Background Paper on Community Concerns in relation to Coal Seam Gas

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University of Western Sydney
Bringing knowledge to life

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1. Introduction

This background paper has been prepared for the Office of the NSW Chief Scientist and Engineer (OCSE). This paper is prepared as an input to an independent review of coal seam gas (CSG) activities in NSW, being undertaken by the NSW Chief Scientist and Engineer in accordance with a request made by the Premier of NSW on February 21st 2013.

The requirement for this background paper was that it would provide information and discussion about community concerns in relation to CSG. The headings in the report mirror those provided in Schedule E by OCSE. The initial section of this report outlines the main areas for community concern followed by a section on the health, and other potential, impacts of these concerns. This is then followed by some discussion about possible strategies that could be considered to help lessen community concerns and associated issues with CSG development. Finally, consideration is given to any knowledge gaps and unknowns and closing comments.

Approach

As noted above, the requirement of this paper was to provide information and discussion about community *concerns*. As such, no attempt has been made in the documenting of these concerns to comment on, or judge, whether such concerns are justified or reasonable; just that they exist in the community. Similarly, no attempt has been made to assess the extent to which these concerns are held across potentially-affected NSW communities or the general population more broadly.

Information sources

With regard to the information sources that have informed this paper, these include media reporting, online information, government and technical reports, and peer-reviewed academic literature. However, the balance of use of information sources is different for different section of the report. Only secondary data have been used in compiling this background paper.

As a starting point, it is important to acknowledge that community concerns are dynamic in nature. They are influenced by current events, e.g. local situations, political decisions and announcements, and current news media, as well as recent, prior, and historic events and their reporting. As would be expected, general discussion and opinion-reporting on current community concerns and issues are most widely covered in popular media, e.g. print, online news, websites, blogs, and social media. Therefore the initial overview section of this paper on community concerns draws heavily on these written media sources.

To ensure that the media content informing the overview of community concerns section of this paper was as current as possible, a Google alert was set up for the duration of the development and writing phase. An alert using the terms “coal seam gas” + “community” was used to provide daily updates from the period 6 May 2013 to 7 June 2013. These alerts identified many forms of online reference to the search terms, including online news, blogs, and website-based information.

Also in overview section on community concerns some limited consideration has been given to significant Australian and American television and film media, as they include reporting of community concerns and they gain national coverage. They can also be easily sourced through their continued availability online. Although additional media sources, such as radio broadcasts and talkback radio, are likely to reflect community concerns the content of radio-based media is more

difficult to capture concisely or retrospectively due to its (often) transient and localised nature. Therefore, radio sources were not considered directly in this paper although some online news reporting also contained audio coverage.

In addition to media reporting, the overview of community concerns section of this paper was informed by the content of material on number of organisation/group websites, including the most active anti-CSG groups, such as the Lock the Gate Alliance, environmental groups such as Doctors for the Environment Australia, and the National Toxic Network, and government websites that seek to address community concerns through FAQs and Fact Sheets, such as the CSIRO website.

Latter sections of this paper - those concerned with health impacts, measurable effects and communication strategies – were informed more extensively by official reporting and academic literature. Keyword searchers were performed in the database SCOPUS to identify relevant academic literature published from 2000 onwards.

Note on media reporting balance and representativeness of community concern

It is appreciated by the authors, and should be noted, that written popular media inputs are often not impartial and are written to attract reader attention and/or to generate an emotional response or call to action. However, such media content forms a large component of the information that the public is presented with in the area of CSG. Media sources are likely to play a significant role in shaping community response, in addition to related social factors and events (for example, public meetings and rallies, the attitudes and actions of friends, family, and significant others), and individual attitudes and beliefs. In the context of reflecting the current *concerns* of the community it was felt that media coverage was the best source of input for the initial section of this paper.

There was no requirement, nor effort made, in this paper to address the balance of community views or to report evidence that may lessen or negate community concerns. Similarly, it should be noted that media reporting may contain assertions and viewpoints held by individuals and/or groups within communities, and therefore no indication of the extent of overall community concern or the representativeness of the level of concern can be gained from such sources as reported here.

2. Overview of Community Concerns

This section of the report deals largely with concerns expressed by groups and individuals regarding coal seam gas drilling and production. It is important that there are issues for the public on both sides of the CSG debate although we have, for reasons just outlined, addressed the issues of those generally against CSG. As previously mentioned, we outline the concerns without attempting to comment on the validity of those concerns. There are some extreme points made by some groups and the debate can be highly emotional and views strongly polarised.

When considering the concerns that the community may have with CSG, its developments, and processes, the main concerns fall under six main categories; noting that some concerns may fall under more than one category, particularly health. We have briefly described the major concerns under these headings:

- Water issues,
- Threats to agriculture and the natural environment,
- Landowner and community rights,
- Issues of trust,
- The role of the media
- Human health and well-being (a common theme that runs across all categories)

This section of the report includes references to a number of key organised groups that are opposed to CSG and/or concerned about its impacts on the health of communities. These main groups are:

Lock the Gate Alliance (LGA): The LGA is the main community group working to raise public concerns about CSG. The LGA describes itself as a "national grassroots organisation made up of thousands of individuals and over 160 local groups who are concerned about inappropriate mining". This group appears to be the largest anti-CSG movement in NSW and the major driving force behind vocalising and raising awareness of the potential concerns of the community regarding CSG in NSW and QLD. This awareness is raised through various methods including their website, social media pages, community meetings and protests.[1]

The National Toxic Network (NTN): The NTN is "… a community based network working to ensure a toxic-free future for all". The NTN has been established for 20 years and claims to give "a voice to community and environmental organisations across Australia, New Zealand and the South Pacific".[2] This group is also a member of the LGA.

Environmental Defenders Office (EDO NSW): The EDO NSW is "the only legal centre in NSW that provides specialist advice about public interest environmental law matters. Since 1985 EDO NSW has pursued its mission of providing public interest legal services to groups and individuals to protect the built and natural environment."[3]

Doctors for the Environment Australia (DEA): The DEA is a voluntary organisation of medical doctors in Australia (and part of a global network) that "aims to utilise the skills of members of the medical profession to address the ill health resulting from damage to the natural environment at local, national and global levels."[4]

In addition to these groups there are many local community-organised and smaller more widespread groups working to raise awareness of issues around CSG, voice community concerns, and/or oppose CSG development.

Water issues

There are many concerns that have been raised in relation to the potential effects of CSG on water. The main public concerns raised by the various groups opposing CSG are:

- Water consumption during drilling and processing
- Chemical usage during drilling and processing, e.g. hydraulic fracturing "fracking"
- Risk of spillage
- Disposal of "flowback" water
- Disposal of "produced" water
- Interference to groundwater, the water table, aquifers, e.g. lowering of water tables and contamination with chemicals

Water is increasingly being valued by communities as one of the most important substances on earth, with water disputes on the increase worldwide. The significance of water to communities – their health, livelihoods, and the environment, makes concerns in this area particularly emotive.

One of the major public concerns around the activities of CSG and hydraulic fracturing (fracking) is how water of various types will be affected or disposed. Concerns about water directly affect other areas, leading to concerns around human health, animal health, agriculture and food security, and natural resources.

Water consumption during drilling and processing

The concern here is that large quantities of fresh water are being used, leading to shortages for other uses, such as drinking water or irrigation.

The process of fracking, which is used in some CSG wells, involves injection of a mixture of sand, chemicals and water at high pressure into a well to crack the coal, open up pore spaces and assist the extraction of gas which flows to the surface. A question commonly included in the FAQs section of websites concerning CSG, such as NSW Government Coal Seam Gas website and the LGA website, is "How much water does CSG extraction use?"[5,6] The question addresses the concern that a large amount of valuable water may be diverted from use in the local community, away from human and/or livestock use, and in some cases from valued ecological systems such as the Great Artesian Basin.

Chemical usage during drilling and processing

The concern here is that toxic chemicals at unsafe concentrations are being used in CSG wells which could endanger health and the environment. Large lists of chemicals thought to be used in fracking are publically available, and this is juxtaposed by the high levels of secrecy (and hence public suspicion) that are felt to be exploited by gas operators who claim they need to keep this information private to protect their 'commercial advantage'. Fracking chemicals are usually considered 'proprietary' and are undisclosed, the process of fracking is widely regarded as 'secret' (uncaught on camera/unwitnessed), and there is a general air of community mistrust about what is

being used and how toxic (polluting) chemicals may affect water. Although it is claimed that not all chemicals are used in all CSG wells and if they are it is at low concentrations, there are widespread concerns about the effects of exposure to these chemicals at relatively high concentrations and such concerns tend to persist, regardless of attempts to improve the level of public information and disclosure provided.

