Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry)

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Contents

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UNCONVENTIONAL GAS IN QUEENLAND

1. INTRODUCTION

No baseline studies and no health impact assessments were done prior to the Coal Seam Gas production licences being issued in Queensland, and in Queensland comprehensive health studies have still not been done. Real time air quality monitoring has never been done. Science has been singularly lacking. There has been no comprehensive assessment of the level of fugitive emissions from the Queensland gas fields. In Queensland there are effectively no limits on emissions from each well or the wider reticulation system. The gas companies can flare or vent 3 million cubic meters of gas from each well during production testing before having to even pay royalties. Emissions from the thousands of high point valves are not used in any calculation of emissions.

Unconventional gas, in the form of coal seam gas, and underground gasification was forced on the people of rural Queensland. Even now, the government is actively seeking development of shale and tight sands. Landholders have been denied the right in legislation to refuse Coal and Gas on their land. They were required by the government, who had given the permits to the resources industry, to accept the intrusion and were "*forced to negotiate merely the price of entry".* The surrounding community, heavily impacted by the activities of the gas industry but without physical gas infrastructure on their property, were accorded no rights or protections at all.

"Co-existence" was the mantra under which the coal seam gas industry was forced upon the people and the gas field commission was set up to facilitate it. The people in Brisbane were assured in TV advertisements that the environmental foot-print of this industry was very small (half the size of a basket ball court); it was the "clean-burning" alternative and it meant jobs and prosperity. The reality in Queensland turned out to be very different. The boom in rural towns such as Chinchilla was short-lived and now less than 6 years later, they are firmly in the bust stage of the cycle. During the boom, some people, such as the publicans, made money. But many people suffered. Rents rose rapidly with the influx of fly-in, fly-out workers. Long-term resident renters, low-income families and pensioners found themselves priced out of their homes and left town never to return. Low-income house owners on fixed incomes found that their rates doubled as the rateable value of the houses in the town increased. House prices rose rapidly and investors funded an ill-conceived building boom, resulting in houses being build on inappropriate sites, causing flooding and expensive remedial drainage funded by the local rates. Now in the bust, hundreds of houses stand empty, unsold and not rented. House prices in Chinchilla have fallen by 30-40% in the past year. During the boom pre-existing business not associated with the mining industry found themselves in serious difficulties. Business owners in town and on the land found they could not compete with the inflated wages being offered by the gas companies, lost their skilled workers and in some cases folded. Brand name businesses such as McDonalds and BP came to town and the distinctive locally owned shops typical of a country town closed their doors. The tourist industry suffered major damage. Tourists simply couldn't stop. Hotels and motels were block-booked by the gas

industry, as were the caravan parks. The grey nomads in particular had nowhere to go. Now, with the end of the construction phase of the gas industry, there is a second round of business closures and there is nothing to fill the vacuum. Proponents of the unconventional gas industry promised billions of dollars worth of investment in infrastructure. Any reasonable person would innocently assume they were talking about bridges, roads, hospitals, schools, etc for the benefit of the resident population. There was no benefit here for the people. Infrastructure meant, in this instance, gas wells, and gas pipelines, and gathering lines, and processing plants, and power plants to power the gas infrastructure, and powerlines to supply the gas infrastructure, gigantic waste dams and waste facilities. Much of the infrastructure was imported.

2. REPORTED HEALTH IMPACTS

Twenty to thirty kilometers away from boom-town Chinchilla, living in the midst of the actual gas field infrastructure, residents were feeling not only the financial, but also the physical impacts of the pollution accompanying the gas industry. In 2013, I conducted a health survey[1] of 113 residents from the Tara rural residential estates and surrounding areas. The pattern of reported symptoms was outside the scope of what would be expected for this small community. 58% of people surveyed were certain their health was adversely impacted by CSG. Of particular concern was the impact on the children. 15 of the 48 children were reported to experience abnormal sensations such as numbness and pins and needles, while 31 children reported headaches, many of them severe. Other possible neurological symptoms reported in all groups included severe fatigue, weakness and difficulty concentrating. Eye and skin irritation were constant background complaints, particularly when outside, and were linked to malodourous events. With changes in wind direction residents could identify distinct odours and tastes often coinciding with exacerbations of symptoms. These included smells like rotten eggs, sickly sweet, like pine tarsal, acetone, creosote, and the after burn from cigarette lighter. Some residents were not sensitive to smell but complained of metallic taste and nausea. Increases in cough, rashes, joint pains, muscle pains and spasms, nausea and vomiting were reported. Approximately one third of residents age 6 and above were reported to have spontaneous nosebleeds. People reported that symptoms improved when they left the area and recurred when they returned home. Two of the four residents employed by the gas industry reported similar symptoms. One was so severely affected they could no longer work.

[1] Symptomatology of a gas field: An independent health survey in the Tara rural residential estates and environs. G.McCarron, April 2013

Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry) G McCarron

[image redacted]

CHILDREN FROM QUEENSLAND GAS FIELDS (PHOTOS COURTESY OF THEIR PARENTS)

3. THE QUESTION OF CANCER

In recent years, during my visits to Queensland's gasfields, residents have repeatedly voiced concerns about the frequency of cancers, as well as unusual types of cancers occurring within the rural triangle bordered by Dalby, Chinchilla and Tara. I approached Darling Downs Hospital and Health Service for cancer statistics pertaining to the area. The data, which I received in September 2015, only included statistics up to 2012. The data combined the total cancers in all the Darling Downs and South West with no detail about the specific area of interest. I asked for more detail of the cancer statistics from the area in question. In reply, Dr Gillies wrote: *"Cancer Statistics are not collected and held by the Darling Downs Hospital and Health Service (DDHHS) other than at a very high level."* In November 2015 I personally asked Dr Jeanette Young, Queensland Health's Chief medical officer for more data, and to date I have had no feedback.
The data I received, crude as it was, is concerning. In 2005 the incidence of invasive cancer in the Darling Downs was 1366. In 2012 the incidence was 1693, an increase of 23.9% on the 2005 figures.

Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry) G McCarron

Figure 12: Queensland Invasive Cancer Incidence and Mortality for Year and Residence

Year	Incidence			Mortality		
	Darling Downs	South West	Total	Darling Downs	South West	Total
2005	1366	137	1503	476	52	528
2006	1500	124	1624	497	42	539
2007	1479	128	1607	483	61	544
2008	1599	173	1772	502	52	554
2009	1681	133	1814	528	58	586
2010	1571	135	1706	521	51	572
2011	1622	138	1760	509	45	554
2012	1693	150	1843	550	60	610

Leaving aside for a moment speculation on possible causes, this is a significant change and is, in itself, cause for question.

With regards to residents' concerns regarding cancer I will give three specific examples.

i. In Ducklo, one of the earliest -developed parts of the gasfield, three men who lived within 10km of each other were diagnosed and have subsequently died from pancreatic cancer. This is in a community of less than 50 people. In 2011 the age-standardized incidence for pancreatic cancer in Australian men was 13 per 100,000. In other words it is not a common cancer. One pancreatic cancer in this small community could be considered unlucky. Three raises serious questions as to cause. Questions were in fact asked regarding this cluster of cancers. Ray Hopper who is the local member raised the issue in the Queensland parliament and it was in theory investigated. One wonders with what rigour. In May 2014, on hearing of the demise of the third man, I wrote to Laurence Springborg, minister for health regarding the progress of the investigation and received the following disgraceful reply.

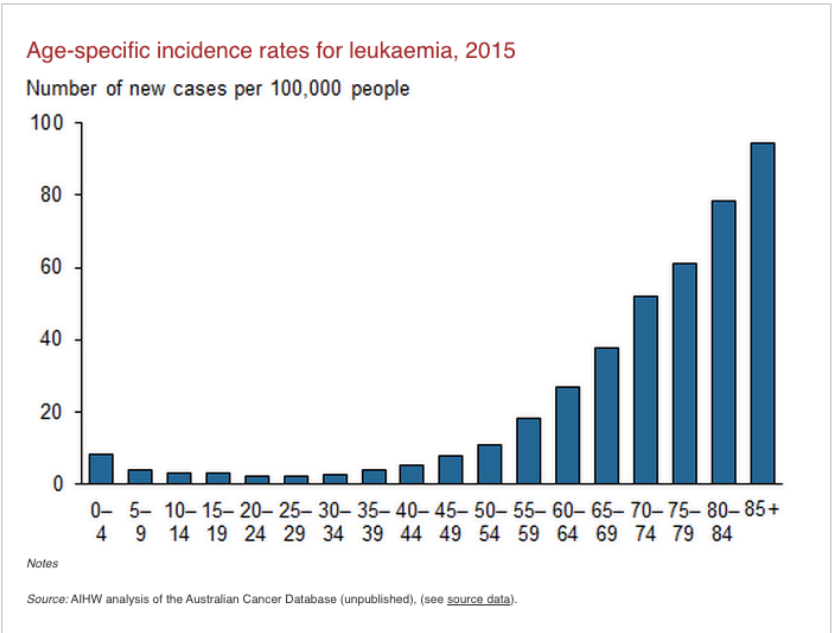
> Despite repeated attempts to encourage other individuals with pancreatic cancer to come forward, there was no response so the investigation could not progress any further.

Unfortunately these are not the only cases of pancreatic cancer. In 2014 a lady who lives just across the Moonie Highway from Ducklo was diagnosed and died from Glucogonoma, an even rarer form of pancreatic cancer with a risk of 1 in 20 million.

ii. Immediately to the west of Brentleigh Park gas facility there are rural residential blocks. There are multiple blocks mapped, but only three family homes, of which two have had continuous long-term occupancy. In 2006 QGC build a huge unlined pond on one of these families property. This was a massive 3.9 hectare pond holding 3ML. In theory it was meant to hold the flowback from one well on the property 800metres from the home. However QGC went on to drill more wells at Brentleigh park but did not have a pond there, so ran an overground pipeline from Kenya east 3 and other wells, and for years pumped drilling waste into this unlined pond. In 2012 they decommissioned the pond and sucked out the sludge in 2013.
The family asked for results of tests taken to confirm safety after decommissioning, and to date have received nothing. In 2005 the family had been given rights to use the water in the pond: In 2009 QGC revoked their rights to use the water.

Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry) G McCarron

In 2009 the family's adult son, age 28, was diagnosed with leukaemia.



As you can see from the graph, leukaemia is not a common cancer in young adults.
In 2011 a second young adult in the same household, a sibling age 29 was also diagnosed with cancer, a very rare cancer called chordoma with an incidence of one case per million per year. In 2013, their immediate neighbour, an 8 year old child who had been ill for more than two years was also diagnosed with leukaemia, with the diagnosis occurring after moving from the property.

iii. Local residents have been very concerned about reports of childhood cancer. In the local media there has been significant coverage of the problems faced by two children, aged 12 and 17 enrolled at Tara State College who have been diagnosed with Ewings Sarcoma (a rare type of bone cancer.) The age standardized rate of Ewing Sarcoma in Australians age 0-14 years between 2003 and 2009 was 4.6 per million. The age standardized rate for 15-29 year olds over the same time frame was 4.5 per million.
Tara State College is a small school with, in 2012, an enrollment of 381 pupils[2].

These are discrete examples of some the reported concerns, but they are no by no means the only ones. For example, in one street of 6 houses, 5 people have cancer. During the early years the gas company took water from the lagoon to clean their pipes and then sprayed the contaminated water on to the dirt roads around the estate. There are more cases of very aggressive leukaemias, and there are lymphomas. In one household both parents of toddlers have cancer. I believe that the residents concerns regarding the incidence, types and spatial clustering of cancers are justified and worthy of rigorous and open investigation. These cancers are not explained by chance, (bad luck) or genetics. This raises the question of environmental contamination, and warrants full investigation of all possible sources.

