Lock the gate Alliance Submission

boudicca cerese to: csg.review 26/04/2013 05:35 PM

History: This message has been replied to and forwarded.

Dear Madam,

Please find attached the Lock the Gate Alliance submission to the review into coal seam gas activities in NSW.

Also attached are five documents with additional information compiled by some of our member groups for your consideration in relation to coal seam gas activities in NSW .

Kind regards,

Boudicca Cerese

Research Coordinator

Lock the Gate Alliance

The Truth Spills Out.pdf

NTN-Submission-to-air-pollution-inquiry-.pdf

Stop_CSG_Illawarra.pdf

Northern _Inland_Council_for_the_Environment.pdf

GAG KYOGLE SUBMISSION TO THE NSW LEGISLATIVE COUNCIL.pdf

LTGA_Submission to NSW Chief Scientist_April_2013.pdf

Submission No 552

INQUIRY INTO COAL SEAM GAS

Organisation: Stop Coal Seam Gas Illawarra

Date received: 8/09/2011

Submission to the General Purpose Standing Committee No. 5 Inquiry into Coal Seam Gas (CSG) Mining in NSW

Prepared by the Executive Committee of Stop Coal Seam Gas Illawarra

7 September 2011

Contact: Jess Moore

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1. EXECUTIVE SUMMARY

This submission is made by Stop Coal Seam Gas Illawarra (**SCSGI**) and addresses the Inquiry Terms of Reference 1a, 1b, 1c, 1f and 1g.

SCSGI is an incorporated, politically independent, community group of about 2,000 members, We organized the beach sign protest at Thirroul beach on May 29 2011, which attracted over 3,000 protesters.

SCSGI calls for urgent action and requests the General Purpose Standing Committee No. 5 Inquiry into Coal Seam Gas Mining in NSW, support the following goals:

- a Royal Commission into all aspects of coal seam gas mining
- a moratorium on coal seam gas mining pending the outcome of the Royal Commission
- a ban on fracking and similar coal bed 'stimulation' technologies and techniques.

While research remains limited there is mounting evidence that coal seam gas mining poses substantial risks. This submission details these risks within the context of the Terms of Reference for this enquiry and specific concerns for the Illawarra region. We call on the Inquiry to exercise the Precautionary Principle.

Contaminated water

CSG mining always involves contaminated water that poses unacceptable risks to water supply, the environment and human health. This is demonstrated by international research and documented adverse impacts, some of which is referenced in this submission.

- Water must be drawn out of the coal seam to access gas. This 'produced water' is highly saline and can contain toxic and radioactive compounds, and heavy metals.
- CSG mining will also be a major user of water. The CSG industry states that a single well takes approximately 3 million gallons or 13.5 million litres of water to fracture.
- Drilling and fracking and similar coal bed simulation techniques can involve a large number of toxic chemicals (over 750 identified) that are released into the environment through underground migration or through discharge during drilling or from storage dams or containers.

- Contaminated water is generally stored in ponds near wellheads.

Map image overlay of the 15 CSG exploration wells approved for PELS 442 & 444

Fifteen exploration wells have been approved in the Northern Illawarra and the 140-190 production wells that may follow are in highly sensitive areas. They are in and around critical water catchments for both Sydney and the Illawarra.

- Seven of the 15 approvals are in Sydney Catchment Authority Special Areas, which have restrictions on land use and access to protect our water supply.

Map overlay showing locations of the exploration wells in relation to SCA water catchment 'Special Areas'

- The approved wells are adjacent to upland swamps that feed and clean the adjacent water catchments, including the Georges and Hacking river systems, and contain endangered ecological communities.

- The approved wells are in Hawkesbury Sandstone. This has an extensive aquifer system that is considered highly valuable, due to its high quality potable water. It soaks up rainfall and discharges water into the creeks and underground fissures that drain the escarpment. It feeds upland swamps and the groundwater sustains rainforest along the escarpment.

- The coal seams of the Illawarra are much shallower than those in the Queensland Surat Basin. Thus there is much more potential for contamination of water that people, plants and animals are exposed to.

Fracking and other 'stimulation' methods

Hydraulic fracturing or 'fracking' is a stimulation process used in CSG mining. It involves the high-pressure injection of large volumes of water, sand and undisclosed chemicals into the ground to fracture coal. Fracking expands fissures in the coal seams, which allows gas to flow much faster and from a wider area. Originally used to tap deep earth oil and gas formations, the use of fracking has been expanded to coal seams, which sit much closer to the surface. This brings contaminated water and geological disruption close to water catchments and aquifers, and the above ground natural and built environment. As a result it poses unacceptable risks.

- The experience of CSG mining in the USA is that the commercial viability of CSG mining is dependent on extensive use of stimulation, such as hydraulic fracturing, and horizontal drilling that extends the reach of stimulation.

- The Northern Illawarra has already been extensively mined for coal. Stimulation in an environment of geological instability, cavities and subsidence, would greatly increase the risk of fugitive methane emissions, the distribution of contaminated water, and seismic activity.

Leaking methane

Not all of the previously trapped methane is captured during the CSG extraction process. Substantial fugitive methane escapes into the atmosphere: pipelines, well heads and processing plants leak; methane is carried to the surface in water drawn out of the coal seam; and any un-captured gas that is released will migrate through underground systems to the surface.

- Unlike oil or traditional gas wells, where extraction rates from reservoirs generally exceed 98%, extractions rates for with CSG ('unconventional gas') mining are as low as 65% . This means that up to 35% of the methane mined will find its way back to the surface in the form of fugitive emissions.

- Both fugitive methane and methane storage pose explosion and fire risks. The content of methane in produced water can be so high that the water becomes flammable. The Northern Illawarra is already prone to severe bush fires.
- Methane is a potent greenhouse gas, forcing warming at 105 times the rate of carbon dioxide over a 20 year period. Reports suggest that the global warming potential of unconventional gas is as bad or far worse than coal, over its lifecycle.

Above ground industrialisation

Production fields usually require a well head every 400-900 metres, all connected by pipelines and roads to get wastewater and gas out. As a result of this the above ground footprint of CSG mining is enormous.