Some of the chemicals causing greatest concern about CSG include:

- Propane
- Hydrocarbons such as Benzene, Toluene, Ethylbenzene, Xylene (BTEX)
- 2-butoxyethanol
- Ethylene Glycol
- Heavy metals (such as arsenic, mercury, lead, cadmium)
- Radioactive elements like uranium and thorium
- Salt
- “Foam”

As chemicals are injected in the ground along with the water, there is community concern about exactly which chemicals are used and how they could affect the surrounding environment. There is a potential fear created by the unknown. Related concerns include the potential negative impact on water, soil and air which could lead to potential health, agricultural and other environmental problems.

Two common questions which relate to this concern are addressed by the NSW Government on the FAQs page on their CSG website, Coal Seam Gas: Informing the Community, (showing a common inquiry and a potential community concern); “How will the environment and water be protected?” and “What chemicals are used in the fracturing process?”[5]

Various organisations note, mostly in general terms, the serious effects of exposure to high levels of some of the named chemicals, for instance:

According to a NTN report BTEX (benzene, toluene, ethylbenzene, and xylene) can be released into groundwater or into air. It describes benzene as a carcinogen (cancer-causing).[7]

The LGA quotes an inquiry report by the NTN into Coal Seam Gas which discusses the side effects of BTEX "…in the short term causing skin irritation, central nervous system problems (tiredness, dizziness, headache, loss of coordination) and effects on the respiratory system (eye and nose irritation). Prolonged exposure to these compounds can also negatively affect the functioning of the kidneys, liver and blood system. Long-term exposure to high levels of benzene in the air can lead to leukaemia and cancers of the blood."[7]

2-butoxyethanol is also linked to CSG, according to Doctors for the Environment. They state it “is easily absorbed, spreads rapidly throughout the body, is toxic to red blood cells, and carries the potential risk of haemolysis and damage to the spleen, liver and bone marrow.”[8]

They also mention the linkage between ethylene glycol and CSG. “When broken down in the blood stream [ethylene glycol can] cause damage to the kidney, nervous system, lungs and heart damage.”[8]

Clearly such information is seen and shared by communities. There are likely to be differing degrees of concern in this area, but the use and effects of fracking chemicals is an ongoing concern for communities, both here and internationally. Government actions to ban fracking and use of BTEX (as has happened in NSW) would generally be expected to meet with community approval, however, such decisions may also be interpreted by some as validation of their concerns and hence actions that add credence to the perception that this is truly a 'risky' process. This situation can, therefore, cause issues when bans are lifted, or practices/use of BTEX chemicals is allowed to occur elsewhere.

The risk of spillage

The community concern here is that there will be spillages of toxic chemicals or waste materials to the environment: during physical processes such as hydraulic fracturing, or during transportation, or from storage tanks.

People have expressed concern about the danger a spill could have on the surrounding community, either during the processes involved in coal seam gas such as fracking, or a spill from the storage tanks. This spill could then potentially contaminate waterways affecting the many aspects of the community life mentioned earlier.

The concern around spills has been raised by the LGA. They refer to previous examples of occurrences on their website.

> *There have been several recent incidents of contamination and pollution related to coal seam gas operations. One coal seam gas company operating in a state forest in north-west NSW admitted that 10,000L of untreated coal seam gas water had been spilled in June 2011. Testing, conducted six months later, of samples taken from near the site of the spill revealed how toxic coal seam gas water can be. The water tests detected heavy metals up to 37 times higher than natural levels and five times drinking water standards.* [9]
>
> *Two coal seam gas operators were penalised by the NSW Environmental Protection Authority for charges relating to the discharge of polluted water from coal seam gas sites.*[10]
>
> *Meanwhile, in Western Sydney a coal seam gas well blow-out which sent an uncontrolled burst of foam into the air a short distance from an open drinking water channel had operator AGL put on notice by the NSW EPA.*[11]

The disposal of "flowback" water

The community concern here is that fluids injected into the well during drilling and fracking which may be toxic will not be disposed of safely when recovered at the surface.

The LGA has raised concerns that the flowback process used in fracking is damaging. Flowback is the process used to recover fracking fluids previously pumped underground which contain heavy metals and hydrocarbons.[12]

A report in 2010 for the CSG industry by Golders Associates stated, "it is conservatively assumed that 40% of hydraulic fracturing fluid volume would remain in this formation and this would respond to 7400kg of chemicals per injection wells."[13]

The LGA is concerned that water as a waste product when contaminated could lead to health risks (see section on health). "The National Toxics Network found that this water can contain chemicals used during drilling or fracking, heavy metals (such as arsenic, mercury, lead, cadmium), hydrocarbons like BTEX, as well as radioactive elements like uranium and thorium."[14, 15]

Disposal of "produced" water

The community concern here is that large quantities of possibly contaminated water produced along with the CSG, especially during the early stage of gas production, will need to be disposed of and could affect local water tables and aquifers. During coal seam gas operations a large amount of water must be pumped out of the coal seam to lower the pressure and allow the gas to flow to the surface. This water needs to be managed and there is concern that even the operators currently acknowledge that they don't have a plan for how this will be achieved – and therefore this is not a sustainable or satisfactory situation.

Response to specific community concerns in this area can be difficult as each CSG project will have a different requirement for water use. As the CSIRO reports, "no two wells or coal seams behave identically and water production can vary from a few thousand to hundreds of thousands of litres a day, depending on the underground water pressures and geology."[16]

The LGA used the National Water Commission as a reference stating "The National Water Commission has said coal seam gas development represents 'a substantial risk to sustainable water management'. It said that 'extracting large volumes of low-quality water will impact on connected surface and groundwater systems' and noted risk factors associated with hydraulic fracturing and reinjection of treated water into other aquifers."[17, 18]

The extraction of produced water would affect water levels in some adjoining aquifers, in some cases for many decades. Hydrological modelling conducted for Arrow Energy predicting "drawdown in the intermediate and deep groundwater systems to be greater than thresholds set by the Queensland Government."[17] "This means that farmers and other water users reliant on the adjoining aquifers will be affected."[19] This, in turn, is believed to threaten agriculture (see section on agriculture) and lead to the suffrage of farmers through health problems related to stress (see section on health).

The water within the coal which flows with CSG is often saline so salt is another by-product of coal seam gas operations "and can have a number of adverse impacts if it enters the surrounding environment. This is a particularly pertinent issue in agricultural areas where salt can permanently damage high quality soils and take them out of production. It is estimated that tens of millions of tonnes of salt will be produced as a waste product of coal seam gas operations over a 30-year period. At this stage coal seam gas companies do not know how they will dispose of this salt".[17] ABC News also has an infographic/special page dedicated to this issue.[20]

In addition to concerns about produced water disposal, are issues associated with methane escaping above grounds from subsidence caused by fracking and drawdown of water. Locals reported gas bubbling along a five kilometre stretch of the Condamine River near coal seam gas operations. Dr Gavin Mudd from Monash University is quoted saying that it is plausible that coal seam gas is "a factor in the methane gas bubbling to the surface of the river."[17]

Interference to groundwater, the water table, aquifers

All of the community concerns raised about water (as just noted), if valid, would contribute to degradation of the water table and local aquifers, through pollution and depletion.

On the "CSG Myth Busting" webpage of the anti-CSG organisation LGA the statement "Myth: Coal Seam Gas is a clean source of energy" suggests that water degradation is a negative effect believed to be caused by CSG and thus, a concern of the community.[21] The LGA is concerned that the process used in hydraulic fracturing could cause contaminated waterways. An American study by researchers at the Center for Global Change, Duke University (Osborn et al, 2011) documented "systematic evidence for methane contamination of drinking water associated with shale-gas extraction."[22, 6,] 'At a Sydney meeting in August 2011, Ross Dunn from the Australian Petroleum Production and Exploration Association (APPEA) said that CSG activity "will to varying degrees impact on adjoining aquifers … the extent of impact and whether the impact can be managed is the question."[17]

Problems that result from concerns with water

The pollution to the groundwater through all the above risks generally results in a set of interlinked community concerns:

- water becomes undrinkable for humans, wildlife, and stock,
- soil will be damaged and lead to unusable land, lower crop yields, and possibly impact on food security more broadly,
- effects on water and land will lower property prices,
- reduction in drinking water quality and/or contamination will lead to human (and animal) health consequences.