4. MENTAL HEALTH IMPACTS

There have been very serious mental health impacts both on the original population as well as the FIFO workers, with an escalating level of suicides in the region. George Bender, for whom this Inquiry is named, by his suicide, brought to the nation's attention the bullying and the extreme unremitting stress that landholders have been subjected to by government agencies and the resource companies for 10 years. Darling Downs Hospital and Health Services are unable to provide any reliable data on completed suicides. Patients who are deceased on arrival are not entered in either emergency or inpatient data sets. However what the DDHHS statistics does show is that admission for attempted suicides in the Darling Downs and South West where the patient's residence was recorded as Chinchilla and Dalby, jumped from 2 in 2006 and 7 in 2007 to 60 in 2013 and 66 in 2014. (2015 statistics incomplete)

Figure 21: All attempted suicides by year and residence – Darling Downs and South West

Residence	Year										Grand Total
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Chinchilla		4	5	5	6	18	30	31	19	9	127
Dalby	2	3	4	10	9	21	29	29	47	19	173

On September 26th 2015 while addressing a Health Expo at Tara, organised by the Tara Health Expo, Mayor Brown, who is also a gasfield commissioner, reported that in 2014 there had been 11 suicides of workers in the man camps, all within the Western Downs Regional Council Area.

5. THE ENVIRONMENTAL FOOTPRINT

Contrary to the promise of a minor environmental footprint, the problem for the people

[2] http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=10737420600 table E2.3

forced to co-exist with the unconventional gas industry is the intense industrialisation and pollution caused by this very dirty industry. “Co-existence” in the Tara/Chinchilla gas fields effectively means living within an immense gas processing plant with not only gas wells but all the associated infrastructure: central processing plants, water treatment plants, reverse osmosis plants, evaporation ponds, regional ponds, frack ponds, scrubber stations, field compressor stations, wet and dry flares, high point vents, low point drains, condensate tanks, high voltage power grids, water gathering lines, gas gathering lines, high pressure pipelines, access roads, and thousands of heavy vehicle movements.

Evaporation ponds, photos courtesy of visiting photographer

Evaporation pond, photo courtesy of visiting photographer

Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry) G McCarron

Destruction of the State Forest, photo courtesy of gasfield visitor

Environmental impact, massive bulldozed 'laneways' criss-cross the site, photo courtesy of local resident

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Gas infrastructure in state forest, photo courtesy of local resident

Gas infrastructure, photo courtesy of local resident

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Gas infrastructure, photo courtesy of local resident

Flare, photo courtesy of local resident

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Flares in the night sky, photo courtesy of local resident

Emissions from reverse osmosis plant, photo courtesy of local resident

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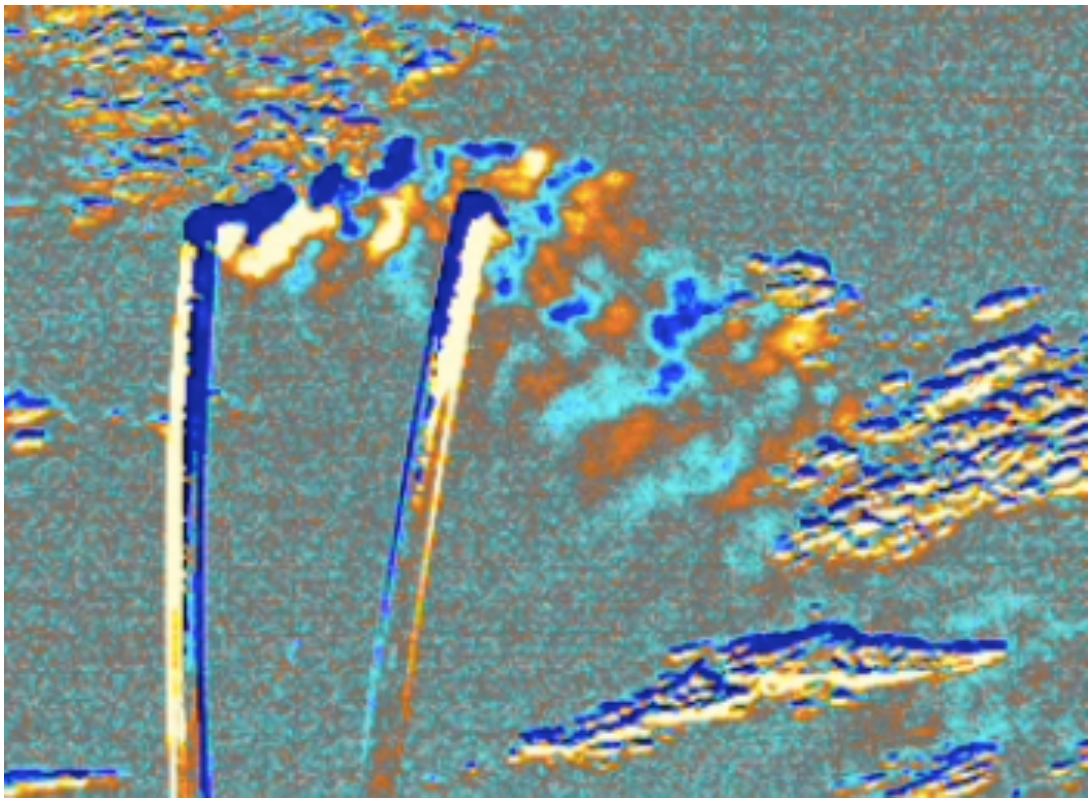
High point vent, photo courtesy of gas field visitor



FLIR CAMERA FOOTAGE HIGH POINT VENT EMISSIONS, photo courtesy of gas field visitor

Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry) G McCarron

Subsidence along the gas pipeline photo courtesy of local resident

The Bubbling Condamine River Photo courtesy of local resident.

Severe environmental harm arising from the activities of the unconventional gas industry is already apparent in Queensland's gasfield. As part of this submission I attach a recent video of gas erupting from the Condamine River. The Queensland government has confirmed that the gas is from the coal seams[3], though their definitive report has been remarkably slow in emerging. When the images of the bubbling in the river were first publicized, Origin energy were very fast to state publically that this was not a new phenomenon. This is despite the fact that according to the elderly residents living along the river, it had never happened before in their lifetime, and no gas company had ever mentioned it in any of their environmental impact statements.

Community bores[4] have been blowing gas and have been shut down. This is in an area where during periodic drought access to groundwater is essential

Biosecurity has been a matter of serious concern, and farmers[5] report agricultural properties have been destocked due to noxious weeds such as African lovegrass, spread by the activities of the CSG companies.

Radioactive sources[6] have used inappropriately on farmland in the Darling Downs, and the landholder[7] on whose property this incident occurred was not even informed.

The issue that has received most media attention has been the extensive contamination of prime farming land at Hopeland, and the court case the Queensland Government has taken against Linc Energy for causing severe environmental harm. The government has found that the soil is contaminated with high levels of hydrogen sulphide, carbon monoxide and hydrogen and over an area of 320 square kilometers farmers have been forbidden to dig a hole deeper than 2 metres due to leakage of these gases from the soil. Government testing has also confirmed soil contaminated with high levels of benzene. The Queensland Environment Department is prosecuting the underground coal gasification company for reckless environmental harm at the plants between 2007 and 2013 and allege groundwater and hundreds of square kilometres of prime agricultural land have been put at risk.

Inexplicably, despite the government having enough evidence of serious environmental harm over an extensive area to actually prosecute the offending company, they have left the families living in the middle of known areas of contamination without appropriate information despite repeated and ongoing requests. This is despite the fact that stock and domestic water bores in the area are "kicking' with explosive levels of gas. Water bores have dropped more than 60 metres and are unusable. Volatile organic compounds at 5%

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[3] Hagemann B. No conclusion yet for Condamine River CSG seepage. Australian Mining. 14 April 2014 http://www.miningaustralia.com.au/news/no-conclusion-yet-for-condamine-river-csg-seepage (accessed 22 December 2014)

[4] http://www.queenslandcountrylife.com.au/news/agriculture/general/news/gas-shuts-down-wallumbilla-bore/2693404.aspx

[5] Stevenson A. Farmer claims CSG companies spreading weeds on southern Queensland properties. abc news. 23 August 2014. http://www.abc.net.au/news/2014-08-23/farmer-claims-csg-companies-spread-weeds-on-southern-qld-propert/5661016

[6] http://www.dalbyherald.com.au/news/qgc-exposed-to-radiation/2242072/

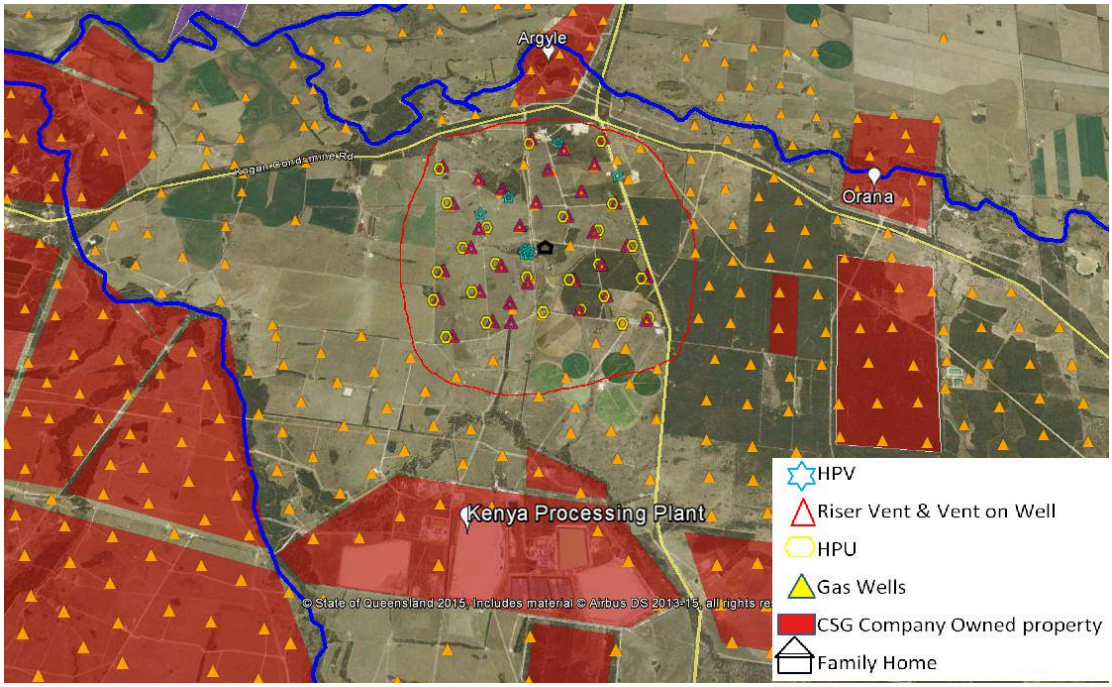
[7] http://www.thechronicle.com.au/news/residents-left-in-dark-coal-seam-gas-radiation/2244686/

per volume have been measured on resident's verandahs and stock animals have been dropping dead. Chemicals of serious concern such as benzene, toluene, naphthalene, cresol xylene and phenol were identified in an investigation into the "Linc Stink" as far back as 2012.

