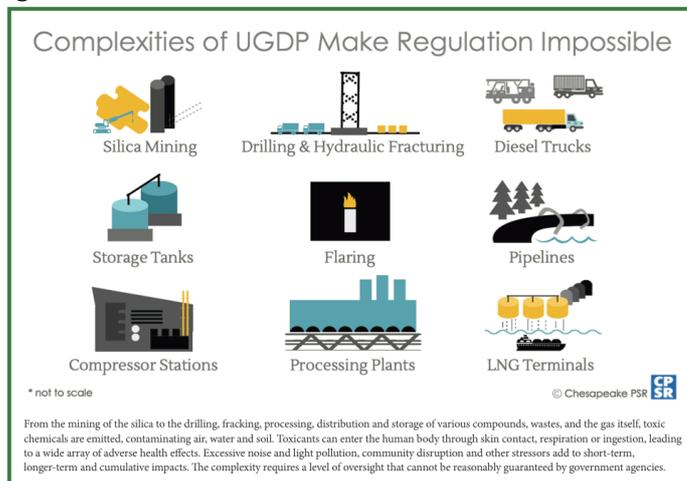
- Currently the NSW State Government is backing calls for a judicial inquiry into misuse of water in Barwon-Darling system

Across Australia there is significant emerging evidence of failures of regulation, and particularly failure of enforcement of regulation. In the Northern Territory there is a massive push from vested interests to exploit shale gas for deemed monetary purposes, despite this being against the wishes of the people (who forced the moratorium).

- What evidence is there that the Northern Territory is, or would be, any different from Queensland and NSW?
- How does one regulate regulatory capture?

The Chesapeake Physicians for Social Responsibility argue that the complexities of Unconventional gas exploration and production make regulation impossible¹.

“From the mining of the silica to the drilling, fracking, processing, distribution and storage of various compounds, waste and the gas itself, toxic chemicals are emitted, contaminating air, water and soil. Toxicants can enter the human body through skin contact, respiration or ingestion, leading to a wide array of adverse health effects. Excessive noise and light pollution, community disruption and other stressors add to short-term, longer-term and cumulative impacts. The complexity requires a level of oversight that cannot be reasonably guaranteed by government agencies.”



COMMENTS ON ORIGIN ENERGY SUBMISSION #153

7.4 Diesel fumes

“there may be a risk of emissions from plant and equipment, such as diesel fumes from drilling equipment and pumps and from off-site increases in road traffic

Response and controls

The risks to public health posed by the combustion of fuels is considered extremely low..”

Simply not true. (see REVIHAAP technical report)

“Diesel engine exhaust is rich in PM, mostly below 2.5 µm. A large database describes all sorts of adverse health effects due to exposure to diesel engine exhaust. Exposure to diesel engine exhaust in healthy volunteers causes inflammation of the airways (Behndig et al., 2006) and reduces vascular function (Mills et al., 2005). In patients with heart problems (stable myocardial infarction), diesel engine exhaust causes myocardial ischaemia and reduces the clot resolving function (endogenous fibrinolytic capacity) (Mills et al., 2007).

..in June 2012, the International Agency for Research on Cancer evaluated diesel-engine and gasoline-engine exhausts and classified diesel-engine exhaust as “carcinogenic to humans” (Group 1).”

ORIGIN ENERGY SUBMISSION # 153

7.2.3

“In addition to testing and analysis of cuttings Origin has under taken detailed water and gas chemistry to understand the type and concentration of any water and gas borne radionuclides in HFS flowback fluids and gas. The assessment concludes

- Based on the most active sample (12.5uSv for 1 litre of water) to exceed 1 mSv/year would equate to 80 litres of water being consumed in one year. It is unlikely that this amount of active water would be consumed by a member of the public.”*

80 litres of water per year is 220mls of water per day, which is a minimal amount. Even if the active water was diluted by a factor of 10, at an average days fluid intake for adults it would still exceed the limit. What additional exposures would there be from bathing in the radioactive water, using it to wash clothes/ clean floors, or inhaling it in the shower? What would the exposure be for example of an infant drinking 6 x250ml bottles of formula per day be?

- “Results from the analysis of the gas sample indicated Radon levels of 225Bq/m3. The potential Alpha Energy Concentration (PAEC) in*

this sample was calculated to be 1.001mJh/m³ which could result in and effective dose to an exposed person of 1.4mSv/year, however the exposure risk can be disregarded in well-ventilated or open air situations due to the very short half-life of the Radon progeny and the fact that the Radon would mix and dissipate quickly in clean air.”