Threats to agriculture and the natural environment

Aside from water issues there are the following community concerns:

Noise pollution

Large trucks are needed to bring all the relevant equipment needed to drill a CSG well and conduct the hydraulic fracturing processes. The noise these trucks make as they travel to and from the CSG project can be of a high volume and create disturbances.

The CSG process can also create loud noise and sound disturbances to the surrounding environment. This noise pollution can disturb the surrounding wildlife and nature, the livestock (agriculture), and the people (health).

Animal health

Related to the earlier point made on disposal of produced water, the LGA has raised concern, referencing the NTN, that "There are also risks associated with the water produced as a waste product of coal seam gas operations. The NTN found that this water can contain chemicals used during drilling or fracking, heavy metals (such as arsenic, mercury, lead, and cadmium), hydrocarbons like BTEX, as well as radioactive elements like uranium and thorium. When coal seam gas waste water is stored in open holding ponds it can pose a serious risk to the surrounding environment and to native animals. Animal skeletons have been found in coal seam gas waste water

ponds in the Pilliga State Forest and extensive tree-kill has been observed in areas surrounding holding ponds and water treatment facilities."[14, 15]

"A 2012 study out of the United States examines links between health and gas drilling. It found that case studies 'strongly [implicate] exposure to gas drilling operations in serious health effects on humans, companion animals, livestock, horses, and wildlife.' "[23, 14]

Air pollution

There are community concerns around air pollution in relation to CSG activity, with fugitive emissions of methane and other gasses (e.g. benzene) around the well head, from holding ponds, and from escape through subsidence etc.

The LGA has concerns that the emissions created by the CSG process are harmful. The main gas produced by CSG is methane and the concern is that it has a higher greenhouse footprint and is more potent than CO^2 used in conventional gas extraction.[24]

Agricultural and land value issues

The community is extremely concerned about the effect that CSG activities could have on agriculture and land values. For most people their home is their greatest asset and threats to this are threats to their overall financial security. This is very upsetting for most people. In addition, those who make their living on the land, such as farmers, have both their home, their job – their entire financial security, based on their land. Therefore preserving its dollar-value and quality are paramount.

A farmer close to a CSG project reported. "It makes an entire area unliveable. You can't sell your cattle, you can't sell your produce, you can't sell your sheep, you can't sell your milk, 'cause it's contaminated". [25]

The President of Stop CSG Tara, Mr Dayne Pratzky, expressed his concerns that local people living around Coal Seam Gas operations believe that there has been a depression in the land values and they are frustrated about the disturbances caused by the processes including noise, traffic and health concerns.[26]

"That alarm is even more dramatic in areas of prime agricultural land such as the Liverpool Plains in NSW and the Darling Downs … in Queensland. Many farmers still believe the value of their properties will be damaged. Others doubt the science and industry assurances that the drilling is safely quarantined and will not harm the water supply. And, of course, any suggestion that drilling could occur near suburbs or towns is regarded as anathema by local resident groups. Everyone blames the gas industry."[27]

Risk of landslides and earthquakes

The underground activity involved in CSG has raised community concerns about subsidence and earthquake activity.

The LGA has expressed concern that hydraulic fracturing can cause earthquakes.[21] "In the United Kingdom in 2011 the British Geological Survey confirmed seismic events were a direct result of drilling and fracking activities by Cuadrilla Resources."[28]

Questions the NSW Government has addressed to allay public concerns included in FAQs on CSG include: “Can CSG drilling result in land subsidence?” and “Can hydraulic fracturing cause earthquakes or seismic activity?”[5]

Landowner and community rights

Community concerns in this area relate to the perceived lack of rights of landowners and the local communities in terms of access to their land, consultation, compensation, loss of property value, lack of rehabilitation or tangible benefits to the landowners or their communities.

People are concerned that large companies are taking advantage of farmers and will ‘bully’ them into using their land for the company’s benefit, without any benefit to the landholder, demonstrating what they feel is a of lack of human rights. The leading anti-CSG organisation ’Lock the Gate Alliance’ was named after the action advocated to enable landowners to prevent unwanted access onto their land.

“We know of landholders who signed because they have no choice. We know of landholders who feel they have been forced or coerced into signing agreements. In some cases, the option is presented as ‘sign or go to court’. No landholder wants to go to court or face massive legal costs,”[29]

Owning the land but not the resources under the ground is a difficult concept for many landowners. “Resources are owned by the Crown, not the property owner. The Crown provides gas companies access to these resources and gives landholders only a minor right to ‘negotiate’ an access agreement and compensation deal with those companies.”[30]

There is a perception that the Government is blindly in support of big companies and that “the law is strongly in favour of coal seam gas.”[30]

“According to... [Ian Macfarlane, Shadow Federal Resources Minister]... there's no way coal seam gas development should proceed without the support of the farmer. Any farmer should have the right, he insists, ‘to just say no.’”[27]

Many opinions were expressed and documented by activists in the documentary “Gippsland is Precious” whose footage was used for a story on the Channel Ten program The Project.

> “Here’s those big multi-national corporations coming in, using Australian police to bulldoze their way past Australian farmers, to come onto their properties to trash it.”[25] (‘Unaustralianism’)

> “We do not give permission for large multi-national companies, to come into our region, onto our land and put at grave risk, everything that is precious to us.”[25] Activist from Gippsland (WE R CSG protest event)

> ‘’The Gas company sends you a letter to tell you they’re going to court to drill for gas in your backyard. They take you to court if you don’t agree.” [25]

When the CSG operations terminate, there is a concern that not all the appropriate environmental rehabilitation will be undertaken and thus, lead to potential environmental detriment leading to

problems in water, agriculture, nature and health. The issue of rehabilitation is addressed by the NSW Government on their CSG website on their FAQs page, "How are well sites rehabilitated?"[5]

Issues of trust

Trust, or lack thereof, lies at the heart of much of the CSG debate and has the potential to thwart attempts to ease community concerns about any issue discussed in this paper. There is evidence of a severe lack of trust from parts of the community in relation to the lack of proper data and evidence, beliefs of biased data and a distrust of proper regulation methods (and 'keeping promises'), trust in the science, in the government and politicians, trust in the operators, and social trust.

Many CSG opponents simply do not trust any gas companies or their representatives (such as APPEA), or the government and politicians, or the media (including journalists) in regards to the safety of CSG operations.

On the other hand some landowners and community members and businesses in favour of CSG feel that the debate has been taken over by environmental activists. Landowners who agree to access by CSG companies can experience social ostracising within their communities.

Lack of data or biased data

There is a general belief that biased data is being produced by either the government or companies in order to justify the safety of CSG sites. People have a grave concern over the data used to prove the safety of CSG processes and whether these data are valid and reliable enough to validate a positive conclusion. There are also concerns that it is not possible to *prove* the negative environmental or health consequences of CSG operations due to a lack of (baseline) data.

The LGA "Emissions" webpage airs concerns that when the CSG industry report the amount of gas produced in the CSG process, that they are biased in their reporting and that the industry has used the best case scenario and the most efficient gas-fired turbines and that "70% of the figure does not include the emissions involved in producing the gas – the drilling, fracking, compressing, pumping, liquefying, and transporting the gas..."[24]

Activists say, in the rush to make big bucks not enough research has been done into the process to make sure it's safe. This is exacerbated by concerns that government departments are losing the skills and resources to collect data, or assess evidence, and are relying on industry, consultants, and others to provide data/reports. "The lack of credible evidence and capability deficiencies within state government agencies cannot be addressed by outsourcing government work to consultants". [31]

Distrust of government or politicians

There is a general distrust of the government, or certain politicians, from individuals, communities, and groups who oppose CSG, and also distrust of those suspected as being on the same side as the gas companies.