Inexplicably also, although the government has postulated that the mechanism of harm was Linc energy caused fracturing of the overburden, allowing escape of gases from the under ground fire and leakage along underground river beds, they have given Origin energy permission to drill more than 100 coal seam gas wells in the same area of Hopelands, fracturing the overburden with each well and providing multiple conduits for seepage of gas to the surface. This is in the same area where a farmer is not permitted to dig a hole deeper than 2 meters.

6. ONGOING IMPACTS, PLIGHT OF FAMILIES

People living in the Queensland gasfields are subjected to the emissions of raw gas (including BETX) being vented from thousands upon thousands of gas relief vents on the water gathering lines. These emissions are not being monitored by government, and no publically available data on the releases from these vents is available from industry. Yet, some of these vents are within of few metres from family homes. Families including vulnerable children are also subjected to particulate pollution and monocyclic and polycyclic aromatic hydrocarbons when raw, unprocessed gas is used as fuel to power the gas wells themselves. They are subjected to the noxious emissions from the flares, from the compressor stations, processing plants and water treatment plant, so that this raw gas can be "cleaned" to trade specifications and pumped overseas.



This map indicates the plight of one Queensland family living in the Queensland gas fields. This is a family with six children living at home. They suffer from the headaches, nosebleeds and rashes common to so many gas field residents. The black marker is the family home. The yellow triangles indicate the position of gas wells. Land coloured red, previously occupied by friends, neighbours and community members and is now gas-

company owned. This family are surrounded by gas infrastructure, including three major gas processing facilities Argyle, Orana, and Kenya. Note the red circle designating a radius of 3km from the family home and the density of the contained infrastructure. As of 28th July 2015 the list of infrastructure/alleged emissions sources **within 3km radius** of the family home was as follows:

HIGH POINT VENTS

ARG_HPV001; ARG_HPV002; ARG_HPV003; ARG_HPV4_; ARG_HPV005; ARG_HPV5_1; ARG_HPV5_2; ARG.HPV.004; ARG_HPV006; ARG_HPV007; ARG_HPV_011; ARG_HPV_012; ARG_HPV_013; ARG_HPV_014; ARG_HPV_015

HYDRAULIC POWER UNITS

ARGYLE #13; ARGYLE #14; ARGYLE #15; ARGYLE #17; ARGYLE #18; ARGYLE #19; ARGYLE #20; ARGYLE #21; ARGYLE #22; ARGYLE #23; ARGYLE #24; ARGYLE #27; ARGYLE #28; ARGYLE #29; ARGYLE #31; ARGYLE #32; ARGYLE #35; ARGYLE #36; ARGYLE #37; ARGYLE #39; ARGYLE #48; ARGYLE #52; ARGYLE #53; ARGYLE #240; ARGYLE #242; KENYA #23

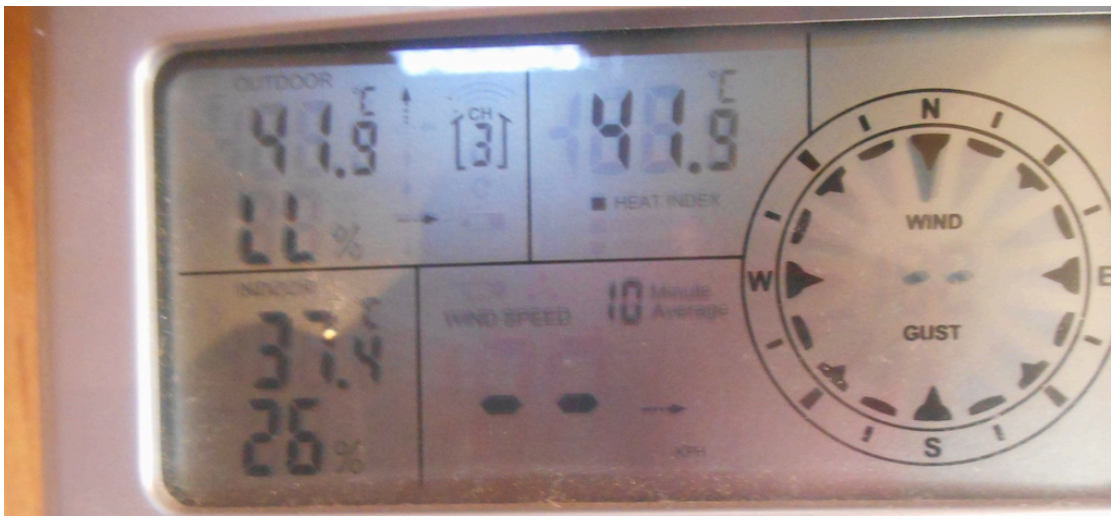
VENT ON WATER PIPE @ WELL

ARGYLE #33; ARGYLE #41; ARGYLE #40; ARGYLE #48; ARGYLE #39; ARGYLE #32; ARGYLE #31; ARGYLE #24; ARGYLE #15; ARGYLE #13; KENYA #23; ARGYLE #14; ARGYLE #23; ARGYLE #16; ARGYLE #17; ARGYLE #19; ARGYLE #20; ARGYLE #22; ARGYLE #27; ARGYLE #18; ARGYLE #21; ARGYLE #29; ARGYLE #28; ARGYLE #35; ARGYLE #37; ARGYLE #34; ARGYLE #36; ARGYLE #43; ARGYLE #44; ARGYLE #52; ARGYLE #45; ARGYLE #53

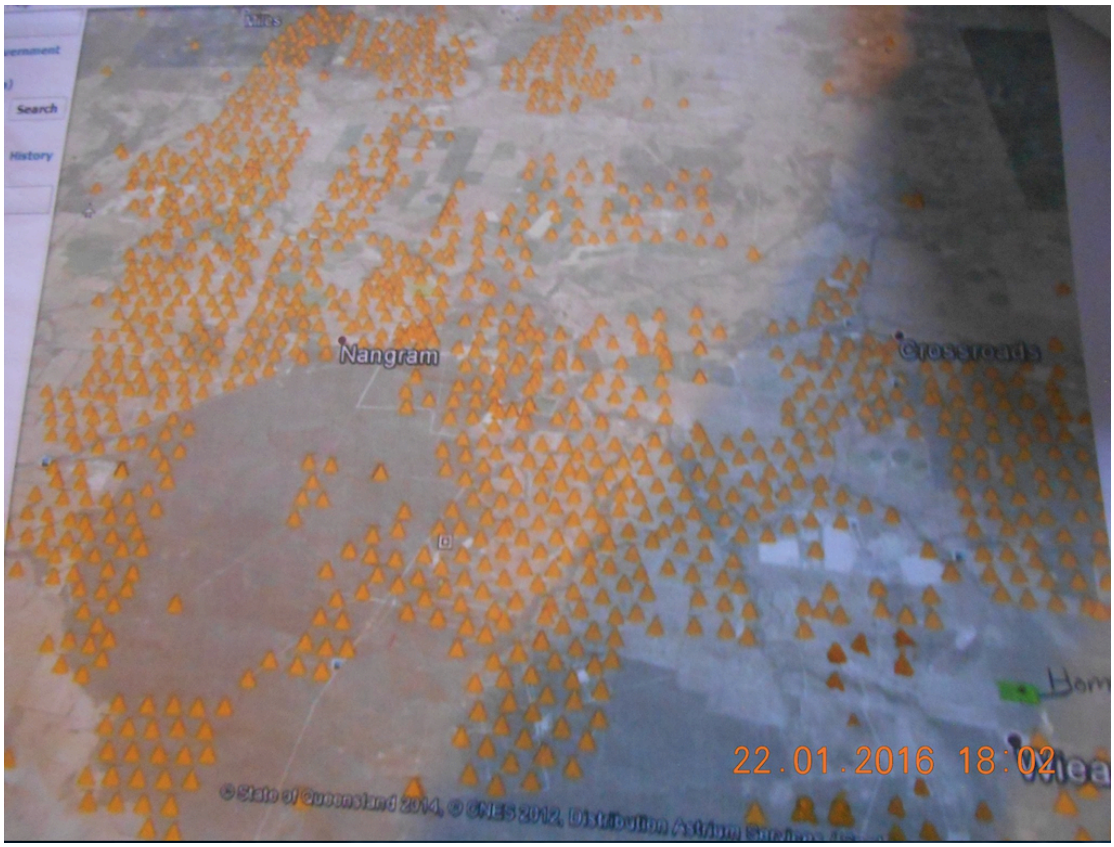
VENT ON WATER OUTLET @ RISERS

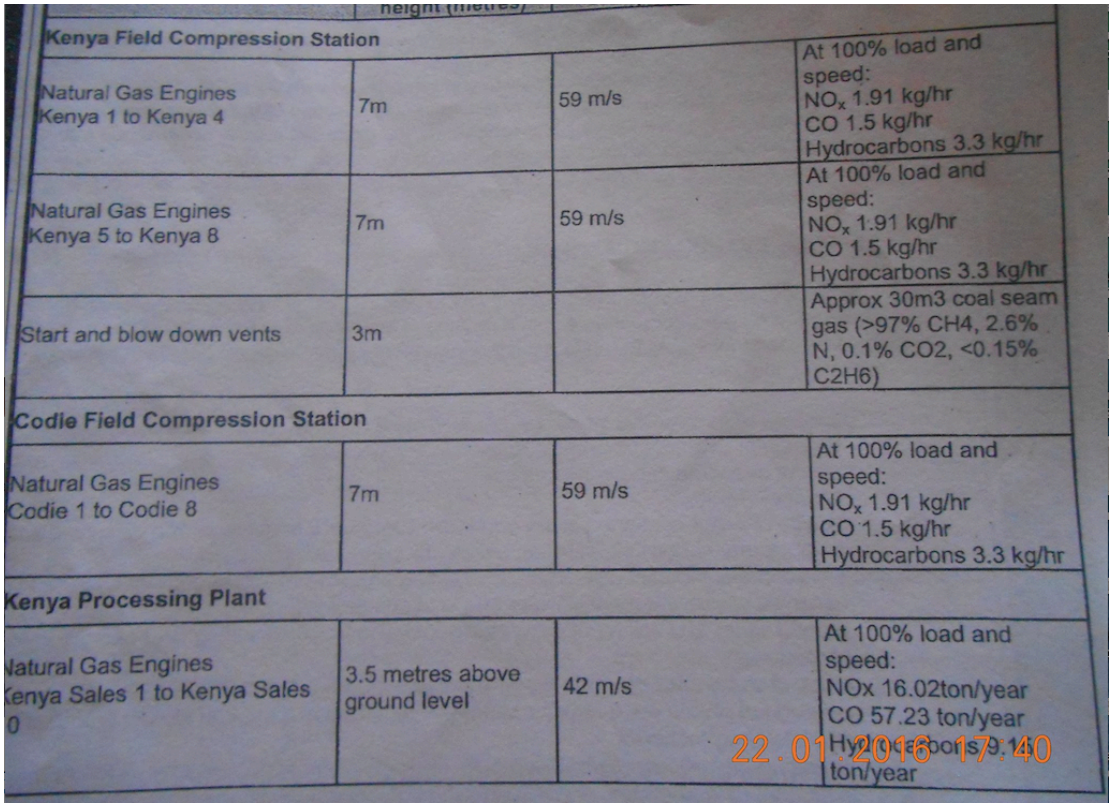
ARG_RIS006; ARG_RIS014; ARG_RIS015; ARG_RIS019

Methane at 85% per volume has been measured coming off these high point vents but direct emissions from these sources are not being calculated or even monitored by government or industry. Results are certainly not published. The National Pollutant Inventory publishes a limited range of contaminants from data which is self-calculated and self reported by industry. Despite, in 2013, the Queensland Government in its own report 'Coal Seam Gas in the Tara area" recommending that a program be implemented to measure total gasfield emissions and the exposure of the community to those emissions, absolutely nothing has been done. The magnitude of the unmonitored emissions is indicated by the following four images supplied by one of the gas field residents. In the heat of the Australian summer, (41.9 degrees outside) their family home (denoted in the second image as a green spot), is surrounded by massive evaporation ponds as well as compression stations and wells emitting volatile organic compounds, carbon monoxide and NO_2.



Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry) G McCarron





Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry) G McCarron

Schedule N— Table 2 (Specifications of Regulated Dams)

Name of Regulated dam	Hazard Category	Maximum surface area of dam (ha)	Maximum operational volume of dam (ML)	Maximum depth of dam (m)	Use of dam
Kenya Pond	High	90	2,800,000	6.7	Evaporation
Wambo Downs 1	Not yet assessed	0.07	1750	2.5	Evaporation
Wambo Downs 2	Not yet assessed	0.06	8550	14.25	Evaporation
Rhynie Pond	High	117.5	3,600,000	12.2	Evaporation

The surface area of the ponds from which VOCs are being emitted is indeed massive. The following images were sent by Dr Penny Hutchinson from Queensland Health to one of the gasfield residents. Side by side from 17km height are comparative Google images of the Kenya evaporation ponds and the Brisbane CBD. As you can see, the ponds cover a similar distance as the bends in the Brisbane River between St Lucia in the South West and Bulimba in the North East.

Image one

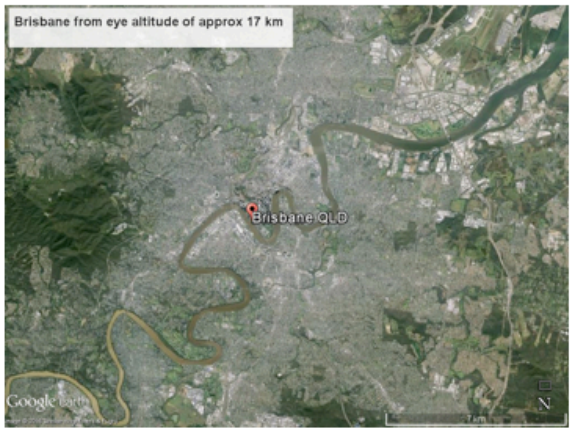


Image two

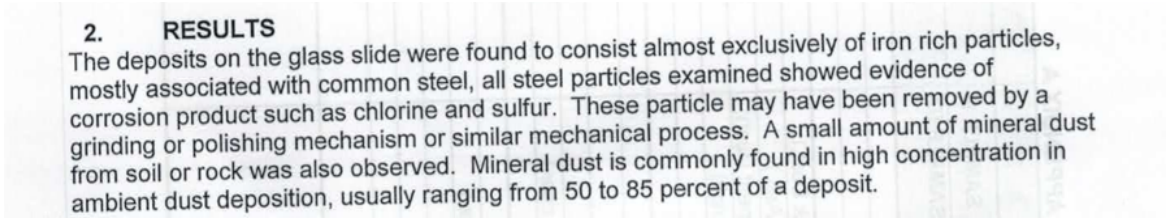
Despite minimal and ad hoc testing, a wide range of gases and volatile chemicals have been detected close to residences, many of which individually or in combination were capable of causing irritation to the eyes, skin, nasal mucosa, and respiratory tract along with systemic effects when absorbed. These included chlorinated hydrocarbons, benzene which is a recognised carcinogen and propylene and acrolein, acute irritants as well as being associated with DNA alkylation. Phenols, some of which have been shown to have impacts on the endocrine system of living organisms were present as well as toluene, a known neurotoxin, an irritant and a suspected reproductive toxin that can be absorbed by inhalation. Toluene is known to be associated with coal bed methane and was found repeatedly in air samples in the residential estates.

Private urine testing has shown that the metabolites of toluene have been found repeatedly in the urine of children and adults in the estates. Residents' urine also tested positive for phenol, cresol as well as acetone, methyl ethyl ketone and the polycyclic aromatic hydrocarbon (PAH)(I-Hydroxypyrene). The conundrum is that norms and safety standards exist for adults working 8 hours a day, 5 days a week with individual toxic chemicals but no safety standards apply for children or adults who live up to 24 hours a day, seven days a week with the same toxins.

The problem with airborne contaminants is that what goes up comes down. For years residents have been complaining of "toxic rain", as debris falls out of the sky onto their homes and property. It is sometimes black, sometimes white, sometimes copper-coloured. It takes the paint off cars and falls onto the roofs and into the collected rainwater, which is traditionally the drinking water supply for these rural families. Tests on collected rainwater by several different entities (local council, TV station, private individuals) have consistently shown serious contamination. The pH has been as low as 4.36, an indicator of acid rain and serious air pollution. A range of heavy metals was detected, including arsenic, chromium, nickel and lead as well as hydrocarbons. All exceeded the Australian drinking water standards. Lead was 10 times above safe levels, and this was in tanks with no lead in the collecting system. Private tests identified radioactive elements in the rainwater tanks.

Under pressure from local residents the gas companies and government agencies have undertaken minimal testing and their explanations have been diverse and ludicrous, ranging from "lerps" to aerial crop spraying. Residents have reported shut down of infrastructure for kilometers around when there is the pretense of testing. Whenever journalists or visiting politicians make their presence felt, the silver lining for the locals is that with the shut down of wells and flaring, they can breathe easier for a day or two.

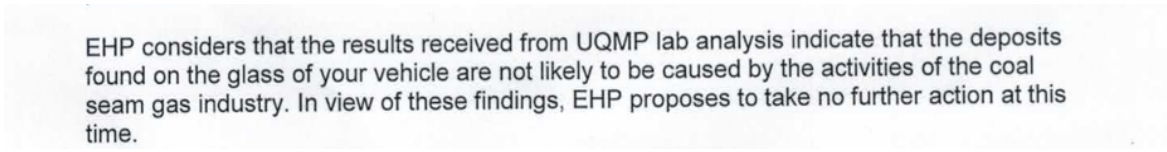
A recent example of lack of appropriate investigation dates from September and October 2015. The air quality was so bad that on 30th September 2015, four residents of Upper Humbug Road were hospitalized in separate events due to difficulty breathing. The residents put in complaints to DEHP. Subsequent to that they noticed copper coloured droplets over their property. On 5th November 2015 DEHP took samples of the coloured deposited on glass. Analysis of the particles showed that they were steel corroded with chlorine and sulfur.



2. RESULTS

The deposits on the glass slide were found to consist almost exclusively of iron rich particles, mostly associated with common steel, all steel particles examined showed evidence of corrosion product such as chlorine and sulfur. These particle may have been removed by a grinding or polishing mechanism or similar mechanical process. A small amount of mineral dust from soil or rock was also observed. Mineral dust is commonly found in high concentration in ambient dust deposition, usually ranging from 50 to 85 percent of a deposit.

Having identified some major elements, DEHP made no attempt to pursue it further. They (oddly) knew where it didn't come from (CSG), demonstrating their incompetence, unprofessionalism and lack of scientific effort.



EHP considers that the results received from UQMP lab analysis indicate that the deposits found on the glass of your vehicle are not likely to be caused by the activities of the coal seam gas industry. In view of these findings, EHP proposes to take no further action at this time.

As to the source, who is now to know? But with steel pipelines, steel drill strings, steel holding tanks, and corrosion from sulphate reducing bacteria, hydrochloric acid and saline flowback, the CSG industry are very definitely in the frame with a possible mechanism being serious blasting/ grinding/ sanding of rusty metal.

With regard to the 113 people I originally surveyed in 2013, to my knowledge, 2 years later at least 45 people had been forced from their homes due to the impact on their health

and wellbeing. Six seriously impacted families were bought out by the gas companies under confidentiality agreements and are not permitted to speak. Some families walked off their land with nothing. At least one family is homeless. Many impacted families remain trapped as there is nowhere for them to go. One elderly couple, (the husband who was terminally ill) was desperate to leave and had their property valued. On retirement to their property they had renovated their three-bedroom home. Their property is now worth 11% less than the unimproved land value in 2009, and still no one will buy it. But as homeowners they were trapped, as they were not eligible for community housing, cannot sell, and cannot afford to rent privately. The widow now lives alone in the gasfield. The impacted residents do not have safe water to drink or use for domestic purposes.

7. RESPONSE OF THE QUEENSLAND GOVERNMENT

As of January 2016, the ministers in the Queensland Government continue to misinform the public regarding the health impacts in the Queensland gas fields. This is an extract from a pro forma letter sent to individuals who had addressed their concerns to Minister Lynham.

> Environmental Health Monitoring
> In 2013, Queensland Heath conducted a comprehensive study into the potential health effects of CSG activity in the Tara district. This report found that a clear link could not be drawn between the health complaints of residents and the impacts of the local CSG industry on air, water or soil within the community.

This statement is simply untrue. In 2013 Queensland Health did not conduct a comprehensive study into the potential health effects of CSG in the Tara district. The report, (*Coal Seam Gas in the Tara Region. Summary risk assessment of health complaints and environmental monitoring data*[8]*. March 2013* released by the Queensland Government was based on minimal, ad hoc, mainly industry derived environmental sampling and very limited clinical investigation.

During presentation of the results to the Tara gasfield residents in 2013 Dr Penny Hutchinson, the Queensland Health Darling Downs Public Health Unit doctor responsible for the clinical input, confirmed that Queensland Health had no input into the programme of environmental testing, and that no resources or funds were provided to her department for data gathering which was done in addition to her normal pre-existing duties in public health. Clinical input was minimal. The clinical diagnosis was not defined for any of the people presenting. In this investigation into potential environmental contamination, no doctor from Queensland health came within 20km of the gas fields or visited any to the residents in their homes. Testing for gas field chemicals was carried out on none of the residents. During the nine months the Queensland government took to write the report only 15 people were seen in person by the consultant to the investigation Dr Adams out of the 56 surveyed. It was certainly not a comprehensive clinical investigation.

In what would appear to be a clear conflict of interest, the Queensland Government appointed QGC (British Gas) to both design and implement the environmental testing programme that was to inform the investigation. From the point of view of the gasfield

[8] http://www.health.qld.gov.au/publications/csg/documents/report.pdf

residents, QGC was not only one of the companies whose activities they associated with their health impacts, but the one who was geographically closest to most of them. The Queensland government failed to organize a testing programme that was demonstrably scientifically independent and unbiased. The Queensland Government report appeared to be at best a highly flawed inadequate investigation, unable to draw conclusions due to lack of appropriate data. *"In summary the most that can be drawn from the DDPHU report is that it provides some limited evidence that might associate an unknown proportion of some of the residents' symptoms to transient exposures to airborne contaminants arising from CSG activities"*

The Queensland Government's health report of 2013 had but one saving grace and that is its very specific recommendation that critically important monitoring be done. *"That a strategic ambient air monitoring program be established by DEHP to monitor overall CSG emissions and the exposure of local communities to those emissions."*

One of the most disturbing aspects of the situation unfolding in Queensland now is the Queensland government's failure to implement this recommendation of its own health report. Almost 3 years later nothing has happened. The gas field residents are still waiting. It is significant that during this time frame there has been an extreme escalation in air pollution due to an accelerated drilling programme, with subsequent flaring and venting of gas. What is particularly worrisome is the realization that an active decision was taken by the Department of Environment and Heritage Protection to not do the testing, as confirmed by Dr Bristow from the Darling Downs Hospital and Health Services. On 27th October 2014 in a letter to me Dr Bristow wrote: *"this recommendation was apparently initially considered by the Department of Environment and Heritage Protection (DEHP) who determined the air quality data from Tara indicated compliance and thus did not support in expanding the program."* On 27th August 2015 Mr Noon, Acting chief of staff for Minister Lynham confirmed this with the statement:

> The review was completed by the Department of Environment and Heritage Protection (EHP) and included a report which did not recommend any expansion of current levels of strategic monitoring. It also recommends a number of actions which will be undertaken as part of ongoing compliance operations.
>
> The data reviewed, included a sampling program for volatile organic compounds (VOCs) completed in the Wieambilla Estate in late 2012 conducted by EHP in conjunction with the then Department of Science, Information Technology, Innovation and the Arts. This report

The catch 22 in this scenario is that the air quality data DEHP referenced was the historical industry data informing the 2013 report- the same report which made the recommendation to do the exposure testing in the first place. This decision to deliberately not undertake environmental testing which would give unbiased scientific data on the health risks faced by gas field residents is critical. I have personally requested a copy of the report on which this decision was based from Dr Jeanette Young Chief Medical Officer for Queensland health as well as from Dr Lynham's Department. It has also been requested under RTI. To date no report has been released.