- CSG exploration and mining will require extensive land clearing for the construction of infrastructure. This includes roads capable of handling heavy vehicles and equipment, pipes, wells, storage tanks and containment ponds.
- In the Illawarra this is on land that, until 2009, had a high conservation zoning.

Approval process

Insufficient consultation and research has preceded approvals around the world. Very little independent research has been conducted on the risks associated with CSG mining, particularly its cumulative impacts.

- In the Northern Illawarra approvals were granted before the vast majority of residents knew what CSG mining was or that there was a proposal to mine locally.
- These were granted under Part 3A of the Environmental Planning and Assessment Act, under which the Minister for Planning deemed the site of 'state significance' and bypassed environmental and local planning controls.

The Northern Illawarra and Woronora Plateau were zoned ‘high conservation’ until 2009. The Department of Primary Industries pressured state government appointed Wollongong City Council Administrators to downgrade the zoning. Against the advice of Wollongong City Council (WCC), the then Department of Environment and Climate Change (DECC) and Sydney Catchment Authority (SCA), the Administrators complied. **The state breached its obligations to protect drinking water supplies.**

PHOTO: **Image of the potential environmental impact of production wells on PELs 442 & 444.**

1. INTRODUCTION

This submission is made by the Executive Committee of Stop Coal Seam Gas Illawarra (SCSGI), an incorporated, non aligned community group.

While SCSGI believes that the substantial risks posed by, Coal Seam Gas Mining are relevant throughout NSW, this submission focuses on the particular circumstances and risks in the Northern Illawarra and adjacent region.

The Northern Illawarra commences approximately 50 km south of Sydney, stretching from the Royal National Park in the north to the Cataract Dam in the south http://g.co/maps/z8k5. It encompasses the Garrawarra State Recreational Area, the Woronora Dam water catchment, the Dharawal State conservation area, **two drinking water catchments**, the upland swamps of the upper escarpment and the Illawarra Escarpment State Conservation Area, together with their associated coastal beaches. It is an area of vital importance to Sydney's drinking water security, as well as a bio diverse region with outstanding areas of special interest and natural beauty **- David Attenborough refers to it as New South Wales' Kakadu**. With over 1,000,000 visitors per year it is an important tourist destination.

1.1. GOALS OF SCSGI

SCSGI's goals are aligned to a growing body of evidence from around the world indicating that **unconventional methane gas mining** (such as CSG and shale gas) **poses a significant threat** to the environment, drinking water sources, food supply and public health. For example a report by the Tyndall Centre For Climate Change calling for a moratorium on shale gas mining in the UK states that:

> *'The dismissal of any risk as insignificant is even harder to justify given the documented examples that have occurred in the US, seemingly due to poor construction and/or operator error. These examples have seen high levels of pollutants, such as benzene, iron and manganese, in groundwater, and a number of explosions resulting from accumulation of gas in groundwater '*[1].

Similar evidence is emerging in Australia, with confirmed incidents of CSG well blow outs, leakage and contamination in NSW[2] and Queensland[3]. During a recent public meeting in Sydney on CSG mining the Australian Petroleum Production and Exploration Association's (APPEA) official spokesman, Ross Dunn[4] was quoted as saying, *'drilling will to varying degrees impact on adjoining aquifers*'.

Consequently, SCSGI believes that the NSW State Government should **adopt The Precautionary Principle regarding CSG mining in Aus**tralia by:

- **establishing a Royal Commission** into all aspects of coal seam gas mining, with recommendations supported by independent research based on the particular conditions applying in the Australian regions where CSG mining is proposed
- **introducing a moratorium on all Coal Seam Gas Mining** pending the outcome of the Royal Commission
- **banning fracking and similar coal bed gas 'stimulation' technologies and techniques** used in CSG exploration and production operations. The evidence of risk with this practice is so compelling that no other action is deemed appropriate.

SCSGI also asserts that the invasive techniques used in exploration are those used in production extraction and therefore **any restrictions placed on CSG mining should include both production and exploration activities**.

The above goals form the basis of the STOP CSG petition, which can be viewed at http://stop-csg-illawarra.org/Stop_CSG_petition.pdf. Over 6,500 signatures have already been added to this petition and SCSGI shortly expects to present Premier O'Farrell with at least 10,000 signatures. More information about SCSGI can be found on its website http://stop-csg-illawarra.org/.

1.2. ABOUT THIS SUBMISSION

This submission is based on wide ranging research and where available, extracts from (or web linkages

to) independent research papers, government reports, media articles and/or general commentary are included. However, **SCSCI wishes to bring to the attention of the Standing Committee, the absence of independent scientific research on the environmental impact of CSG mining in Australia.** Consequently, much reliance is placed on overseas research, including research from world renowned universities such as Cornell, Duke and Manchester. It is a similar situation with documented CSG mining safety incidents, water and air contamination, hazard alerts and seismic events. 'Unconventional' methane gas has been mined in the USA on a large scale for a decade and as a result the environmental impacts are more apparent.

However, there is direct evidence that **adverse impacts to the environment and public health, similar to those experienced in the USA and elsewhere, are beginning to materialise in Australia**:

- O**n June 23 2011** there was **a blow out at an** Arrow Energy **CSG well head near Dalby in Queensland[5]. ** Methane and water spewed up to 90 metres in the air for two days before being capped. This is one of several incidents with Arrow, which has since been fined by the Queensland Government.

- **On 17 May 2011 a blow out occurred at AGL's CSG well head at** Camden North **in NSW** during routine maintenance. This incident released plumes of contaminated water and foam into the atmosphere in the vicinity of housing and a water catchment feeder stream. AGL, which failed to report the incident for two days until the leakage was shown in TV, has been formally warned by the NSW government[6].

Despite these incidents CSG exploration drilling and production gas mining activities continue unabated throughout NSW, including in and around the Northern Illawarra water catchment and Royal National Park, Camden Valley (which also abuts the same catchment), the inner west of Sydney (within 3kms of the CBD), the Hunter Valley area (where new drilling works commenced on Sunday August 14 2011), the Northern Rivers region and a number of areas in rural NSW.