Journalist Sandi Keane, in an article for Independentaustralia.net claims, "The revolving door culture of self-interest on both sides of NSW politics, means it is difficult to distinguish between government, lobbyists and the CSG industry."[32]

There is also a sense that government is scapegoating or blaming industry rather than facing up to its responsibility regarding CSG activity. “Politicians are now also blaming the industry for not properly (and belatedly) explaining their procedures and actions to the community.”[33]

To take a specific issue, communities in some areas of Sydney are frustrated and angry by what they regard as a broken promise by the NSW Premier. Before the state election Mr O’Farrell stated “the next National/Liberal government will ensure that mining cannot occur ... in any water catchment area... no ifs, no buts, a guarantee.”[34] However, licenses to explore for CSG within the Sydney Water Catchment were granted after the election.

Separate to mistrust of individual politicians there is creeping mistrust of the structures and committee put in place to regulate and protect natural resources, and the motives of government. In December 2012 criticism was raised (and mistrust inferred) at the lack of a public health expert being appointed to the board of the Sydney Catchment Authority, and the appointment of someone considered to have close mining links.

Luke Foley, NSW Opposition Planning and Infrastructure Minister said “I think mining's being put before public health here." "That's the only conclusion you can reach when you see the public health expertise has been removed all together from the Sydney Catchment Board and a person with umpteen mining directorships, in Mr Bethwaite, is appointed to head up the Sydney Catchment Authority."[35]

Similar concerns were raised by the Greens MP John Kaye who is quoted as saying "The coal seam gas industry has its eyes on Sydney's water catchment area for a bit of drilling.” “Putting onto the board, a man who has a long connection to the mining industry is a signal of Katrina Hodgkinson's intention to compromise the water quality and allow coal seam gas drilling to go ahead."[35]

Such accusations are severely damaging to public perceptions of state government, especially in such a contentious area and at such as sensitive time.

Distrust of gas companies

The main areas of community concerns around lack of trust and suspicion with the gas companies are that they are in some way manipulating or controlling the government and the regulatory process and being allow to operate with minimal scrutiny, that they are granted special terms to operate (access to sensitive areas, legal advantages, expedited processes), and that they don’t care about the harm they do to the environment or communities.

An additional driver of distrust is what is perceived as a lack of fairness or balance in the risks and benefits associated with CSG. At its most extreme the view is that large mostly foreign-owned energy companies are rushing in to make big profits, stripping Australia of its resources, damaging the environment and natural (water) resources, ruining the lives and health of individuals and communities, and then making large profits selling their gas overseas and leaving behind contaminated and devastated land. In this view of the world all the ‘risk’ and damage is experienced at a local level and all the ‘benefit’ is overseas (or at best some benefit is with government).

Communities are generally not convinced by arguments that CSG is a greener option or a transition fuel, and that CSG mining will result in lower (or will put any hold on rising) prices for gas in the

future. Many reports have drawn attention to flaws in these arguments. The Australian Energy Regulator's report in December 2012 pointed to rising costs of gas due to international sales putting upwards pressure on prices[36] and ABC's "The Drum" shed doubt on claims by APPEA that protesters are to blame for rising gas prices.[37] The ABC's "Four Corners" program in April 2013 ("Gas Leak"[38]) questioned CSG's green credentials, as have other experts in the field, e.g. Dr Colin Hunt, University of Queensland writing in the Canberra Times.[39]

Finally, there would appear to be some evidence of industry running misleading or deceptive advertising and making unsubstantiated claims; interpreted as evidence of lying in the eyes of anti-CSG organisations. The Stop-CSG Illawarra website has a whole page dedicated to what they claim are examples of lying,[40] showing claims around groundwater safety made by CSIRO in industry advertising, being 'corrected' by CSIRO, and a 'fake' farmer claiming successful co-existence of CSG and cropping in an advertisement.

Misleading promotion of CSG, and media coverage and expert claims that shed doubt on the claims made by industry about the benefits of CSG help to fuel distrust and damage industry reputation; especially in a climate where people are already primed to believe the worst. Such examples provide opportunities for organisations that seek to influence public opinion about CSG negatively, and oppose CSG.

Epistemic trust – distrust of the science

It is possible that the community mistrusts or, at best, is confused by the scientific knowledge presented around CSG mining, fracking chemicals, and water impacts. The use of scientists and experts by opposing sides in a debate (especially one that is emotive) can lead to a mistrust of the science and the scientists. Such situations have occurred in the climate change debate and in debates around nuclear energy. If ulterior motives and political spin are suspected in the choice of expert delivering the science (or his/her current or past affiliation/s) people are more likely to 'tune in' to those who represent the side of the debate they support, and disregard or dismiss the other sources. In the context of community *concerns* (i.e. typically the negative sides of the CSG debate) this leaves the public vulnerable to being more open to fear-inducing messages.

Regulatory distrust - a distrust in 'adequate' regulatory methods

Tied up in the general concerns about trust are trust in the regulatory process; the processes around the granting of licenses and the regulation and monitoring of the safety of operations, as well as general governance and oversight. The speed at which the industry is felt to have taken off in Australia and government's role, with perceived conflicts of interest – over tax revenues and gains, against their requirement to show due diligence in their processes and protection of the public leads to general public mistrust and is a position hard to defend in a politically-charged and media-spun system.

Voiced by the LGA, the NTN, and recently the Australian Medical Association there has been concerns about whether the level of monitoring and assessment of CSG projects have been adequate enough, especially to do with the chemicals used in hydraulic fracturing.[41] There is then a general concern on how this will impact the environment.[42]

"We can light our water bore. The government comes out with very sophisticated equipment and they say there is no gas in our water bore; the water deteriorated to the point where the stock would no longer drink it, where the frogs that had happily lived in the tank died." – Brian Monk, QLD Farmer.[25]

The mass reporting in the media of cases of methane in water and health impacts in humans and animals and the consistent government assessment of a lack of proof that such cases are linked to CSG activities is frustrating to the public. Although it is appreciated that such evidence is anecdotal the public perception can be that there is a lack of will to find such evidence and that there is a cover up. The potential for a cover-up is a good media hook.

Finally in this area is the concern about decisions of *where* licenses have been granted, the perceived unfairness of a system that allows gas companies into national parks and prime agricultural land to explore and drill for gas, whereas others would not get such access, helps to add to the perception that gas companies are somehow exempt or are receiving privileges from government.

Social distrust - social ostracising

There is potential for the creation of resentment within farming (and other) communities with the social consequences of "selling out" to the CSG mining companies, a mistrust of neighbours. If farmers do allow the CSG companies onto their land or sell their land to these companies, this can lead to resentment in the surrounding community; due to the benefits given to the farmer involved, and the detriment to the surrounding farmers/people who are not benefiting. This can lead to social ostracising. The contiguous impacts of one person's actions can lead others to feel helpless – at the mercy of other people's decisions. This perceived lack of control can be very detrimental to societal relationships as well as individual health and wellbeing.

"But one man's farm is another man's neighbouring property. Even getting individual approvals doesn't resolve continuing community angst about the potential impact of coal seam gas, especially on water."[27]

The role of the media

The media plays a pivotal role in framing the CSG debate. On balance, media reporting appears to be more anti-CSG than pro-CSG, most likely because this is the side of the debate that makes a better story and garners more interest. There is also likely to be far more opportunities to identify negative stories, with the widespread 'threat' of CSG across many communities. In this section we make reference to a number of online films and documentaries. These are all easily available to view online and links to them are included in the Further Reading section at the end of the report.

Portrayal of CSG in on-screen media - The United States

Two of, probably, the most influential pieces of media that relate to the current context are from the United States and based around shale gas, not coal seam gas, the first is the film "Gasland" and the second is "Split Estate".

"Gasland" (2010): One of the seemingly most influential forms of media is environmentalist documentaries, particularly an American documentary called Gasland, which won several awards. This documentary was directed by Josh Fox and released in 2010 with a goal of gaining support for

the anti-fracking movement on a world-wide basis. It was released in twenty-two countries and with various screenings and follow-up discussions with the audience.[43] Gasland Part II, a sequel to Gasland has recently been premiered (May 2013) and will be screened on HBO in July 2013. This film continues a number of the stories covered in the initial film and looks at the consequences of fracking globally.

Despite a lot of criticism with many flaws and errors claimed in the initial documentary, e.g. the gas in the water coming from the tap is swamp gas – not CSG, the film received major coverage and is used as evidence against CSG. There was a lot of attention, both in negative and positive forms, paid to the film and it has been used to by groups in Australia to demonstrate/highlight concerns that CSG occur here. There is a concern that this documentary and its screenings is unduly shaping the Coal Seam Gas debate and heavily influencing Australia. [44]

"Split Estate" (2009): Split Estate (2009) focuses on the issues around the landowners not owning the rights to the minerals under their land.[45] The film deals with civil liberties, communities, and their health.