8. DISPOSAL OF TOXIC WASTE- JUST CALL IT "BENEFICIAL USAGE"

Disposal of waste is one of the massive unresolved problems of the gas industry. The industry in Queensland was brought in with promises of "beneficial usage" of the salt, and drought proofing with beneficial use of CSG water. Both have been shown to be

spectacular failures. There is no beneficial use for the massive amounts of salt contaminated with heavy metals, radioactive materials and other chemicals. The reverse osmosis plants have failed to deliver on any reliable quantity or quality of clean water. It is all too difficult and expensive which is why the industry is turning to the cheaper and nastier options of spraying the waste on roads, reinjecting into aquifers and landspraying during drilling. People who are required to co-exist with the resources industry are impacted by fugitive emissions. They are also impacted by deliberate methods of disposal of vast amounts of contaminated waste. Untreated CSG waste has been sprayed on residential roads and overflowed into domestic dams. When dry and churned up by traffic the contaminated dust becomes airborne. Untreated human sewage as well as drilling waste is stored in huge open ponds and disposed of on agricultural land in the Western Downs[9]. There has been no attempt to provide scientific data to justify this supposed "beneficial usage". An equivalent scheme by AGL[10] in Northern NSW using CSG water for irrigation was found to be "unsustainable" and ended after regulators found it left behind unacceptably high levels of salts and heavy metals.

Reinjection well, photo courtesy of local resident

Aquifer reinjection has occurred despite the fact it has been shown to cause earthquakes, and in New Zealand the largest processor of milk refuses to take produce from land contaminated with drilling products. Published studies from USA show that even after treatment, flowback water had dangerous levels of bromine and radium 226. Analysis of waste from pits has confirmed the dangers from enhanced radioactive materials. It really is a no brainer that placing subsoil on top of topsoil is not in the interests of the long-term productivity of the land. Spraying brine on the land is a sure recipe for infertility and erosion. The projected long-term contamination of the land both with heavy metals and radioactive elements is a serious issue. Radium^{226}, once mobilised from the source rock and brought to the surface undergoes a cascade of radioactive decay, with daughter radionuclides such as radon, lead ^{210} and polonium^{210} causing health risks both in the short term and for decades to follow. This risk is increasingly well recognized in America as recent published papers show. Published studies from USA show that even after

[9] Zambelli environmental. Kogan multiple beneficial use approval. 23 January 2014. http://zambellienvironmental.com.au/kogan-multiple-beneficial-use-approval.html (accessed 22 December 2014)

[10] http://www.smh.com.au/environment/water-issues/agls-irrigation-trial-using-csg-waste-water-found-to-be-unsustainable-20150416-1mmf82.html

treatment, flowback water had dangerous levels of bromine and radium 226. Analysis of waste from pits has confirmed the dangers from enhanced radioactive materials. But in Australia ARPANSA admits that these risks have not been assessed, as detailed in a letter to me on 22nd July 2014.

> ARPANSA is not aware of any comprehensive radiological risk assessments conducted in Australia dealing specifically with the impact of TENORM emitted by coal seam gas exploration, extraction and processing.

Chemicals used in the unconventional gas industry, and the toxins exhumed from deep in the ground along with the gas create health risks. Some of the chemicals we know, and know them to be harmful. The identity of some chemicals is hidden under the cloak of commercial in confidence. Some chemicals are declared, but quality assurance of these imported chemicals is so questionable that in one documented instance in Queensland asbestos was being used instead of groundnut kernels. There are also unquantified risks from unknown and unidentified chemical reactions.

Environmental “management” of CSG waste, photo courtesy of local resident

Open sewage pit, photo courtesy of local resident

Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry) G McCarron

9. DISPOSAL OF TOXIC WASTE- SHIFTING THE PROBLEM BETWEEN STATES

CSG waste transported from AGL Gloucester NSW to Unitywater, Brisbane.

The disposal of CSG waste in New South Wales is such a problem for AGL that they have been transporting it 600km from the Gloucester gas wells to Narangba in Brisbane. In NSW AGL was not permitted to dispose of the produce water in evaporation ponds; there was a furore in 2014 when it became clear AGL had been dumping their waste in Newcastle's city sewerage system. No water treatment authority in NSW would accept it for disposal.

The ABC reported[11] the plan to transport 2.7megalitre, equivalent to an Olympic-size swimming pool of flowback water from the Waukivory CSG site to Queensland. Between 27th June and 15th September 2015 Toxfree trucked 20,000 litres three times a week to the BCD/Toxfree plant at Narangba Innovation Precinct which is immediately beside the densely populated North Lakes housing development. After "treatment" by BCD, Unitywater (the corporation which is partly owned by Moreton Bay Council and responsible for safe drinking water and sewage in the Moreton Bay region) accepted the effluent into the Burpengary East treatment plant. From there it was discharged by a diffuser 1.2km from the mouth of the Caboolture River into Moreton Bay.

Unity water relaxed the already fairly minimal sewage admission standards advertised on it's website. These standards relate only to chemical oxygen demand, suspended solids, nitrogen, sulphate and phosphorus. For Toxfree's CSG waste the allowable limit for sulphate was increased to 2000mg/L (more than 130 times advertised) and Chemical Oxygen Demand 1500mg/L (2 ½ times the maximum advertised limits)

Unity water depended upon BCD/Toxfree to treat the waste but there are very significant problems with the Plasma arc technology used. PLASCON can degrade complex organic waste into simpler inorganic compounds so in theory can treat BETX and petrochemicals. Although simpler they may not be innocuous or beneficial, for example on their website PLASCON state: *"Sufficient oxygen is added to convert carbon to carbon monoxide which is subsequently converted to carbon dioxide in a flare."*

There is strong evidence that Toxfree did not have the capacity to treat the volumes of contaminated flowback waste they were accepting from AGL and this implies that even the organic components of the CSG waste which the plasma arc should have been able to treat were inadequately treated. On their website PLASCON state: *"The plant will destroy between one and three tonnes of waste per day depending on the chemical composition of the feed."* On Toxfree's website they state: *"Over the past two years BCD Technologies have operated their PLASCON® plant 24 hours a day, destroying waste at the rate of 40-45 kg/h, returning a Destruction Efficiency of >99.9999%."* Since June Toxfree had been transporting 3 tankers per week, each carrying 20,000L of CSG waste. That is three times the volume of waste they had the capacity to treat- or four times the capacity they had to treat if they still had contracts which were keeping the PLASCON plant running 24hrs per day before June.

[11] http://www.abc.net.au/news/2015-06-26/agl27s-gloucester-csg-flowback-water-to-be-transported-to-bris/6575530

Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry) G McCarron

The plasma arc process cannot treat the inorganic materials, heavy metals and radioactive contaminants, all associated with CSG flowback waste.
In accepting this hazardous CSG waste, already rejected by their peers in NSW, the onus was on Unitywater to test the effluent for all chemicals, organic, inorganic and radioactive which could reasonably be expected to be in CSG flowback before releasing it into the Caboolture River which runs into Moreton Bay. There are a significant number of chemicals with known human toxicity and a significant number of chemicals for which toxicity has not been defined, which are used in drilling, fracking , are naturally occurring in the coal seams and returned in the flowback waste. Some of these chemicals are listed in the tables 6 and 7 "Hydraulic Fracturing for Shale and Tight Gas in Western Australian Drinking Water Supply Areas: Human Health Risk Assessment June 2015"

Table 6. Substances used for hydraulic fracturing and detected in flowback fluid, guideline values and hazards.

CASN	Chemical Name	Guideline value	NOEL toxic effect	Carcinogen	DART
95-63-6	1,2,4-Trimethylbenzene				
57-55-6	1,2-Propanediol				
108-67-8	1,3,5-Trimethylbenzene				
123-91-1	1,4-Dioxane	0.05mg/L	Hepatocellular tumours rats	Suspected	
64-19-7	Acetic acid	Food additive	-		
67-64-1	Acetone	3mg/L	Nephropathy rats		Yes
98-86-2	Acetophenone	0.4mg/L	No specific		
107-02-8	Acrolein	0.002mg/L	Increased mortality rats		
7429-90-5	Aluminium	0.1mg/L aesthetic	Taste		
7664-41-7	Ammonia	0.5mg/L aesthetic	Taste		
7440-38-2	Arsenic	0.01mg/L	Carcinogenicity humans	Known	
71-43-2	Benzene	0.001mg/L	Carcinogenicity humans	Known	
111-44-4	Bis(2-chloroethyl)ether			Suspected	
124-38-9	Carbon dioxide	Food additive	-		
16887-00-6	Chloride	250mg/L aesthetic	Taste		
7782-50-5	Chlorine	5mg/L	No specific		
16065-83-1	Chromium (III)	5mg/L	No specific		
18540-29-9	Chromium (VI)	0.05mg/L	Historical level	Known	Yes
7440-50-8	Copper	2mg/L	Gastric irritation humans		
117-81-7	Di(2-ethylhexyl)phthalate	0.07mg/L	Hepatomegaly guinea pigs	Suspected	Yes
100-41-4	Ethylbenzene	0.3mg/L	Organomegaly	Suspected	
107-21-1	Ethylene glycol	7mg/L	Renal toxicity rats		Yes
64-18-6	Formic acid		Skin & mucosal irritant		
7439-89-6	Iron	3mg/L	No specific		
67-63-0	Isopropanol	Food additive	-		
7439-92-1	Lead	0.01mg/L	Lead retention infants	Suspected	Yes
67-56-1	Methanol	2mg/L	Neurotoxicity rats		
91-20-3	Naphthalene	0.07mg/L	Decreased weight rats	Suspected	
85-01-8	Phenanthrene	0.1mg/L	No specific		
108-95-2	Phenol	1mg/L	Low maternal weight rats		
7631-86-9	Silica				
14808-79-8	Sulphate	500mg/L	Purging humans		
108-88-3	Toluene	0.8mg/L	Hepatomegaly rats		Yes
1330-20-7	Xylenes	0.6mg/L	Decreased growth rats		
7440-66-6	Zinc	1mg/L	Erythrocyte changes humans		
Legend		No available health or aesthetic guideline values.			