1.3. Recommendation to the Standing Committee

SCSGI calls for urgent action and recommends the General Purpose Standing Committee Inquiry into Coal Seam Gas Mining in NSW, support its three principal goals as stated in 1.1 above.

2. Coal seam gas mining in the Northern Illawarra

While the potential risks posed by Coal Seam Gas mining are applicable to any area of Australia, this submission examines these major risks in the context of the particular circumstances of the Northern Illawarra - the community that SCSGI seeks to represent.

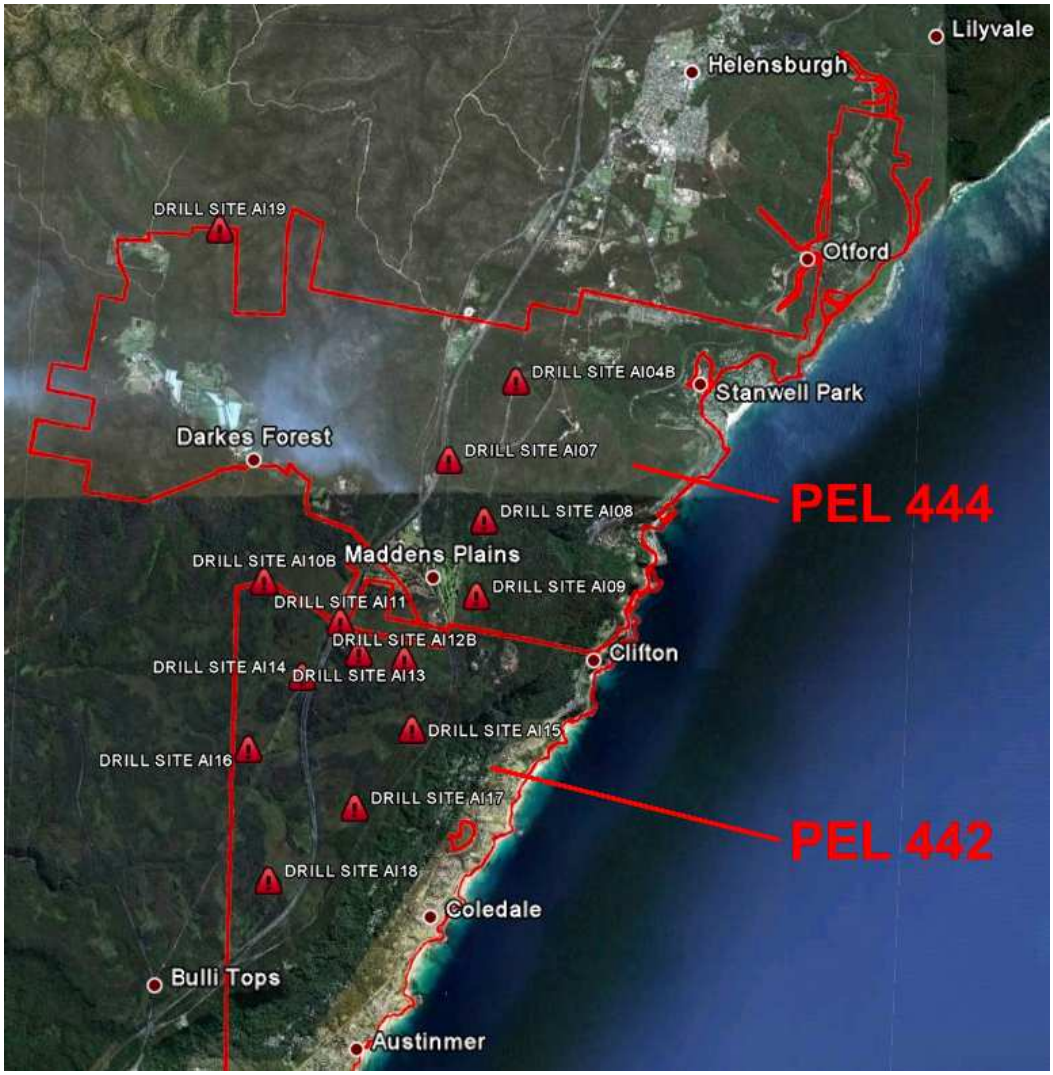
2.1. Areas covered by the PELs

Coal Seam Gas Mining is administered under the Petroleum Exploration Act of 1991, which was originally intended to regulate deep earth/water exploration (below 3,000 metres) of oil and natural gas reserves, rather than CSG. CSG is found at much shallower depths – in the Illawarra as close to the surface as 250 – 300metres. CSG mining drilling areas are defined in NSW Petroleum Exploration Licenses or PELs.

Two CSG PELs cover the Northern Illawarra (PEL442 and PEL444), both owned by APEX Energy NL. Fifteen (15) CSG exploration wells have been approved for development under these PEL numbers[7], although further wells are being discussed and applied for in the region. Please note that these approvals are for exploration wells only and according to APEX Energy management, **production CSG extraction would involve 140-190 wells over the same area**.

The areas covered by PELs 442 and 444 are illustrated in Figure 1 below, along with the approximate location of the 15 approved exploration sites. This information has been extrapolated from information provided by APEX Energy in its applications

FIGURE 1 : MAP IMAGE OVERLAYS OF AREAS COVERED BY PELS 442 & 444



Note: FIGURE 1 MUST BE PRINTED IN COLOUR IN ORDER TO BE LEGIBLE

2.2. APPROVED PELS IN AND ADJACENT TO THE SYDNEY WATER CATCHMENT

PELs 442 and 444 are in and adjacent to, the Woronora and Upper Nepean water catchments administered by the Sydney Water Catchment Authority (SCA).

Figure 2 shows the 15 sites for CSG exploration drilling sites currently approved under PELs 442 and 444, in relation to the Sydney Water Catchment Special Areas.

FIGURE 2 PROPOSED EXPLORATION WELLS IN RELATION TO WORONORA AND UPPER NEPEAN SPECIAL AREAS

Note 1: this map does not depict the full extent of the catchment, which is considerably larger

Note 2: the map depicts 15 exploration wells only. Production could involve up to 190 wells across PELS 442 & 444.