As would be expected, most media documentaries focus on the negative consequences and uncertainty around unconventional gas production. However a new documentary, FrackNation, has been released recently which seeks to redress the balance in the media coverage.

"FrackNation" (2013): FrackNation (2013) is a documentary by Phelim McAleer.[46] This documentary film opposes and targets the views developed in Gasland by Josh Fox whilst raising "a bigger question: Is it possible to criticize environmentalists without being a tool for big industry?" It claims that a lot of activists have used faulty claims using these as a basis for their argument.[47]

The film FrackNation was funded "by the people, for the people" and donations from oil and gas companies or their executives were explicitly rejected.[46]

Portrayal of CSG in the media - Australia

Four Corners "The Gas Rush" (2011) and "Gas Leak" (2013): In on-screen media in Australia there have been a few documentaries produced around CSG. ABC's program "Four Corners" covered issues around CSG in February 2011, in a program called "The Gas Rush". This documentary covered a range of issues from gas companies accessing farmland, to concerns about water levels. The program "Gas Leak" was screened in April 2013. This focussed on flaws in the development approval process as well as rounding-up on the main concerns covered in the earlier program.

"Gippsland is precious" (2013): CSG is mentioned regularly in Australian media. In May 2013 the news program "The Project" covered a section on CSG and their report reviewed a new Australian documentary called "Gippsland is Precious". During the report they mentioned Gasland, stating "In 2010, the American documentary Gasland exposed the potential dangers of coal seam gas mining when it claimed that gas had entered the drinking water. While this hasn't happened here, the farmers believe that the water they feed their animals isn't safe." [25] The documentary "Gippsland is Precious" follows communities based on the prime farming land as they unite to oppose CSG development.

Apart from these major film documentaries there is a regular flow of media coverage on CSG in the Australian online news and print media and on radio. Mostly coverage follows state government announcements and official reports on CSG and community action and reporting of civil disobedience. The media coverage doesn't appear to be particularly biased, although as already noted, there is typically more to report on the anti-CSG area and community concerns, than there is to report about more positive stories. Also, stories with human interest and claims of injustice are more colourful and interesting to audiences.

In addition to print and online news media, there are many blog sites and community action organisations using social media. Clearly the content in the social media tends to follow the focus of the group.

The media coverage of CSG *is* what most of the population know about CSG, hence there is probably a greater fear or wariness in the general public when it comes to the subject of CSG activities. Most people, even if unaffected directly by CSG activities, will find some part of the mosaic of concerns that resonate with them; whether it be safe drinking water, health concerns, concerns for the environment, or human rights.

Human health and well-being

Concerns regarding human health and well-being cut across most of the concerns covered in this section. Health is seen as one of the priorities when it comes to community concerns about CSG and this area is covered in more detail in the second section of this report on the impacts of community concerns.

Research by Doctors for the Environment Australia (DEA) has found that the current level of assessment, monitoring and regulation of CSG exploration and mining activities in Australia is inadequate to protect the health of current and future generations of Australians. DEA identified three key areas where there is the potential for adverse human health impacts:

- through contamination of water, air and soil
- through diversion of water and land away from agricultural food production
- from mental health impacts on communities who have had environmental changes imposed upon them'[8]

With respect to health concerns, most attention to date in Australia has been paid to health concerns of residents in the Tara region in Queensland.

Bishop McGuckin, speaking following a recent meeting of the Toowoomba Diocesan Social Justice Commission said that the Commission heard accounts from local Tara residents of physical and mental health conditions that they believe are attributed to nearby coal seam gas activity. Most distressing are medical symptoms seen in some of the local children, including photographs showing children suffering skin rashes and nose bleeds.

Bishop McGuckin said a number of Tara residents believe multiple medical conditions are the result of chemical exposure caused by adjacent coal seam gas mining activities "Queensland Health Department knows about this issue," Bishop McGuckin said. "But more needs to be done to allay the understandable anxieties of the people who are being affected." "We support the recent call by the

Australian Medical Association that governments strengthen the assessment and monitoring of health impacts of coal seam gas (CSG) developments in Australia." [48]

As just mentioned, assessments have been made of these health impacts by Queensland Department of Health, and this will be covered in the following section.

Regarding mental health, like physical health there has been some reporting of concerns from those in the medical profession.

There are some concerns the CSG activity and mental health issues could be linked. "Upper Hunter psychiatrist Dr Steve Robinson says he has observed anti-social behaviour, angry outbursts and symptoms of depressive illness in individuals with no prior mental health history [however] Robinson noted that those with illnesses of depression, anxiety and paranoia that are currently under control run the risk of having those illnesses reactivated."[14]

Lismore-based clinical psychologist Dr Wayne Somerville has also raised serious concerns about the risk of anxiety and depression due to a break-down of social cohesion resulting from the roll-out of the coal seam gas industry.[49] He claimed that the coal seam gas industry could result in destruction of property, lifestyle and prospects and this would result in "predictable emotional responses", and he went on to suggest that anger, revenge, violence, and even suicide could be possible outcomes.

The potential for health impacts of CSG and the need to improvements in health impact assessments has led DEO to produce a report "The Health Factor"[50]. This report describes cases where coal projects have been allowed to pollute at levels known to compromise human health and where inadequate monitoring of air quality disguises the dangers. The report describes how cardio-respiratory and other diseases in nearby communities are likely to be caused or exacerbated by pollution from coal mining and transport. It also points out the research and regulation on coal seam gas lags well behind these developments, and the degree to which they harm human health is not yet understood.

"It is clear State government approvals of coal and coal seam gas projects are often influenced by potential economic gain without thorough assessment of potential harms," DEA spokesperson David Shearman said.[51]

"Permitting dangerous pollution is creating a costly legacy for Australia that is being picked up in the healthcare and other sectors. The social and financial costs of this pollution are not being measured or factored in when projects are given the go ahead."[51]

"Assessment of the health impacts of resource projects need to be much more robust and consistent across all States." Dr Shearman said, "Governments need to conduct proper health impact assessments before projects are approved to better protect the health of communities. Rules for monitoring pollution during the life of the project and beyond must be introduced." [51]

Widespread health concerns surrounding CSG prevail in communities affected by CSG activities and those who face the possibility of CSG exploration and mining in the future. The next section will address some of the impacts of these health concerns.

3. Impacts of concerns on individuals

As with the previous section, this section on impacts does not make judgments on whether the hazards that relate to community concerns *are* present; we have assumed that if they are present, or perceived to be present, then these could be their potential effects on individuals and communities.

As noted in the first section of this report describing community concerns, there is a high degree of interconnectedness between them. Although some concerns, and therefore their impacts, may be reduced through changes to policy and regulation, e.g. land access, fracking controls, or financial compensation, others are harder to mitigate for, such as concerns for health and in particular longer term health and the potential cumulative health effects of CSG. As two significant reports have recently been released that focus on CSG regulation (SCER, June 2013)[52] and unconventional gas production (ACOLA, June 2013),[53] and these cover many of the development and operational safety aspects of CSG operations, we have chosen to focus on health impacts in this background paper. These two recent documents will be considered briefly.

The recently released draft report by the Standing Council for Energy and Resources, "The Draft National Harmonised Regulatory Framework"[52] has comprehensively considered the regulatory context of CSG activities and has set out to address community concerns about the potential environmental, health, and social impacts of CSG development. The report identifies a more consistent approach to managing CSG developments and has been prepared as a guidance document for governments. The report recommends 18 leading practices to mitigate the potential impacts associated with CSG development; some are overarching, and others apply to the four core areas covered in the document - well integrity, water management and monitoring, hydraulic fracturing, and chemical use. If the framework is implemented nationally it has the potential to reduce some community concerns through providing greater reassurance to the public through greater consistency in regulation, use of best practice, and a better balance of social and environmental values and economic outcomes.