Table 7. Additional substances detected in flowback fluid, guideline values and hazards. (continued)

CASN	Chemical Name	Guideline value	NOEL toxic effect	Carcinogenicity	DART
87-61-6	1,2,3-Trichlorobenzene	0.03mg/L	Hepatic/Thyroid changes rat		
120-82-1	1,2,4-Trichlorobenzene	0.03mg/L			Yes
105-67-9	2,4-Dimethylphenol	0.07mg/L	Behaviour change mice		
87-65-0	2,6-Dichlorophenol				
91-57-6	2-Methylnaphthalene	0.1mg/L	Alveolar proteinosis mice		
95-48-7	2-Methylphenol	0.2mg/L	Neurotoxicity rats	Possible	
79-31-2	2-Methylpropanoic acid				
109-06-8	2-Methylpyridine				
503-74-2	3-Methylbutanoic acid				
108-39-4	3-Methylphenol	0.2mg/L	Neurotoxicity rats		
106-44-5	4-Methylphenol	0.2mg/L	Neurological effects rats	Possible	
57-97-6	7,12 Dimethylbenz(a)antracene				
107-13-1	Acrylonitrile	0.1mg/L	Blood abnormalities rats	Suspected	Yes
309-00-2	Aldrin	0.0003mg/L	Hepatomegaly rats/dogs	Suspected	Yes
7440-36-0	Antimony	0.003mg/L	Decreased lifespan rats	Suspected	Yes
12672-29-6	Aroclor 1248				Yes
7440-39-3	Barium	2mg/L	Renal toxicity mice		
50-32-8	Benzo(a)pyrene	0.00001mg/L	Carcinogenicity mice	Known	Yes
205-99-2	Benzo(b)fluoranthene	0.0001mg/L	Carcinogenicity mice	Suspected	
191-24-2	Benzo(g,h,i)perylene	0.001mg/L	Carcinogenicity mice		
207-08-9	Benzo(k)fluoranthene	0.0001mg/L	Carcinogenicity mice	Suspected	
100-51-6	Benzyl alcohol	Food additive	-		
7440-41-7	Beryllium	0.06mg/L	Intestinal lesions dogs	Known	
319-85-7	beta-Hexachlorocyclocylohexane	0.00007mg/L	Infertility rats	Possible	Yes
7440-42-8	Boron	4mg/L	Foetal weight rats		Yes
24959-67-9	Bromide	4mg/L	No specific		
75-27-4	Bromodichloromethane	0.25mg/L	Carcinogenicity rats	Suspected	Yes
107-92-6	Butanoic acid				
104-51-8	Butylbenzene				
7440-43-9	Cadmium	0.002mg/L	Renal toxicity humans	Known	Yes
10045-97-3	Caesium 137				
7440-70-2	Calcium	125mg/L	Renal calculi humans		
75-15-0	Carbon disulphide	0.4mg/L	Foetotoxicity rabbits		Yes
74-87-3	Chloromethane			Suspected	Yes
7440-47-3	Chromium	0.05mg/L	(further testing required)		
7440-48-4	Cobalt	0.005mg/L	Cardiomyopathy humans	Suspected	Yes
57-12-5	Cyanide, free	0.08mg/L	Ambivalence pigs		
319-86-8	delta-Hexachlorocyclohexane				
53-70-3	Dibenz(a,h)anthracene	0.00001mg/L	Carcinogenicity mice	Suspected	
124-48-1	Dibromochloromethane	0.3mg/L	Carcinogenicity rats	Possible	Yes
84-74-2	Dibutyl phthalate	0.4mg/L	Increased mortality rats	Suspected	Yes
75-09-2	Dichloromethane	0.004mg/L	Hepatic changes rats	Suspected	
60-57-1	Dieldrin	0.0003mg/L	Hepatomegaly rats/dogs	Suspected	Yes
84-66-2	Diethyl phthalate	3mg/L	Decreased growth rats		Yes
117-84-0	Dioctyl phthalate	1mg/L	Hepatic changes rats		
122-39-4	Diphenylamine	0.07mg/L	No specific		Yes
959-98-8	Endosulfan	0.02 mg/L	neurotoxicity		
7421-93-4	Eldrin aldehyde				
206-44-0	Fluoranthene	0.1mg/L	Nephropathy mice		Yes

There is no evidence of adequate or appropriate oversight or monitoring of Toxfree's activities by Unitywater. The only heavy metals ever tested for were arsenic, zinc, copper and chromium, and the FIRST test for these was done on September 11th 2015, one week AFTER the 4BC radio programme brought the issue to the attention of the Brisbane public. Apart from that, the only random tests Unitywater carried out were for sulphate, phosphorus, nitrogen, suspended solids, COD, TDS, conductivity and pH. There was no testing done for any of the radioactive contaminants associated with produce water. It is unclear who did the testing for BETX as it is not coded under Unitywater tests in the spreadsheet they provided.

By September 25th 2015 Unitywater had wiped its hands of the problem. Mr Simon Taylor from Unitywater wrote that Toxfree has advised Unitywater that they will no long receive coal seam gas water at their Narangba site. Mr Jim Soorley, CEO of Unitywater refused repeated requests for a meeting. He wrote *"We are not treating and therefore we are not disposing of CSG water. So there are no concerns to worry about"*

However in November 2015 AGL confirmed that Toxfree were again transporting two tankers three times a week from Gloucester, and on 2nd December Unitywater confirmed that they were receiving it, along with this comment from Joanna Evans form Unitywater customer relations: *"CSG water, which is basically saline and benign, is not labelled as hazardous waste by either Queensland or New South Wales authorities."*

The Peer reviewed literature indicates that there are very serious health concerns related to the disposal of unconventional gas wastewater.

- A study, appearing in the ACS journal Environmental Science & Technology, has found that discharge of fracking wastewaters to rivers, **even after passage through wastewater treatment plants**, could be putting the drinking water supplies of downstream cities at risk.[12] The researchers diluted river-water samples of fracking wastewater discharged from operations in Pennsylvania and Arkansas, simulating real-world conditions when wastewater gets into the environment. In the lab, they then used current drinking-water disinfection methods on the samples. They found that even at concentrations as low as 0.01 percent up to 0.1 percent by volume of fracking wastewater, an array of toxic compounds formed**. Based on their findings, the researchers recommend either that fracking wastewater should not be discharged at all into surface waters or that future water treatment include specific halide-removal techniques.**

- In an analysis of more than 1,000 chemicals in fluids used in and created by hydraulic fracturing[13] (fracking), Yale School of Public Health researchers found that many of the substances have been linked to reproductive and developmental health problems, and the majority had undetermined toxicity due to insufficient information. Further exposure and epidemiological studies are urgently needed to evaluate potential threats to human health from chemicals found in fracking fluids and wastewater created by fracking, said the research team in their paper, published Jan. 6 in the *Journal of Exposure Science and Environmental and Epidemiology*. The researchers determined that wastewater produced by fracking may be even more toxic than the fracking fluids themselves. This led the researchers to conclude that more focus is needed to study not just what goes into the well, but what chemicals and by-products are generated during the fracking process.

In summary, the transportation and disposal of CSG waste from the AGL fields is a matter of serious concern. Toxfree refused to answer any questions regarding their treatment or disposal of the waste. Despite "treatment" which was patently not fit for purpose in either scope or capacity, and inadequate testing it was accepted into the sewage system by Unitywater and released into Moreton Bay. The responses from the CEO Mr Soorley and

[12] http://www.acs.org/content/acs/en/pressroom/presspacs/2014/acs-presspac-september-24-2014/fracking-wastewater-that-is-treated-for-drinking-produces-potentially-harmful-compounds.html
[13] http://news.yale.edu/2016/01/06/toxins-found-fracking-fluids-and-wastewater-study-shows

customer relations officer Joanna Evans indicate a blasé and entirely inappropriate attitude towards this hazardous waste.

10. FEDERAL AND STATE RESPONSE: LACK OF APPROPRIATE SCIENTIFIC RIGOUR

On calling for funding for research into the health impacts of unconventional gas I have recently been reassured by a federal government agency that considerable work is being undertaken by the Australian Government in relation to coal seam gas (CSG) including the National Chemicals Notification and Assessment Scheme (NICNAS), Commonwealth Scientific and Industrial Research Organisation (CSIRO), Department of Environment, Australian Research Council (ARC), and other government agencies.

I am aware of the published work of some of these agencies with regard to unconventional gas and it simply reinforces my view that funding must be found for unbiased scientific research that is rigorously planned, implemented and actually addresses the questions that need to be answered. The unbiased scientific contribution by these agencies with regard to unconventional gas is, in my opinion, pitifully lacking.

As an example of my concern, I would point you to the recently published report from the office of the Chief Economist entitled *"Review of the socioeconomic impacts of coal seam gas in Queensland 2015"*[14].
Stakeholders involved in formulation of this report included:
• social science and other researchers, including from the Gas Industry Social and Environmental Research Alliance (GISERA), and the University of Queensland's Centre for Coal Seam Gas (UQ-CCSG)
• Queensland Government representatives, including the Office of Groundwater Impact Assessment (OGIA) and the Department of Natural Resources and Mines (DNRM)
• representatives from the GasFields Commission Queensland (GFCQ)
• industry associations, including the Queensland Resources Council (QRC) and the Australian Petroleum Production and Exploration Association (APPEA)
• representatives from coal seam gas companies and joint ventures operating in Queensland.
Remember that GISERA is a partnership between CSIRO, Australia Pacific LNG (APLNG) and QGC; and the Centre for Coal Seam Gas at the University of Queensland (UQ-CCSG), which has funding from Santos, Arrow Energy, QGC and APLNG all gas companies with a vested interest in the outcome of any study.

The remarkable and shocking admission in this Government Report, considering that this was in theory a report that was meant to review the socioeconomic impacts of CSG in Queensland was: **"We made a conscious decision not to meet with local landholders and community groups."** This fundamental omission demonstrates a lack of understanding of both the issues at stake and the context of socioeconomic impact assessment.

With regard to the work of CSIRO, I think it would be fair to say that in the years before CSIRO was subjected to massive personnel and funding cuts and political interference, it was an organisation whose research was recognised and highly respected both nationally and internationally. Nevertheless, their published research so far as it relates to the CSG industry does not, I believe, meet the exacting standards the public would expect from the

[14] http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/coal-seam-gas/Socioeconomic-impacts-of-coal-seam-gas-in-Queensland.pdf

CSIRO. In 2014 CSIRO published a report[15] into CSG fugitive emissions. It is true they labelled it a 'pilot' study, but since CSIRO is our national scientific agency, and since CSG had, at that time already been a serious issue in Queensland for 8 years one might have expected more diligence in the design of the project. Minimal wells were tested (43 out of more than 5,000 wells) and even the selection of those wells was biased, influenced by the participation of the companies. Of the 43 non-randomised wells examined, only three showed no emissions. These were two plugged and abandoned wells and one suspended well that had been disconnected from the gas gathering system. But of real significance CSIRO noted a larger source of methane that they were not monitoring for, a source which was interfering with their study, that was found on a gas relief vent on a water gathering installation close to one of the wells examined. They noted that an indicative estimate of the emission rate from this vent suggested that the source was at least three times higher than the largest well pad emission rate. Similar installations are widespread through the Queensland gas regions.

I am aware of NICNAS and its study of CSG chemicals. Naively I would have assumed that prior to 2006, that is, prior to the commencement of intense CSG exploration, the chemicals to be used for this purpose, in the massive quantities necessary would have been vetted for safety by the national industrial chemicals regulatory body. That obviously did not happen. My understanding is that of the 23 chemicals commonly used for fracking in Australia, only 2 of them have been assessed by NICNAS in any context, (unrelated to CSG) and nothing do date has been published by NICNAS regarding assessment of chemicals associated with CSG extraction. This is despite NICNAS commencing a project in 2012 to address this issue.[16] The exclusions for this project are rather important.