The Sydney Water Catchment Special Areas protect our water supply by acting as a buffer zone to help stop nutrients and other substances that could affect the quality of water entering the storages[8].

Under the Sydney Water Catchment Management Act 1998 **there** are two water quality protection zones:

- **Schedule One** (land close to the water storages)
- **Schedule Two** (second tier buffer zone, adjoining Schedule One).

These zones are known as SCA Special Areas[9] and they are heavily restricted to protect water quality, with strict controls on land use, development and access. For example**, fines of up to $11,000 can be imposed for simply** walking in the Special Areas[10].

Figure 2 shows that **all 15 of the approved CSG exploration wells are in, or abut, SCA Special Areas**.

2.3. Significance of the areas proposed for CSG Mining in the Illawarra

2.3.1. Overview

The area within and around PELs 442 and 444 and the 15 approved CSG exploration sites are in a highly sensitive and biodiverse region of special environmental significance. It is of vital importance to Sydney's drinking water security, as well as a major recreational zone. This is reflected in the fact that:

- it spans **two vital NSW drinking water catchments** (Woronora and Nepean) and their associated Special Areas
- it includes **a number of State Conservation Areas**, State Reserve Listings and National Parks. These include the Garrawarra State Recreational Area, the Dharawal State Conservation Area, Dharawal Nature Reserve, the unique upland swamps of the upper escarpment and the Illawarra Escarpment State Conservation Area and associated coast lands
- the Illawarra Escarpment is the **most extensive area of rainforest** in the Sydney Basin Bioregion[11], supporting many vegetation communities that are only found in the Illawarra[12]

- **The NSW Government has committed to legislate** to establish the Dharawal National Park[13] which will contain some 26 swamps, with **over 200 km of watercourses that are little disturbed and collect water of very high quality**. The Plan of Management for the Dharawal Nature Reserve and Dharawal State Conservation Area states that:

  > *'…the volume and quality of the water discharged from the reserves is significant to the health of the Georges River…tributaries, are classified as Class P (Protected Waters), and…Class S (Specially Protected Waters), under the Protection of the Environment Operations Act 1997 and Regulation.* ***No effluent may be discharged into Class S waters and discharges of effluent into Class P waters are limited to those with a quality similar to that required as a raw source of potable water.'*** [Emphasis added] ***14***
  >
  > '*These swamps are considered exceptional because equally high levels of richness have not been encountered in similar communities elsewhere*.' [15]

Commercial CSG mining puts the protection of these water sources at considerable risk.

In addition, the upland swamps contain particularly flammable vegetation and are a high risk location for fire ignition[16]. Fire risks increase as a result of CSG exploration and mining activities (see section 4.6), and this is a particular concern in water catchments.

In June 2011, the NSW Scientific Committee recommended that the region's coastal upland swamps be listed as an endangered ecological community. The preliminary findings of the report recognise the threat posed by coal seam gas mining[17].

The cultural and environmental significance of the area and its significance as a water catchment were also recognised by the Member for Heathcote, Lee Evans, in his inaugural speech to the NSW Parliament:

'I was proud to walk Dharawal State Reserve with Barry O'Farrell when we made the commitment to make it a national park. This will preserve the headwaters of the Georges River and priceless Aboriginal rock carvings. It is the water catchment area for the Woronora Dam. ***This area, with its natural swamplands, filters our drinking water. The whole area needs careful management****. I look forward to again joining Barry O'Farrell at the commitment ceremony.* ***Many of my constituents have great concerns with methane gas exploration in our electorate. The water source for the Illawarra and Sutherland shire must be protected****. I will represent the many concerns of my constituents and make their voices heard. My focus as the member for Heathcote is to encourage economic growth and environmental sustainability. These tasks are not taken lightly.'* [18]

The figure below illustrates the great beauty of the Northern Illawarra region, and the location of the 15 approved exploration wells.

FIGURE 3 MAP IMAGE OVERLAY OF NORTHERN ILLAWARRA ESCARPMENT SHOWING LOCATION OF THE 15 EXPLORATION WELLS

2.3.2. SYDNEY WATER CATCHMENT

More than four million (4,000.000) people - about 60 per cent of the NSW population rely on the catchments of the Warragamba, **Upper Nepean**, Blue Mountains, **Shoalhaven, and Woronora river** systems to supply their drinking water.

These catchments are the source of the raw bulk water stored in SCA dams**.** Keeping the catchments healthy, and improving our understanding of how we impact on them, is essential to protecting water

quality in these areas.[19]

At present, **the water catchment areas are largely pristine, as a result of the extremely strict controls that have protected these important water source and habitat areas**. The controls have been so strict that **even bush walking is prohibited in the Catchment, with a fine of up to $11,000 for any breach.**

Prior to the changes in Zoning by the Wollongong City Council in 2009, which occurred at the request of the NSW Department of Primary Industries (DPI) to enable the approval of all 15 exploration wells in PELs 442 and 444, the **Sydney Catchment Authority (SCA) would only allow** access to Special and Controlled Areas **if the activity met all of the following requirements**:

- it cannot be carried out elsewhere
- it will provide some benefit to the SCA management of the Special Areas
- it will not adversely affect the SCA's interests
- it will not be a security threat to the SCA's infrastructure, water supply or Special Areas.[20]

The NSW Government needs to explain **why planning zones were amended to allow CSG mining on PELs 442 and 444, when it meets none of the above requirements.**

It is the view of SCSGI that by influencing WCC to change zoning restrictions to allow CSG mining activities to commence on PELS 422 and 444, **the Government exerted inappropriate and undue pressure on the WCC's planning department, whilst it was under its administration, and in doing so may have breached its obligation to** protect drinking water supplies**.**

SCSGI is concerned that under the Onshore Petroleum Licensing Act 1991, the legislation under which PELs are authorised, **SCA does not have the same 'owners rights' in opposing CSG mining as it does with (say) conventional coal mining**.