The report by the Australian Council of Learned Academies[53] considers the potential for shale gas production in Australia, including consideration of the economic, environmental, and social impacts. Of particular relevance to this current background paper, the report contains a chapter dedicated to Community (pp152-167) and draws on the concerns, perceptions and experiences of CSG in Australia. This chapter includes consideration of community engagement and social license to operate and human health impacts. This report quotes the American Public Health Association in the context of high-volume hydraulic fracturing (HVHF) stating that "the public health perspective has been inadequately represented in policy processes related to HVHF. Policies that anticipate potential human health threats, require greater transparency, use a precautionary approach in the face of uncertainty, and provide for monitoring and adaptation as understanding of risks increases may significantly reduce the negative public health impacts of this approach to natural gas extraction."[53]

The ACOLA report comments that Australia would be prudent to learn from experiences in the United States in this area. Although this report is written in the context of shale gas extraction, the message would seem equally relevant to CSG.

Environmental health impacts

Many of the potential health impacts are directly linked to CSG operations, specifically those that could be linked to water and air contamination through use of fracking and fracking chemicals, through fugitive emissions of methane and fracking chemicals into the air, and from the management and disposal of produced water. In addition there is the potential for health impacts through the development and operation of drill sites from ground works and logistics, such as dust, plant and traffic noise, vibration, and pollution. Broadly speaking these can be referred to as environmental health impacts.

However, in addition to environmental health impacts that cause physical symptoms, there are those that impact on psychosocial wellbeing and mental health that can arise from concerns around possible environmental health impacts and the broader conceptualisation of CSG activities as an unwanted presence, and therefore a stressor or 'threat'. All of the concerns previously noted have the potential to manifest as psychosocial or mental health symptoms.

The environmental health impacts of the contamination and degradation of air and water have the potential to cause significant physical harm. The Australian Medical Association (AMA) recently called for the blocking of CSG developments if any doubt exists that there could be serious or irreversible harm to health.[41]

Clearly contamination of drinking water supplies with hydrocarbons and fracking chemicals is one of the main community concerns and would result in physical health impacts, such as headaches, nausea, skin rashes, vomiting, and eye and throat irritation. Further impacts could include kidney damage, endocrine effects, and cancers. Based in the United States the organisation TDEX, founded by Dr Theo Colborn, holds a publically available list of almost 1000 chemicals used during natural gas operations with details of their potential health effects.[54] She has also published details of some of these health effects in peer-reviewed journals (e.g. Colborn et al, 2011).[55] The effects of methane, benzene, and other volatile organic chemicals have been mentioned briefly earlier in the report and are detailed in many submissions produced by Doctors for the Environment.[56]

Contamination to ground water, issues around produced water and seepage and evaporation from evaporation pools may result in health impacts in livestock and wildlife, general environmental and soil degradation due to increases in salinity or toxic chemicals. Airborne concentrations of volatile organic chemicals from evaporation ponds or fugitive emissions around drilling sites or damage to underlying geological structures may cause loss of consciousness, in sufficient quantities, but also give rise to headaches, rashes, and eye and throat irritation.

Noise and vibration from infrastructure development and drilling operations may cause sleep disturbance and associated issues, emotional distress, and annoyance (see later). Dust from ground works and fumes/particulates from vehicles may result in respiratory symptoms, e.g. shortness of breath, asthma, and general distress.

Psychosocial wellbeing and mental health impacts

Concern, fear, anxiety, and MUPS

More directly linked to the impacts of 'concerns' as opposed to direct physical or chemical hazards as considered above, is the potential for psychosocial and mental health impacts. Such impacts may be experienced in response to an actual or perceived threat being present, e.g. exposure to a threat, but further than that, impacts may be felt in anticipation or expectation of a threat occurring. Therefore in the context of this paper, if CSG activities are perceived as threatening/unpleasant impacts to an individual may be experienced when such activities occur, but they may also be experienced in anticipation of CSG activities.

People facing a range of potential threats as they perceive them may acutely or gradually develop anxiety regarding their possible effects; such as their effects on health, financial security, or other aspects of their life. Such fears and preoccupations may be increased when public concerns are further aroused by circulating rumours, media controversy, or an adversarial social context, that might provide additional details. Everyday symptoms may then take on a new significance; become a greater focus, and may become attributed to toxic or other uncertain dangers. Commonly described general patterns include headaches, shortness of breath or chest pain, body pains, sleeping difficulties, chemical sensitivity, and poor appetite.[57] These and similar patterns have been described after a wide range of exposures with perceived threat including toxic waste sites, air pollution, irradiation, and other threats (e.g. Dunne et al 1990, van den Berg et al, 2005).[58, 59]

Systematic medical and scientific assessment are unable to confirm these as physical consequences of the perceived threat and they have been labelled as Medically Unexplained Physical Symptoms (MUPS) – also often referred to as somatisation disorder. It should be noted that, although we are considering MUPS here in the context of concerns/anxiety, such symptoms may not always be associated with psychiatric factors (Nimnuan et al, 2001).[60]

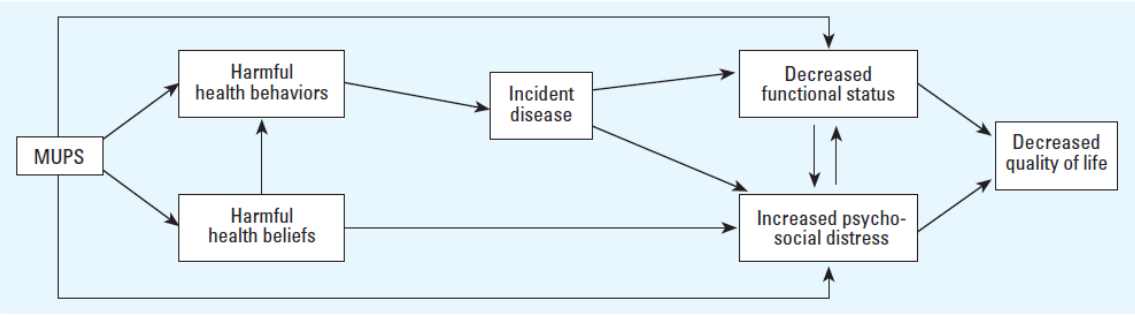

Figure 1. Causal pathways by which MUPS may lead to a reduction in health status. Engel, Adkins, and Cowan (2002)[61].

The treatment of MUPS poses challenges for health care providers. There needs to be careful and considered communication between patients and their care providers as although the symptoms may be medically unexplained the condition is not trivial and there can be a tendency for patients to be left believing that their symptoms are all in their mind which may be unhelpful for future recovery. Of particular relevance to this paper is the potential for conflicted causation, where MUPS occurs in the context of a situation that is in the public arena and may involve media controversy,

advocacy groups, scientific and political debate and even legal proceedings.[61] In these situations the treatment of MUPS is more complex and there is a greater need maintain a good patient-health care provider relationship to avoid erosion of trust.

Over time, concerns and associated distress may settle or become more severe and entrenched. Accurate and regular information from trusted sources, e.g. local leaders, trusted experts, with opportunities for questions and discussion may be helpful particularly if communities are engaged and believe their worries are being addressed. However if the sense of uncertainty and threat grows and strong beliefs develop that there are dangers that will cause, or are already causing, harm/disease local leaders may seek to find proof that there is a significant problem and that others such as politicians, industry, are "covering up".

When these concerns, whether accurate or otherwise, become entrenched they are more difficult to manage. The anxiety states that may result may also add to health vulnerabilities especially when the way of life, the home (often the main resource of the family), and the capacity to work or make a living are threatened. In reality there may be uncertainties for all so honest and open, ongoing communication as well as engagement of relevant stakeholder, including media, may be relevant.

Anger and frustration

The uncertainties people may experience; perceived potential threats to property, business, and home, disruption of familiar environments, and fears of gas, chemicals, and possible toxic health effects, can all lead to real impacts on health. These can be related to distress about continuing uncertainty, financial insecurity, changed health behaviours, stress effects and mental health issues such as anxiety and depression. There may be further anger over time, due to a sense of injustice, frustration over lack of clarity, perceived inability to help oneself, and no easy solutions. This can increase distress and exacerbate existing health problems.

Loss of control, helplessness, depression

As mentioned in the section on community concerns, one of the issues noted in the media is a sense of loss of control over what is happening, either in terms of lack of personal choice or being 'surrounded' when neighbours permit CSG activities on their properties[62]. This disempowerment is problematic on many levels, not least of all health. A large body of evidence links loss of control to feelings of helplessness and hopelessness, and then to symptoms of depression. Depression can be experienced at a range of levels, from mild to severe and can be totally debilitating. Depression is also a common factor in suicide (Hawton et al, 2008).[63]

In the previous section the term solastalgia was mentioned, to describe the distress produced by environmental change in the environment. Albrecht, Sartore, Connor et al, (2007)[64] report that solastalgia can be exacerbated by a sense of lack of control over unfolding changes in a person's normal environment.