"In particular, the National CSG Chemicals Assessment project does not examine impacts of drilling and hydraulic fracturing chemicals on deeper groundwater systems such as confined aquifers. Also, the assessment does not examine fugitive emissions of geogenic gases such as methane. The assessment of human health and environmental impacts associated with geogenic chemicals and other chemicals used at CSG sites, such as diesel fuels and machinery lubricants, is also outside the current project scope; as is an examination of the risks associated with the chemicals used in the extraction of shale and conventional oil and gas extraction in Australia."

We are informed by NICNAS that the 'mixtures' of drilling or fracking chemicals will not be assessed in this study, only individual active ingredients, despite the call by the WHO and other researchers to assess the cumulative load of chemicals used. NICNAS has acknowledged there is a lack of human or environmental toxicological data for many of the products in use but will not be in the position to address these data gaps. The project by NICNAS will not initiate new health studies and there is no 'health and medical research' mandate. It is a simply a desktop investigation along the lines of their IMAP process, which coincidently has just lost its ongoing funding. In November 2013 Dr Brian Richards, director of NICNAS, assured the community and NGOs that this national assessment was expected to be completed in 2014. However, four years after commencement of the

[15] http://www.environment.gov.au/system/files/resources/57e4a9fd-56ea-428b-b995-f27c25822643/files/csg-fugitive-emissions-2014.pdf

[16] http://www.nicnas.gov.au/communications/issues/fracking-hydraulic-fracturing-coal-seam-gas-extraction/information-sheet

project, as we enter 2016 thousands of wells have been already been drilled, thousands of wells have been fracked and refracked in the shallows and there is not even the most basic information yet available from our national industrial chemicals regulatory regarding the safety of the chemicals being used. Dr Mariann Lloyd-Smith, senior advisor to IPEN and a member of the UN Expert Group on Climate Change and Chemicals has labelled the government's[17] assessment of Coal Seam Gas chemicals "a total farce".

At this late stage in the CSG industry's development, the dearth of independent, high quality scientific research into the human health impacts of the unconventional gas industry in this country is a very significant problem.

11. INTERNATIONAL EVIDENCE REGARDING UNCONVENTIONAL GAS HEALTH IMPACTS

The unconventional gas industry has now been in full swing for 6 years in Queensland. Ours is meant to be a world of evidence-based medicine. States throughout Australia have been, and are, looking to Queensland to inform their own decision-making on unconventional gas. It is a remarkable indictment on our policy makers that to this day not a single, fully-funded, well designed health impact assessment has been put in place anywhere in Australia. However despite the striking inertia of our governments and scientific institutions, the evidence on the human harms associated with unconventional gas has been made available through international peer reviewed medical journals, and through the efforts of bodies such as the New York department of Health. The Concerned Health Professionals of New York have published an updated compendium[18] of peer-reviewed literature every six months with a new edition due in March 2016. They note: "*Our knowledge base is very young. The study citation database maintained by PSE Healthy Energy shows that over half of the available studies on the adverse impacts of shale and tight gas development have been published since January 2014. In 2014, 192 peer-reviewed studies on these impacts were published. In the first six months of 2015, 103 studies appeared. The vast majority of these studies reveal problems. Specifically, as demonstrated by PSE's statistical analysis, 69 percent of original research studies on water quality found potential for, or actual evidence of, water contamination; 88 percent of original research studies on air quality found elevated air pollutant emissions; and 84 percent of original research studies on human health risks found signs of harm or indication of potential harm*."

My concerns regarding the impact on human health are reinforced by evidence from the following studies.

- Bamberger and Oswald[19] documented in six US states serious health effects on humans and companion animals, livestock, horses and wildlife including animal deaths, failure to breed and reduced growth. Because animals often are exposed continually to air, soil, and groundwater and have more frequent reproductive cycles, animals can be used as sentinels to monitor impacts to human health.

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[17] http://www.sunshinecoastdaily.com.au/news/csg-assessment-total-farce-says-advisor/2911067/

[18] http://concernedhealthny.org/compendium/

[19] Bamberger, M. & Oswald, R.E., Impacts of Gas Drilling on Human and Animal Health. New Solutions 2012; 22(1): 51–77.

Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry) G McCarron

- NIOSH[20], the American Occupational Health and Safety organization highlighted the serious risks of cancer and chronic lung disease from silica used in fracking. Respirable crystalline silica is the portion of crystalline silica that is small enough to enter the gas-exchange regions of the lung if inhaled; this includes particles with aerodynamic diameters less than approximately 10 micrometers. Hydraulic fracturing sand contains up to 99%silica. Breathing silica can cause silicosis, a lung disease where lung tissue around trapped silica particles reacts, causing inflammation and scarring and reducing the lungs' ability to take in oxygen. Silica can also cause lung cancer and has been linked to other diseases such as tuberculosis, chronic obstructive pulmonary disease, and kidney and autoimmune disease.

  (In Queensland, to add to the harm the residents are being exposed to, a new quarry is being proposed within the Tara residential estates to mine fracking sand)

- In Shale Gas Development and Infant Health[21]: Evidence from Pennsylvania Elaine Hill from Cornell University found that babies born within 2.5km of a gas well had lower birth weight and more health problems than babies who were born within 2.5km of a future well. These results do not differ across water source (i.e. public piped water vs ground well water) and suggest that the mechanism is air pollution or stress from localised economic activity. These findings suggest that shale development poses significant risks to human health…A low birth weight/ preterm baby incurs an average of $15,100 additional hospital costs in the first year of life. Each low birth weight infant is fifty percent more likely to require special education services as well as having lower life time wages.

- A report on the analysis[22] of 124,843 births in Colorado released in January 2014 found that in areas with the highest number of gas wells there was a 30% increase in the number of babies born with congenital heart defects compared to areas where there were no wells within a 10mile radius. Babies in the areas with the highest numbers of gas wells were two times more likely to have a neural tube defect (eg spina bifida) than those with no wells within a 10 mile radius, based on 59 available cases. Birth defects were most likely undercounted, because non-live births, terminated pregnancies, and later life diagnoses (after age 3 years) were not included. Small negative associations with term low birth weight and preterm birth in the study population were unexpected given that other studies had reported positive association between these outcomes and urban air pollution (Ballester 2010, Brauer 2008, Dadvand 2013, Ghosh 2012, Llop 2010) and proximity to natural gas wells (Hill 2012).

- A review of 150 studies[23] concluded that chemicals released during natural gas extraction may harm human reproduction and development. There is a strong evidence of decreased

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[20] Worker Exposure to Crystalline Silica During Hydraulic Fracturing http://blogs.cdc.gov/niosh-science-blog/2012/05/silica-fracking/

[21] http://dyson.cornell.edu/research/researchpdf/wp/2012/Cornell-Dyson-wp1212.pdf

[22] McKenzie L, Guo R et al, Birth Outcomes and Maternal Residential Proximity to Natural Gas Development in Rural Colorado. Environmental Health Perspectives 2014

[23] Developmental and reproductive effects of chemicals associated with unconventional oil and natural gas operations Ellen Webb, Sheila Bushkin-Bedient*, Amanda Cheng, Christopher D. Kassotis, Victoria Balise and Susan C. Nagel*
Rev Environ Health 2014; 29(4): 307–318

semen quality in men, higher miscarriage in women and increased risks of birth defects in children. The developing fetus is particularly sensitive to environmental factors, which include air and water pollution. Research shows there are critical windows of vulnerability during prenatal and early postnatal development, during which chemical exposures can cause potentially permanent damage to the growing embryo and fetus.

- Krzyzanowski[24] concluded Northeast British Columbia has experienced increased rate of cancer and other illness due to contaminants and stressors associated with unconventional gas. Contaminants reach human receptors through environmental pathways, namely air, soil, water, and food. Of particular concern are airborne sulphur and nitrogen oxides, hazardous volatile organic compounds, hydrogen sulphide, ozone, noise and radiation; as well as soil- or water- borne hydrocarbons, heavy metals and radiation- some of which can also impact human health though food pathways. It has been determined that unconventional oil and gas is negatively impacting human health. Further information such as environmental monitoring is required.

- Colborn et al[25] reported that many chemicals used during the fracturing and drilling stages of gas operations may have long term health effects that are not immediately expressed. More than 75% of the chemicals could affect the skin, eyes, other sensory organs, and the respiratory and gastrointestinal systems. 40% to 50% could affect the brain/nervous system, immune and cardiovascular systems, and the kidneys; 37% could affect the endocrine system; 25% could cause cancer and mutations.

- Steinzor et al[26] in Pennsylvania undertook environmental testing and documented 25 of the most prevalent symptoms associated with exposure to gas development including fatigue (62%) nasal irritation (61%),throat irritation (60%) sinus problems (58%) severe headaches 51%…and concluded*: "Contaminants that are associated with oil and gas development are present in air and water in areas where residents are experiencing health symptoms consistent with such exposures." "And by permitting widespread gas development without fully understanding its impacts to public health- and using that lack of knowledge to justify regulatory inaction- Pennsylvania and other states are risking the public's health.*

- Colborn et al[27] took air samples every week for over a year. They picked up 44 air toxics close to gas activities. Notably, the highest percentage of detections of non-methane hydrocarbons (NMHC) occurred during the initial drilling phase, prior to hydraulic fracturing on the well pad. Many of the NMHCs had multiple health effects including 30 that affect the endocrine system. Despite industry claims that methylene chloride (a solvent) is not used, methylene chloride as detected regularly and stood out due to the extremely high concentrations in some of the samples. A number of PAH's including

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[24] Krzyzanowski J., Environmental pathways of potential impacts to human health from oil and gas development in northeast British Columbia, Canada. *Environmental Reviews* 2012; 20(2): 122-134.
[25] Colborn T, Kwiatkowski C, Schultz K, and Bachran M., Natural gas operations from a public health perspective. *Human and Ecological Risk Assessment 2011*; 17(5):1039-56.
[26] Steinzor N, Subra W and Sumi L. Gas Patch Roulette, How Shale Gas Development Risks Public Health in Pennsylvania. Earthworks Oil & Gas Accountability Project, October 2012
[27] Colborn T, Schultz K, Herrick L, and Kwiatkowski C. An exploratory study of air quality near natural gas operations. *Human and Ecological Risk Assessment 2012.*

naphthalene were detected in every sample. PAH's were at higher concentrations than those found in previous urban studies linking prenatal exposure to low developmental and IQ scores.

- In remote and rural Utah[28], which is far from major urban and industrial regions but is the site of major oil and gas development, air pollution over two consecutive winters far exceeded that in the most heavily polluted inner cities. It was 10 to 100 times worse than the average US city. The volatile organic compound emissions were the equivalent to the annual emissions from 100 million cars.