PHOTO: Looking South West across SCA Special Area, from the 10A fire Trail, Dharawal Nature Reserve

2.3.3. State Environmental Planning Policy and Water Catchments

The Drinking Water Catchments Regional Environmental Plan No 1 was replaced by The State Environment Planning Policy (Sydney Drinking Water Catchment 2011 (The SEPP) commencing 1 March 2011. The SEPP aims to:

- provide for healthy water catchments that will deliver high quality water while permitting development that is compatible with that goal
- provide that a consent authority must not grant consent to a proposed development unless it is satisfied that the proposed development will have a neutral or beneficial effect on water quality
- support the maintenance or achievement of the water quality objectives for the Sydney drinking water catchment.

The SEPP **requires all proposed development in the Sydney drinking water catchment to have a neutral or beneficial effect on water quality** and the SCA is currently working in partnership with

councils in the catchment area to help them fulfil their responsibilities under The SEPP.

The SEPP also requires that all land development and other activities in the Sydney drinking water catchment incorporate the SCA's current recommended practices and standards. These are best practice guidelines to protect water quality and cover many key areas of planning and development.

SCSGI contends that CSG mining in PELs 442 & 444 does not meet the requirements of either the current or former policies, both clearly designed to protect drinking water catchments into the future.

3. CSG MINING – A DESCRIPTION

3.1. THE BASIC PROCESS

Coal seam gas is accessed by drilling vertically into strata until a coal seam is reached, at which point horizontal drilling is likely to occur in order to extend the reach of the well. Horizontal drilling may reach 1.5 -2 kilometres from the base of the well. Drilling involves the injection of a number of chemicals to optimise drilling efficiency. The bore of the well is lined with concrete to prevent leakage of gas and contaminated water into the subsurface. Methane, which is physically trapped in the coal structure with water under pressure, is released by reducing the pressure in the seam. This is initially done by pumping out water but **almost always some form of additional 'stimulation' is need needed to extract the methane on a commercial basis. Hydraulic fracturing ('fracking) is one common type of stimulation technique**.

Figure 3 below is a simplistic representation of a vertical well. In many cases horizontal **bore holes will radiate from the initial bore hole for several hundred metres and potentially several kilometres. In** the Northern Illawarra this means wells could reach far into the water catchments and under the escarpment and beachside communities. Figure 3 does not indicate how thin and fragile the drill line is in relation to its length. Most importantly, it does not show the many fissures and fractures in the surrounding rock, into which concrete can be lost when the casing is being cemented. **These gaps and fractures can make it extremely difficult and in some cases almost impossible to completely seal the**

casing, leading to the types of contamination and gas migration events that are detailed later in this submission.

FIGURE 4 ILLUSTRATION OF A CSG EXTRACTION WELL[21]

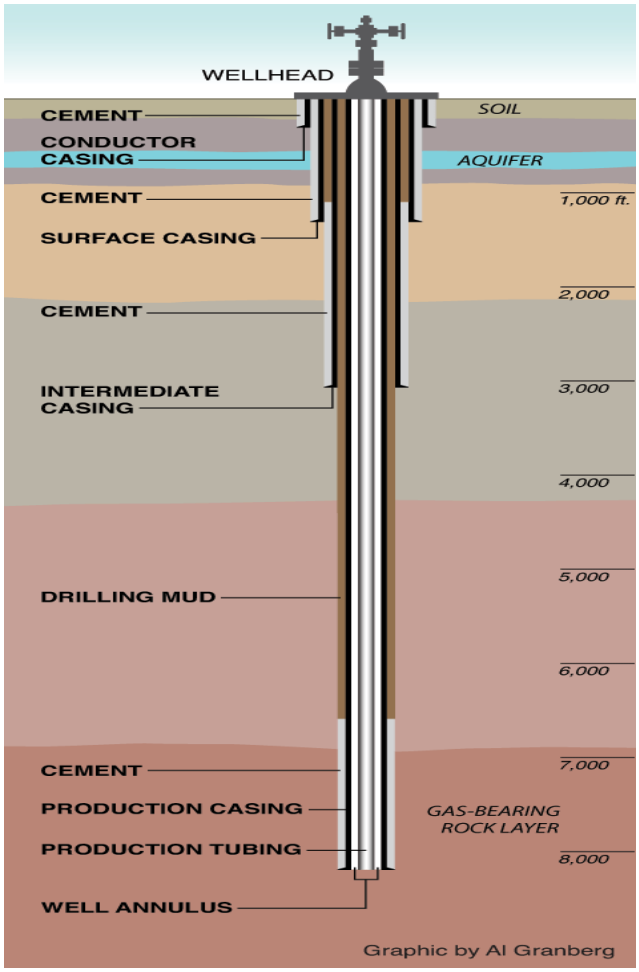


PHOTO: the impact of CSG well heads on the landscape

There are risks associated with CSG drilling operations that need to be considered:

- The drilling rigs are large and heavy, transported to the well head on large trucks of more than 30 tonnes displacement. Roads must be developed for this purpose and platforms laid down to support the rigs. Large ponds for holding contaminated water brought to the surface, chemical tanks, gas pipes and storage tanks make up the rest of the necessary infrastructure, which **disturbs at least 1 hectare of land per well**.

- **CSG drilling operations involve a large number of toxic chemicals**, including diesel to drive the equipment, and there is a high risk of spillage and soil contamination.

- Drilling operations disturb and connect the disparate geologic strata, either temporarily or permanently. This disturbance, in combination with high water and gas pressures, can and does result in **migration of contaminated water and gas either underground, or in the case of methane, to the surface.** This migration is certain but not predictable: depending on geological structure it can take a short time, or even decades (long after the well has been shut down).

- The concrete and steel well liners are subject to high stress, and may fracture or corrode, **resulting in the leakage of methane and contaminated water.**

- If the coal bed has low permeability, the well will be 'fracked' to release the methane (see Section 3.2). **Drilling the strata, fracking the coal seam and pumping out the water liberates gases and hydrocarbons**, not only for the commercial life of the well but for many years to come.