Cumulative impacts and unknowns

The multiple stressors and fears people experience may lead to preoccupation with negative possibilities and lead to rising levels of distress. This can become a tipping point leading to angry acting out possibly against those seen as responsible. Alternatively when there are prolonged

uncertainties and frustrations people may become despairing and at risk of further health deterioration.

Worries about longer term health impacts of CSG would include concerns about irreversible kinds of damage to kidneys and other organs, and concerns about cancer. These worries and their impacts may be particularly acute for those concerned about the health impacts on their children and their fears that *they* have endangered their children through their actions, or lack thereof, e.g. by their choice of location to live, or their inability to leave due to financial or other circumstances. Again, a sense of helplessness or despair at not being able to take action to protect oneself, or alter the situation, can have damaging longer term mental and physical health consequences.

Assessment of health effects in Australia

As already noted there is limited research into the health effects of CSG, or detailed assessments of the symptoms reported by communities who believe they have been affected by CSG.

One of the more comprehensive assessments of health complaints was recently published by Queensland Department of Health (QDH).[65] This report detailed an assessment of a range of data sources; health data and environmental monitoring data collected from the Tara region. The aims of the assessment were to investigate health complaints among residents in the region, identify what is known about the impacts of CSG activities on environmental factors that may affect the health of this community (environmental health determinants), and assess the most likely relationship between the residents' health complaints and any documented impacts of CSG on environmental health determinants.

The main source of health complaint data was from a report compiled by the Darling Downs Public Health Unit (DDPHU) [65]. The most predominantly-reported symptoms were headaches, eye irritations, nosebleed, and skin rashes. QDH concluded that these symptoms might be attributable to transient exposure to airborne contaminants arising from CSG activity, but that there was no clear link to the local CSG industry. Noise and vibration complaints from CSG activities were found to be a source of annoyance, although levels did not exceed environmental limits. Such exposure can result in headaches. Annoyance has been found to be an issue in studies of the health impacts of wind turbines/wind farms (Knopper and Ollson, 2011) [66]. Research in this area may be useful to help inform this aspect of CSG activity, especially as annoyance was identified as not only being associated with noise levels, but also with subjective factors such as attitude to visual impact and sensitivity to noise.

A recent journal article by Hossain et al (2013) [67] has concluded that mining and CSG has had an impact on community mental health and wellbeing in rural communities in South West Queensland. Their data were based in 12 workshops and in this study the mental health effects were largely around financial stress (e.g. higher costs of living and housing availability) and service availability linked to the influx of non-resident workforces and inequity of financial benefits.

In general, the consideration given to potential health impacts is regarded as inadequate by many communities, and some health-related groups and agencies have also voiced their concerns. Doctors for the Environment Australia (DEA) has published a report "The Health Factor" which outlines their concerns about the lack of Health Impact Assessments, and the general lack of attention given to health issues in the rush for CSG approvals.[50] Earlier in the year NSW Ministry of Health called for a

"comprehensive assessment of potential risks to human health" in relation to CSG drilling in the Liverpool and Camden areas in Sydney, an assessment not requested by government at that point.[68]

Assessment of health effects internationally

This background paper does not allow for detailed consideration of the health impacts of CSG or other forms of unconventional gas production literature globally. Most evidence to date has been produced in the United States, although in terms of health-related peer-reviewed literature this is sparse. As already noted, there is no shortage of documented evidence of methane in drinking water and ground water, benzene in the air, and people reporting symptoms that appear to relate to those that would be caused by air or water contamination by hydrocarbons and other chemicals in the process of CSG or shale gas production.

In the US much of the peer-reviewed literature has focussed on fracking/fracking chemicals and impacts in the large region covered by the Marcellus Shale Formation. Witter et al reviewed the literature on the human health risks in 2008, in reference to gas operations being undertaken in Colorado.[69] Finkel and Law (2011) wrote in the American Journal of Public Health to advocate for the precautionary principle to apply in the case of fracking due to the potential for harm to health.[70] In 2012 Mitka, writing in the Journal of the American Medical Association, briefly reviewed the medical evidence to date and commenting on the lack of any rigorous studies[71]. In general it appears that there is a paucity of epidemiological studies in this area.

With regard to peer-reviewed literature, only one longitudinal study of health impacts and stressors was found.[72] This research team conducted interviews with residents living close to Marcellus shale developments at two time points, two years apart. Although their data are based on very small convenience samples (n=20 and 33), they found some evidence of perceived health impacts increasing over time, whilst stressors remained constant. This team's conclusions mirror comments made by many groups and experts in the health field, which are that not enough is known about longer term health impacts of unconventional gas production and epidemiological studies are needed to address this.

4. Potential strategies to help reduce community concerns and associated issues

From the wide-ranging set of community concerns presented to this point it is clear that the task of reducing these concerns and allaying fears associated with CSG is a challenging one and not one that will have any quick fixes.

The current climate for CSG in Australia

In the context of CSG, Australia is in a complex situation at this point in time. The energy companies are indicating that costs of mining here are escalating making their businesses less profitable, and that changes (or uncertainty) surrounding government regulation and policy, and mounting community opposition is giving rise to increasing concern about their futures here. In the period May-June 2013 a number of companies have pulled out of mining in NSW, e.g. Planet Gas, Dart Energy and Metgasco, some citing changes in state government regulation as the reason.

Comments from industry leaders and politicians in the media in recent times have indicated both a sense of surprise at the strength of feeling and the growing resistance to CSG development across NSW, and other states, and also a level of dismay at the Greens withdrawing their support for CSG.

Chris Hartcher, NSW Energy Minister has been quoted in the media recently, at the APPEA conference, expressing these sentiments. "When we all started this journey, gas here in Australia was viewed as a transition fuel. And I think what has happened, interestingly and I have to say incredibly disappointingly, the Greens are now opposing gas". NSW resources and energy minister Chris Hartcher said the level of intensity in the coal seam gas debate was unlike anything he had seen, and blamed the industry in part for failing to initially engage with communities and explain the process. "That vacuum has very quickly been filled by extremist Greens, fortified by a level of ignorance in the community".[73]

Meanwhile Santos Chief Executive David Knox has acknowledged that “the industry has been slow in addressing the concerns of rural communities about coal seam gas (CSG) developments”.[74]

In addition to the media drawing attention to small signs of resignation from industry and government in the CSG debate, there is the added complexity in Australia of an election year. There can be little doubt that the adversarial and politically-charged climate has done little to help the situation, with electorate-level campaigns based around anti-CSG stances being popular with communities, and parties in power wishing to be seen to be ‘listening’ to communities by being tougher with the large energy companies. The rising frustration and irritation in the business sector was evident in recent media quotes from APPEA’s Chief Executive, David Byers, who said that in an election year there was “a lot of people who are looking to win friends and raise votes by raising the hurdles that we face even higher”. “And here I’m not just talking about the Greens”. “In recent time we’ve seen government of both political persuasions at both federal and state levels prone to flip flopping on gas regulation”.[75] The reason that these prevailing conditions matter is that they provide the backdrop against which strategies to address community concerns must work.

Another important factor, not discussed (or required) in this document, is what is the case for CSG in Australia? Essentially, what are the benefits that exist that may counter the perceived costs that communities feel they are being asked to pay? These are the potential levers that could help to

offset some concerns. Are these points being raised effectively and are they open to scrutiny or verifiable?

Broad assessment of community concerns and possible strategies

As part of a preliminary and indicative only, scoping exercise, Table 1 summarises a top level set of community concerns and perceptions, distilled from the details in Section 1, and seeks to suggest some possible strategies that could be taken to address those concerns. This is also accompanied by a brief assessment of the likely costs or problems that might be associated with those strategies. As the authors of this background paper are not experts in business or strategy these suggestions are offered as talking points only, clearly expert review would be required here.