- The health impacts of air pollution spreads across a wide area, and those who rely on locally produced food whether from their own production or bought at market, risk contamination. The flares contain widely-recognized toxins, such as benzene, which pollute the air. Local people complain of respiratory problems such as asthma and bronchitis. There have been over 250 identified toxins released from flaring[29] including carcinogens such as benzopyrene, benzene, carbon disulphide (CS2), carbonyl sulphide (COS) and toluene; metals such as mercury, arsenic and chromium; sour gas with H2S and SO2; Nitrogen oxides (NOx); Carbon dioxide (CO2); and methane (CH4) which contributes to the greenhouse gases

- In 2013 the World Health Organisation[30] defined outdoor air pollution as a class I carcinogen. Diesel fumes, benzene, particulate matter all cause cancer. The health danger of particulate matter[31] is well understood. Particles, if small enough, can be absorbed from the lungs directly into the bloodstream causing damage to multiple organs. This includes lung damage, strokes, heart attacks, kidney damage, diabetes, hypertension. With particulate matter, as with benzene, there is no safe level of exposure or a threshold below which no adverse health effects occur. Air pollutants react to form other harmful compounds. Ozone is formed when the oxides of nitrogen and volatile organic compounds combine in the presence of sunlight. Ozone can permanently damage children's lungs. A study by the University of Southern California[32] of fourth grade school children found that each increase of 20 parts per billion in ozone was associated with a 63% school absence rate increase for illness.

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[28] Highly Elevated Atmospheric Levels of Volatile Organic Compounds in the Uintah Basin, Utah D. Helmig *, C. R. Thompson , J. Evans , P. Boylan ,J. Hueber , and J.-H. Park Institute of Arctic and Alpine Research (INSTAAR),University of Colorado, Boulder, Colorado 80309-0450, United States *Environ. Sci. Technol.*, 2014, *48* (9), pp 4707–4715

[29] Global Impact of Gas Flaring, O. Saheed Ismail, G. Ezaina Umukoro, Energy and Power Engineering, Vol. 4 No. 4 (2012) , Article ID: 20231 , 13 pagesDOI:10.4236/epe.2012.44039

[30] -International Agency for Research on Cancer, press release no 221 17 Oct 2013 http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf -

[31] -Review of evidence on health impacts of air pollution REVIHAAP project, WHO 2013, http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf

[32] -The Ozone We Breathe, http://earthobservatory.nasa.gov/Features/OzoneWeBreathe/ozone_we_breathe2.php

Submission: Select Committee on Unconventional Gas Mining (Bender Inquiry) G McCarron

- A Harvard University study,[33] A Nested Case–Control Analysis within the Nurses' Health Study II Cohort, shows that women who are exposed to high levels of fine particulate air pollution in late pregnancy have twice the risk of having an autistic child.

- Occupational health standards cannot be applied to children. Children are not just little adults, and in children the risks of exposure to low level toxins is not well understood. The level of risk which is considered acceptable for exposure of an adult 80kg worker to a single toxin over an 8 hour working day cannot be extrapolated to an unborn baby or infant exposed 24hours a day to a mixture of toxins, many of which are unidentified. Some chemicals can affect the endocrine system at extremely low levels[34]. Children and unborn babies are most vulnerable. In pregnancy and early infancy chemicals can cause permanent brain damage at levels of exposure that would have little or no adverse effect in an adult.

- In a paper[35] published by John Hopkins Bloomberg School of Public Health in October 2015, there was found to be a 40% increase in the risk of preterm birth among infants born to mothers who live near active drilling and fracking sites in Pennysylvania.

- Hospitalizations for heart conditions, neurological illness, and other conditions were higher among people who live near unconventional gas and oil drilling (hydraulic fracturing), according to research[36] from the University of Pennsylvania and Columbia University. Their findings revealed that cardiology and neurologic inpatient prevalence rates (the proportion of a population found to have been hospitalized per 100 residents per year) were significantly higher in areas closer to active wells, as determined by the proximity of wells to a person's home and their density as defined by the number of active wells per square kilometer. In addition, increased neurologic inpatient prevalence rates were associated with higher well density. Hospitalizations for skin conditions, cancer, and urologic problems were also associated with the proximity of dwellings to active wells.

  (I believe the following paper by Dr David Brown is very important, because it highlights the fact that the current accepted method of monitoring emissions does not take into account the actual, sometimes very high, levels of periodic exposures as the extreme variation as table 1 shows.)

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[33] Autism Spectrum Disorder and Particulate Matter Air Pollution before, during, and after Pregnancy: A Nested Case–Control Analysis within the Nurses' Health Study II Cohort Raanan Raz, Andrea L. Roberts, Kristen Lyall, Jaime E. Hart, Allan C. Just, Francine Laden, and Marc G. Weisskopf DEC 14 http://dx.doi.org/10.1289/ehp.1408133

[34] -http://ntn.org.au/wp/wp-content/uploads/2010/02/intergenequityinaction.pdf -Neurobehavioural effects of developmental toxicity. Philippe Grandjean, Philip J Landrigan, Lancet Neuro/ 2014; 13: 330-38 Published online February 15, 2014 http://dx.doi.org/10.1016/S1474-4422(13)70278-3

[35] Unconventional Natural Gas Development and Birth Outcomes in Pennsylvania, USA Carey.J et al John Hopkins Bloomberg School of Public Health, Oct 2015

[36] Unconventional Gas and Oil Drilling Is Associated with Increased Hospital Utilization Rates Thomas Jemielita , George L. Gerton , Matthew Neidell, et al Published: July 15, 2015DOI: 10.1371/journal.pone.0131093

Table 1. Variation in ambient air measurements of five VOCs near a compressor station in Hickory, PA, reported in ug m^{-3*}.

	May 18		*May 19*		*May 20*		
Chemical	Morning	Evening	Morning	Evening	Morning	Evening	3-day Average
Ethylbenzene	No detect	No detect	964	2015	10,553	27,088	13,540
n-Butane	385	490	326	696	12,925	915	5,246
n-Hexane	No detect	536	832	11,502	33,607	No detect	15,492
2-Methyl Butane	No detect	230	251	5137	14,271	No detect	6,630
Iso-butane	397	90	No detect	1481	3,817	425	2070

*The PA DEP collected data on many more chemicals than those listed above; the authors selected these chemicals specifically to highlight variation in emissions. See Reference 12, Appendix A. p. 31.

- In the present study[37] we consider estimates of emissions from well pads, compressor stations and processing plants to gauge individuals' possible exposures and the health risks those exposures pose. This is necessary because much of the publicly accessible emissions data has been collected to provide average exposures over a lengthy period of time and because the data collection is intended to document compliance with regional air quality standards.
  To assess health impacts, it is, therefore, necessary to look at human exposures in the short term. What matters from a health perspective is the content and intensity of exposures at the individual level. The critical questions are: What is a person, in a given household, exposed to? How high do those exposures climb? How often is that resident exposed to these high levels? What happens physiologically when a particular toxic comes in contact with the body?
  The frequency and intensity of exposures to PM2.5 and VOCs at a residence surrounded by three UNGD facilities was determined. The findings show that peak PM2.5 and VOC exposures occurred 83 times over the course of 14 months of well development. Among the stages of well development, the drilling, flaring and finishing, and gas production stages produced higher intensity exposures than the hydraulic fracturing stage. Over one year, compressor station emissions created 118 peak exposure levels and a gas processing plant produced 99 peak exposures over one year.
  As a group, emissions from one part of the process differ from those produced by another. The particular mix of emissions from a processing plant is different in kind and quantity, from that of a compressor station, which is different from emissions produced by the drilling of a well. That said, there are certain contaminants that are common across many, if not all, parts of the process; two of the most notable being VOCs and particulate matter. The Southwest Pennsylvania Environmental Health Project's ground-level experience with individuals, along with continual assessment of the literature on UNGD emissions, leads us to propose several essential criteria for evaluating individual exposures. These are: 1) proximity of well pads, compressor stations, production facilities or other operations associated with UNGD; 2) varied stages of operations occurring at the just the well pads; 3) the presence of chemical mixtures in air emissions; 4) the role of weather in dispersion of air pollutants; 5) the resulting chemical composition and concentrations exposing the

[37] David R. Brown, Celia Lewis & Beth I. Weinberger (2015) Human exposure to unconventional natural gas development: A public health demonstration of periodic high exposure to chemical mixtures in ambient air, Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering, 50:5, 460-472, DOI: 10.1080/10934529.2015.992663http://dx.doi.org/10.1080/10934529.2015.992663

individual; 6) the frequency and duration of exposures.
The present study demonstrates that households near UNGD sites are subjected to variable particulate and chemical air exposures that may reach potentially dangerous levels. Furthermore, it broadens the concern to the whole lifetime of shale gas development rather than primarily focusing on hydraulic fracturing as the predominant polluter. Hydraulic fracturing itself occurs over a matter of weeks, while compressor stations and gas processing plants, also located near people's homes, pollute 24 hours a day for as long as gas is flowing through the pipeline. These parts of the process produce significant air contaminants and deserve more attention than they have received thus far.

12. CONCLUSION

In December 2014, New York State banned HVHF on the grounds of public health[38]. The studies mentioned above are just a small sample from the rapidly expanding body of medical evidence linking human health harms and unconventional gas development. Of importance are the gaps in evidence, and the rising realisation that children may sustain permanent and serious harm when exposed to mixtures of low levels of toxins that would cause no discernible effect in an adult. When extreme industrialisation and pollution is superimposed onto a resident population as it is with unconventional gas development, then this is a critical factor for decision makers. The public health doctors who authored the report on which the New York decision was based were looking at the "entire process of natural gas well development and production" This Public Health document contains 90 pages of references and abstracts from studies which informed the report. Howard Zucker, New York's acting health commissioner said the study had identified "significant" public health risks. Dr Zucker[39] went on to say: *"I asked myself, 'would I let my family live in a community with fracking?' The answer is no. I therefore cannot recommend anyone else's family to live in such a community either."*

That is the standard of care that should be, but has not been, applied in Australia. In 2010, the GLNG projects were pushed though despite Simone Marsh, the public servant charged with drafting the environmental response stating clearly that serious environmental harm would ensue.

"It is clear the project's activities will lead to wide-spread, serious environmental harm and material environmental harm, as defined by the Environmental Protection Act, both during and following the removal, transportation and processing of coal seam gas,"[1]

Unfortunately, her warnings were entirely accurate and the people of the Western Downs are now living with the health, environmental and economic consequences of negligent and unlawful decisions.

Decision makers need to understand that healthy co-existence with unconventional gas is a myth. Healthy communities cannot thrive in the middle of an unconventional gas field. The choice to be made is between pre-existing industries such as agriculture or gas. It is a choice between healthy food production or gas. It is a choice between the long-term safety

[38] A Public Health Review of High Volume Hydraulic Fracturing for Shale Gas Development, New York State Department of Health, Dec 2014
[39] https://www.health.ny.gov/press/releases/2014/2014-12-17_fracking_report.htm

of the water supply or gas. It is a choice between tourism or gas. Any land earmarked for gas is a sacrifice zone.

In making a decision on the future of unconventional gas, decision makers need to learn from the painful lessons coming out of Queensland and internationally, and do everything in their power to protect the health of the people now living in their communities as well as those not yet born. They can protect and develop established communities and enduring jobs in agriculture and tourism rather than allow them to be decimated by a destructive, short-term industry. They can make a choice not to risk the security of their food producing land and safe water supply for generations to come. They can ensure that the sacred sites representing 40,000 years of Australian culture are protected. They can ensure that their efforts and energies are directed towards fast tracking research into, and developing a truly clean, renewable energy industry with all the jobs that will come with it. Australia must transition rapidly to zero net emissions, and due to the growing evidence of fugitive emissions from unconventional gas processes it is obvious that that is not the route. Contrary to previous hype and scaremongering by vested interests, there is adequate conventional gas to make the transition to renewables. The nature of the unconventional gas process is such that it cannot be safely managed or regulated. Even if it were not intrinsically unsafe, which it is, it is apparent from many disasters such as the Hazelwood mine fire in Australia, and the Porter Ranch disaster in America that regulatory processes can and do fail, with devastating results.

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31st January 2016