3.2. HYDRAULIC FRACTURING

Hydraulic fracturing or 'fracking' uses high-pressure pumps to inject **large volumes of water, sand and undisclosed toxic chemicals into the ground** at very high pressures of up to 5000psi **to fracture coals**

seams and release the trapped **gas. Fracking expands fissures (cleats) in the seams allowing gas to flow much faster and from a wide**r area. **CSG wells are likely to be fracked multiple times throughout their life**.

Originally used to tap deep earth oil and gas formations, the use of fracking has been expanded to geologic formations, such as coal seams which reside geologically much closer to the surface, water catchments and aquifers.

FIGURE 5 ILLUSTRATION OF HYDRAULIC FRACKING[22]

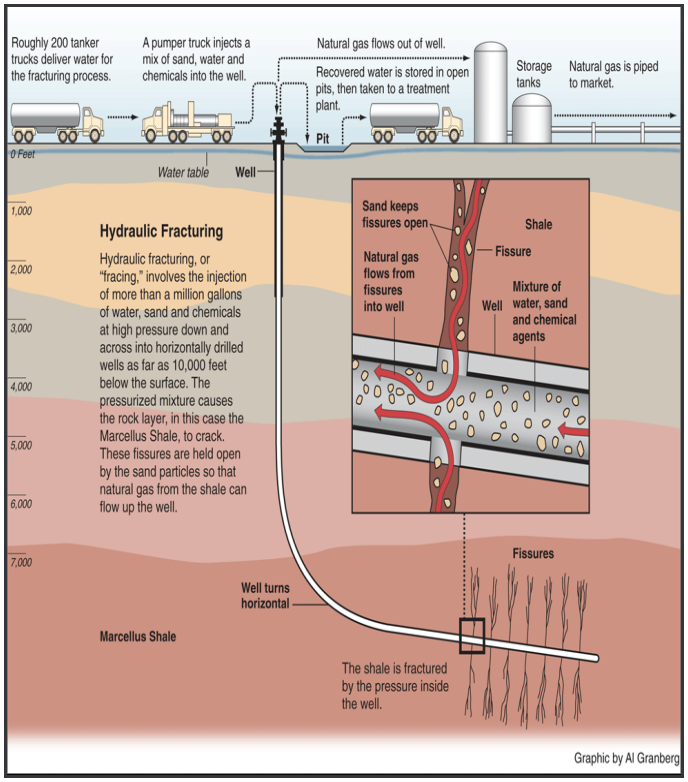


PHOTO: Closed system hydraulic fracturing of a vertical well PA (*Source: ALL Consulting, September 2008)*

The experience of CSG mining in the *USA is that* ***the commercial viability*** **of CSG mining is dependent on extensive use of stimulation, such as hydraulic fracturing, and horizontal drilling** that extends the reach of stimulation.

A February 2011 National Toxics Network briefing paper **said fracking will be used in up to 80% of Australian gas wells** in the next ten years[23]. **The public assurances of APEX Energy not to frack throughout the life of these wells are therefore not credible**, especially given their refusal to enter into a binding agreement with the community through SCSGI.

The coal seams of the Illawarra are much shallower than those in the Queensland Surat Basin, with minimal separation between upper and lower level coal seams being tapped for CSG, therefore there is **much more potential for contamination of water and land**.

The Northern Illawarra has already been extensively mined for coal and is suffering significant subsidence as a result of long wall mining[24]. **Stimulation, in an environment of geological instability, cavities and subsidence, would greatly increase the risk of fugitive methane emissions, the distribution of contaminated water and** seismic activity similar to that experienced in the UK[25].

A 2011 submission to the US Congress identified **over 750 different chemicals and compounds that are known to have been used in fracking.** Most are not disclosed by operators and none of have yet undergone CSG hazard testing and clearance. The following is a partial list of the different types of additives that are used in fracturing operations, as indicated by the New York State Department of Environmental Conservation.

TABLE 1 CHEMICALS USED IN FRACKING

Classes of Additives	Purpose	Examples
Acid	Facilitates entry into rock formations	hydrochloric acid
Biocides	Kill bacteria and reduce risk of fouling	glutaraldehyde, 2,2 Dibromo-3-nitrilopropionamide

Breaker	Facilitate proppant entry	peroxodisulfates
Clay stabilizer	Clay stabilization	salts, ie tetramethylammonium chloride
Corrosion inhibitor	Well maintenance	methanol
Crosslinker	Facilitate proppant entry	potassium hydroxide
Friction reducers	Improve surface pressure	sodium acrylate, polyacrylamide
Gelling agents	Proppant placement	guar gum
Iron control	Well maintenance	citric acid, thioglycolic acid
Scale inhibitor	Prevention of precipitation	ammonium chloride, ethylene glycol, polyaccrylate
Surfactant	Reduction in fluid tension	methanol, isopropanol

There is currently no requirement for CSG companies in Australia to disclose the constituents in their fracking fluids and only 20 of the 750 are listed by APPEA as known to be used in Australia[26]. **Given their proximity to drinking water catchments, fracking fluids are unsuited for use in PELs 442 and 444.**

4. Risks posed by CSG mining

4.1. Introduction

SCSGI contends that the findings and recommendations of this Inquiry should be based on the best independent scientific research, conducted in Australia. To do otherwise, would be to put at risk our water, our health and our environment.

Unfortunately, there is **an alarming absence of independent scientific research on the environmental impacts of CSG mining in Australia**. Consequently, a fair amount of the information cited in this submission is based on research, government reports and other evidential materials sourced from overseas, where unconventional gas mining has occurred for a decade or more and where adverse

environmental impacts are more apparent. Some proponents of CSG mining in Australia claim that much of the US and European research on shale gas mining is irrelevant to Australia. This claim only holds if there is Australian research that demonstrates the irrelevance of the US research, which requires a comprehensive independent scientific assessment of the inherent risks within an Australian context.