People live in enclosed spaces, and radon hugs the ground especially during still nights and temperature inversions. Radon has a short half-life, but it does not disappear. Its progeny are also radioactive as the radioactive decay series for radium indicates.

	Half life	decay	
Radium 226	1600 years	alpha	
Radon 222	3.8 days	alpha	
Polonium 218	3 minutes	alpha	
Lead 214	27 minutes	beta	
Bismuth 214	20 minutes	beta	
Polonium 214	180microseconds	alpha	
Lead 210	22 years	beta	
Bismuth 210	5 days	beta	
Polonium 210	138 days	alpha	
Lead 206	stable		

Exhuming radioactive substances (radium 226 and radon gas) along with methane gas, from where these elements are currently safely buried at depth in the shale creates immediate health risks along with legacy issues. The half -life of radon is 3.8 days. Within a week half has decayed to radioactive lead 210, whose half-life is 22 years. If one exhumes radon one should be also testing for lead 210, and eventually polonium 210 and lead 206. Testing in Queensland’s gasfields has shown that lead, including lead 210, is already present in elevated levels in the drinking water tanks from roof collecting systems. (where no lead is part of the collecting system itself).

Comment re Page 75 (bubbling Condamine)

“Similarly, it is well documented that the bubbling of methane from the Condamine River in Queensland has increased threefold since ongoing measurement began in early 2015, although it is now declining. However, there is no conclusive evidence that this increase is related to CSG activities. It may relate to the migratory emissions described by the MEI, but it could also relate to changes in river water flows or natural changes in groundwater flows.”

With regard to the Condamine there are some clear facts.

Any faults existing in the area have been there for (possibly) millions of years. The river was not seen to be bubbling.

In environmental impact statements by four different gas companies there was never once note made of a bubbling Condamine River, which

points to remarkable failure of due diligence, or the river was not bubbling.

People who lived beside and swam in the river over a 60 year period noted that during all that time they had never seen the river bubbling. River water flows have changed seasonally in drought and flood. The river was not reported to be bubbling.

Natural changes in groundwater flows have been happening since the river has been flowing. The river was not reported to be bubbling.

The gas companies (deliberately) dewatered the aquifer. (Origin being the company with the closest leases)

The river started bubbling and has continued bubbling for 5 years.

As I documented in my submission, in 2012 a local resident filmed and put on the Internet this new and dramatic phenomenon of the bubbling Condamine River. In 2012 the gas industry and politicians immediately denied all responsibility (and later announced an 'investigation'). 3 years later in 2015 Origin finally got around to measuring the bubbling, diverting the gas to land and flaring it there. The flare is still burning and the river is still bubbling but less intensely.

ⁱ Queensland Government. Black lung white lies. Inquiry into the re-identification of Coal Workers' Pneumoconiosis in Queensland
<http://www.parliament.qld.gov.au/documents/tableOffice/TabledPapers/2017/5517T815.pdf> accessed 2nd July 2017

ⁱⁱ https://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf

ⁱⁱⁱ Air Pollution and Mortality in the Medicare Population
Qian Di, M.S., Yan Wang, M.S., Antonella Zanobetti, Ph.D., Yun Wang, Ph.D., Petros Koutrakis, Ph.D., Christine Choirat, Ph.D., Francesca Dominici, Ph.D., and Joel D. Schwartz, Ph.D.
N Engl J Med 2017; 376:2513-2522 [June 29, 2017](https://doi.org/10.1056/NEJMoa1702747) DOI: 10.1056/NEJMoa1702747

^{iv} <http://www.npi.gov.au/npi-data>

^v <http://www.ntn.org.au/wp/wp-content/uploads/2013/05/Symptomatology-of-a-gas-field-An-independent-health-survey-in-the-Tara-rural-residential-estates-and-environs-April-2013.pdf>

^{vi} Decision New Acland Coal Pty Ltd v Ashman & Ors and Chief Executive, Department of Environment and Heritage Protection
<https://www.sclqld.org.au/caselaw/QLC/2017/024> accessed 2nd July 2017

^{vii} Queensland Government. Black lung white lies Inquiry into the re-identification of Coal Workers' Pneumoconiosis in Queensland
<http://www.parliament.qld.gov.au/documents/tableOffice/TabledPapers/2017/5517T815.pdf> accessed 2nd July 2017