Top level community concerns (perceived needs)	**Community perceptions**	**Possible strategies**	**Potential costs of those strategies / problems**
Rate of CSG development (Improved governance and process)	Processes are rushed and risks are not adequately considered. Decisions are made that are unfair, unjust, subjective, inconsistent, motivated by divided interests.	Improve transparency of processes (in hand*). Increase level of independence/oversight. Independently audit or openly review past actions/decisions. Slow things down.	Time. Unlikely to solve existing issues (but good for future). Uncertainty for industry. More operators pulling out of projects. Less government revenue.
Health and Safety (Reduced risks and greater protections)	Harmful chemicals are used in fracking. Health risks of chemical and other impacts of CSG (water impacts) not known. Cumulative impacts are unknown. Existing health impacts not recognised or acknowledged as being linked to or caused by CSG. Perceptions of secrecy, lack of openness in monitoring and assessment (leads to suspicion)	Make chemicals used in fracking known/approve chemicals that can be used. Ban or limit fracking. Increase level of inspection and enforcement of requirements – provide open reporting. Gather better health data – before/after CSG activities, longitudinal epidemiological studies. More openness in reporting of issues arising and detailing of monitoring/checking being undertaken	Time. Possible commercial impacts. Perceptions by industry of greater government interference and/or costs. Costs of additional manpower to inspect. Financial costs for data collection/research.
Environmental impacts (Increased environmental protection)	Excessive use of water, water contamination – aquifers, groundwater, air contamination, pollution, detrimental impacts for agricultural land, impacts on wildlife and ecology, irreparable damage to landscape.	Provide greater protection for agricultural land. Increased research and investigation of water and air impacts and improved ecological impact assessments. Review of full 'costs' across lifespan of well/development – e.g. water use and rehabilitation. Greater emphasis on rehabilitation and planning	Increased costs. More bureaucracy. More data needed. Time.

		for future (e.g. produced water management)	
Landowner and community rights (Empowerment - legal rights and civil liberties)	Landowners have no rights to protect land. Communities can't say 'no' to CSG – or stay protected in the longer term. Government decisions are inconsistent and/or reactive and can be overturned.	Improve processes by which agreements are reached – more open approach including a third party. Greater independence and scrutiny of decision-making	Greater costs, legal involvement. Slower agreements – industry costs/frustration. More bureaucracy.
Financial loss and land values (Financial protection)	Inadequate, unfair, inconsistent compensation. Views of operators are short term – impacts on individuals are long-term.	More openness. Greater protection or guidelines for minimal requirements or assessments of value based on longer term impacts.	Industry regarding as interference/commercial sensitivity.

Table 1. Top level community concerns and potential strategies – preliminary review.

(Standing Council of Energy and Resources. (2013). The draft national harmonised regulatory framework: Coal Seam Gas[52]).*

In addressing many community concerns the strategies (and the potential problems) are very similar for most of the concerns. Fundamental requirements needed for public acceptance of CSG activities are linked to trust in the processes and decision-making; the requirements of fairness, justice, openness, and transparency. The 'costs' on the other hand, are typically time (delays), perceptions by industry of government interference, and potential costs – both financial costs in collecting data and employing people, but also commercial costs to industry. It does appear that the pace with which industry wishes to proceed with CSG developments is at odds with community needs for more information and protection.

Requirements for effective strategies to address community concerns

To be able to take effective action to address community concerns there are some essential components that are required; trust and fairness, engagement, and social license to operate.

Trust and fairness

As noted above, and discussed in detail in Section 1, in the CSG debate there are a number of issues associated with (dis)trust. Paul Slovic, an eminent researcher in the area of risk and well-known for his research in nuclear risk perception, coined the phrase 'asymmetry of trust'; being that trust is much easier to destroy that create. This appears to hold true, especially in the contexts of issues that are polarised and/or contentious, where prior attitudes and beliefs affect how people respond to information. There is a good body of academic literature in this area, e.g. Poortinga and Pigeon, 2004[76], and this includes consideration of issues involved in risk perception such as 'negativity bias', in which negative information tends to be given more attention and weight, and may appear more credible than positive information. This facet of human information processing tends to favour more negatively skewed views in the context of risk associated with CSG.

Trust is hard won, and improvements in trust are typically incremental and achieved over time. Trust also links to credibility.

Fairness, or perceived fairness has been found to be critically important to public engagement and support and acceptance of decision-making[77] provides a good overview of this literature). In general

terms good practices that include openness, honesty, transparency, fairness and justice in decision-making and process are likely to improve public acceptance of the outcomes – even if they are not decisions that are 'wanted'.

Community engagement

Effective communication with communities requires good community engagement, and community engagement is an essential part of the process of gaining social license to operate. Community engagement encompasses the processes and practices used when working together with a community to achieve a shared goal, and whilst being guided by a commitment to a common set of values, principles and criteria. Community engagement can be defined across a continuum of participation from the passive receipt of individually-targeted information, e.g. brochures, pamphlets, manuals, through to partnerships and self-empowered communities that initiate actions independent of external agents[78]. Community engagement requires ongoing commitment to work together to achieve goals. Greater participation and inclusion of communities in all stages of development and operation is likely to improve outcomes. Empowering communities to work with CSG operators will work to strengthen community resilience.

The challenges of effective community engagement can be many. The CSG industry could consider taking the same approach as the Australian Wind Industry and produce a collective set of guidelines for community engagement. The report "Community Engagement Guidelines for the Australian Wind Industry", released in May 2013 provides a comprehensive overview of approaches and practices in community engagement.[79] This document is also accompanied by "Wind Farms: A guide for communities"[80].

Social license to operate

Social license to operate (SLO) encompasses community engagement, but is a much broader consent. SLO is regarded as the general "level of acceptance or approval continually granted to an organisation's operations or project by the local community and other stakeholders."[81] SLO is, as it sounds, something that is intangible and dynamic. Like trust, SLO is built up over time and requires investment. It is dependent on how well the company meets social expectations of its behaviour and impacts. [82]

The shortcomings of the CSG industry with respect to SLO are fairly clear from the extensive concerns raised in this report. The need to work towards gaining a SLO is reflected in recent comments to the CSG industry by NSW Resources Minister, Chris Hartcher, who "...recently rebuked the gas industry for failing to engage with the community and allowing the objections to CSG to build to the point where the government had to act in February to impose 2km exclusion zones around residential areas."[83] The need for the CSG industry to have a SLO was also noted by a report from the Committee for Economic Development in Australia in September 2012.[84]

The concept of SLO is too broad to try to detail in this background paper, and the area has been comprehensively covered in general terms and specifically for the CSG industry in recent reports. The Gas Industry Social and Environmental Research Alliance (GISERA) has recently published a literature review "The social license to operate and coal seam gas development".[82] Although focussed on Queensland this report provides useful insights to inform NSW.

Other helpful research outputs have been produced by researchers in Canada on how to get and how to keep SLO,[85] and the Australian Centre for Corporate Social Responsibility (ACCSR) is also active in this area and has useful material on its website.[86]

5. Knowledge gaps and unknowns

From earlier sections of this report it is clear that from the perspective of communities there are many unknowns and, for some, a high level of uncertainty around CSG development and the potential impacts it could have on them. Many gaps have already been outlined, such as the need for more information about the chemicals used in hydraulic fracturing and the impacts of CSG activities on water resources and the environment.

As this paper was focussed on community concerns, one obvious gap in knowledge is the prevalence of these concerns in potentially-affected communities and the broader population. One limitation of using media sources is that articles are written 'to sell' not as data in their own right. Those who want to be heard can get coverage in the media, but that does not necessarily provide information about how representative their views are in the community. Therefore the *scale* of community concerns is not fully known.

Perhaps one of the most important knowledge gaps is in the area of risks to health and the potential health impacts of CSG activities. As noted, fear of health impacts for oneself and loved ones can be a source of prolonged concern for some individuals and communities. It is not clear if audits of health records or existing longitudinal/repeated cross-sectional population health research projects, such as the NSW Ministry of Health Population Health Survey Program or the SAX Institute's '45 and Up' study, could assist with providing geographically-linked health data in sufficient quantities to inform this area. However, a rigorous epidemiological study would be required to assess the impacts of CSG on community physical and mental health in the longer term.

6. Closing comments

This background paper on community concerns has reviewed a broad range of community concerns in relation to CSG activity. As outlined at the outset, the report does not question whether concerns are justified or reasonable, or the extent to which they are felt within and across communities. There are clearly a number of issues that need to be resolved with communities if CSG developments are to succeed in NSW. There is a need for greater transparency and consistency to build trust and to demonstrate fairness in process and practice. Operators need to review their approach to communities and engage with them in more meaningful ways if they wish to gain and maintain a social license to operate.

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