4.2. THE THREAT TO OUR WATER

A common conclusion of independent research is that unconventional mining poses a potential threat to water supplies. For example, researchers at Duke University's Nicholas School of the Environment argued that *'systematic and independent data on groundwater quality, including dissolved-gas concentrations and isotopic compositions, should be collected before drilling operations begin in a region..'* [27]

This view is almost identical to the conclusions drawn in similar research at Cornell and Manchester Universities. The reason for this is that CSG always produces water contaminated by:

- entrained methane and chemicals brought to the surface in the production process
- fracking fluids injected but not retrieved
- chemicals/toxins released naturally from the coal seam with the water.

The acting chief executive of the National Water Commission, James Cameron, noted recently that while the CSG industry has potential to deliver significant economic benefits 'there are also **significant potential risks to water and our water management as a result of the scale of the development of the sector'**.[28]

In a recent public meeting in Sydney, a spokesman for the Australian Petroleum Production and Exploration Association (APPEA) was quoted as saying '**drilling will to varying degrees impact upon adjoining aquifers'**[29]**.**

The National Water Commission estimated in a recent position paper entitled 'The Coal Seam Gas and Water Challenge', that the Australian CSG industry will extract around 7,500 gigalitres (GL) of co-

produced water from ground water systems over the next 25 years, equivalent to around 300 GL per year. They also note that the **potential impacts of CSG development on water systems**, particularly the cumulative effects of multiple projects, **are not well understood**. [30]

Given Australia's limited water resources and propensity to drought, any activity that threatens our water security must be considered against the Precautionary Principle. Yet in the vital water catchment areas of the Northern Illawarra 15 exploration wells have been with an anticipated 140-190 production wells required for production. These are in and around critical water catchments serving both Sydney and the Illawarra. **Seven of the 15 drilling sites are on land so protected that public access is prohibited**, with fines of up to $11,000 applied for breaches of these restrictions. In addition to this:

- They are in or adjacent to Sydney Catchment Authority Special Areas that supply more than four million affecting two the major catchments of Woronora Cataract, which have restrictions on land use and access to protect drinking water supply.
- They are adjacent to upland swamps that feed and clean the water catchments and St George and Hacking river systems. These have been recommended by the NSW Scientific Committee for listing as an endangered ecological community.
- The coal seams of the Illawarra are much shallower than those in the Queensland Surat Basin, with **minimal separation between the upper coal seams being mined and the surface and between these upper and lower level coal seams, also being tapped for CSG.** The area also has underground fissures that naturally drain towards the local coastline and community. As a consequence there is much more potential for cross over contamination
- Water must be drawn out of the coal seam to access gas. This 'produced water' is highly saline and can contain toxic and radioactive compounds and heavy metals[31], as highlighted in the recent report by Doctors For The Environment Australia (DEA).
- Drilling, fracking and similar coal bed simulation techniques can involve a large number of toxic chemicals. These can find their way into the environment through underground migration or discharge during operations (contaminated water recovered from underground is generally stored in open surface evaporation ponds near the wellheads, or shipped offsite for treatment and disposal).
- The Illawarra escarpment provides a ready exit point for ground water along its base and below the shore line. Around 75,000 people live along the base of the scarp.

4.2.1. DRILLING AND FRACKING FLUIDS

Many of the chemicals used in fracking are known to be toxic to humans and there are numerous documented cases of the health consequences to families who live in close proximity to CGS wells.

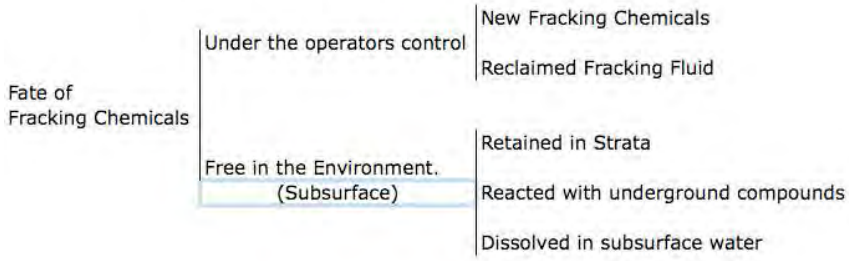
In February 2011 a briefing paper on fracking by National Toxics Network called for **a moratorium on the use of fracking fluids until health risk are better understood[32].**

The United States EPA has also raised concerns about the potential public health risks posed by diesel fuel used in hydraulic fracturing fluids. In a 2004 report, EPA stated that the 'use of diesel fuel in fracturing fluids poses the greatest threat' to underground sources of drinking water. Diesel fuel contains toxic constituents, including benzene, toluene, ethylbenzene, and xylenes (collectively known as 'BTEX' compounds). **BTEX compounds are also found naturally in coal seams and may be released by CSG drilling and fracking**.

The US Government it has found it virtually impossible to identify the exact combination of chemicals used by CSG companies, as they are listed as 'proprietary' or 'trade secret'. The Committees of Congress have been unable to penetrate this secrecy, with requests to gas mining companies to disclose the contents of their fracking fluids met with the response that *'they did not have access to proprietary information about products they purchased "off the shelf" from chemical suppliers. The proprietary information belongs to the suppliers, not the users of the chemicals'* [33]. In effect, these companies are saying '**we don't know what we are using and we, therefore, don't care whether there are adverse consequences to water, air or public health.'**

When fracking fluids are injected into the wells under high pressure, the chemicals interact with other compounds found naturally underground – including BTEX chemicals. Most of them are retained underground in the gelling compounds. After the fracking operation the fluids are pumped from the well under considerably less pressure. According to research from Duke University, **recovery of the fracking fluids varies between 15 - 80% depending on conditions in the well[34]**.

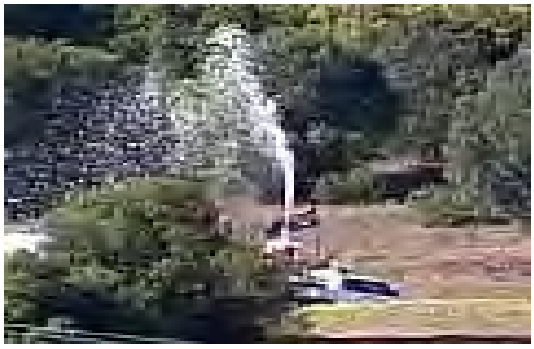
FIGURE 6 THE FATE OF FRACKING CHEMICALS



Given the toxic nature of fracking fluids and the close proximity to vital water catchments, allowing their use within PELs 442 and 444 would be an act of negligence and irresponsibility.

4.2.2. WATER AND LAND CONTAMINATION

PHOTO: Blowout at an AGL CSG wellhead at north Camden NSW in June 2011



CSG mining always involves contaminated water, even if fracking does not occur. This is because that in order to extract gas, pressure within the seam must be reduced by pumping water from cleats in the coal seams, allowing the methane to be desorbed from the coal pores. **This dewatering results in a significant drawdown of water levels in overlying and underlying aquifers in the region during CSG production**. According to a study by the Sustainable Metals Institute[35] the *'spatial extent of the drawdown is expected to extend beyond the boundary of the gas field production area and recovery of the groundwater systems is expected to extend significantly beyond cessation of CSG operations'*.

The integrity of impermeable strata is compromised by local defects such as fault lines and local stress cracking, which are then further stressed by extraction and stimulation activities. This **creates many channels through which fugitive fluids and gases can flow.** The well casings, which are located at

frequent intervals during the production phase, also provide a clear pathway for exchange of gas and water between the rock layers and the surface. Whilst CSG engineers go to some lengths to avoid this, the configuration of the structure make it difficult to ensure integrity, or even detect a problem. **This risk is far greater in the Northern Illawarra given the geology of the region and damage caused by extensive coal mining**.

The large amount of 'produced water' that is drawn out of the coal seam during the drilling process is usually highly saline and contains various other pollutants. The process of drilling often involves the use of Potassium chloride (KCl) and the Environmental Assessment for the Illawarra CSG exploration drilling indicates that **the salinity of the water produced will severely impact the surrounding water if a release occurs**[36].

The produced water can contain toxic and radioactive compounds, endocrine disruptors, heavy metals and BTEX compounds, all of which are found naturally in coal seams. Therefore any produced water requires long term containment (open evaporation ponds commonly used for this purpose- see below) or purification – which requires trucking large volume of contaminated produced water offsite to desalination or other specialist treatment facilities. These are both areas of potential spillage. According to AGL's 2010 Annual Report, such an incident occurred at the Gloucester Gas project in NSW in 2009:

> *'A reportable incident occurred on 29 June 2009 after an accidental overflow of drilling water from a tank. Approximately 5,000 litres of drilling liquid overflowed and some left the AGL site and flowed onto adjacent paddocks. Due to the off-site impact, AGL was required to notify the Department of Primary Industries of the incident. No enforcement action was taken.'* [37]

There have been a considerable number of reported water contamination incidents around the world. Recent examples include:

- contamination at Parson's Well in New York caused by migrating fracking fluids[38]
- carcinogens found by the Queensland Government in 14 CSG wells operated by Arrow Energy[39].

The latter incident is not an isolated one for **Arrow Energy, who were fined earlier this year for breaching their permits**. **AGL has also experienced multiple incidents** at its NSW CSG operations resulting in **censure by the NSW Government**.

Apex drilling hole A105, which is located close to an Upland Swamp, presents a significant risk to the water catchment area.

T**he Woronora Plateau is an area of extreme rainfall events**[40]**,** with the swamps acting like large sponges that soak up water and release it slowly. The Hawkesbury sandstone acts like a groundwater aquifer at times of extreme rainfall events.

In an attempt to reduce the risk of overflowing storage ponds, the use of excavated sumps to retain water, and bunds (earth retaining walls) is recommended in Appendix 1 of the Environmental Assessment. The height of the earth retaining walls is specified as 660 mm in the original Environmental Assessment. However, according to the records from the Darkes Forest rain gauge, there have been a number of rainfall events in the area which exceed 500mm (for example 573mm in 3 days in 1992). This means there is **a very high risk of a release of contaminated saline water spreading via groundwater into the adjacent upland swamp lands and water catchment.**

The fact that **Overland water flow causes significant damage to farmland** over a wide area is well demonstrated in the following extracts from the official Minutes of Arrow Energy's Intensively Farmed Land Committee Meeting on February 10 2011[41]. This flooding occurred during last summer's excessive rainfall.

ITEM	DETAILS	ACTIONS
	.	
ITEM 4	Updated – Land Owner Issues	
	Overview of the impact of the flood Overland water flow causes significant damage. - There was significant erosion around above ground infrastructure (approximately 20% the Condamine floodplain impacted) - Flood water flow cut gullies on properties approximately 3-5 km long and 0.5-1.0 m deep. - Minor changes in the flood plain had significant impact during this flood event. - The landowners believe that these issues could be addressed by Arrow Energy working with landholders. Council road formation diverted the Brigalow flood plain water course: - Small changes to the height of a council gravel road of approx. 200mm caused overland flow diversion. - Diverted water travelled between catchments and created 7 km of new water cause downstream. - Resulted in loss of 500 acres of cotton for one landholder. - Impact area of approximately 20km downstream.	Non listed

The Queensland government has since banned the use of evaporation ponds[42].

According to a study by Atkinson, **AGL has disposed of produced water at Camden by adding potable water to it until the discharge reaches regulatory limits**. This method is a poor use of water resources. Gastar reported that they produced about 100,000L of saline water every day (about five water tankers) from each of their six Bohena pilot wells in Queensland.[43]

If the produced water on the Woronora Plateau is to be trucked out of the area for treatment, as suggested by APEX management at a recent public meeting, then it will require the building of a substantial trail and road infrastructure within the SCA catchment and upgrading of local feeder roads, once production commences.

4.3. Fugitive emissions from CSG Mining

Fugitive emissions from CSG mining can result from:

- leaking pipelines, well heads and processing plants
- entrained methane in produced water
- methane escaping through underground systems.

4.3.1. LEAKING PIPELINES, WELL HEADS AND PROCESSING PLANTS

Recent conducted at Cornell University[44] found that between 3.6% and 7.9% of methane from shale gas production escapes to the atmosphere in venting and leaks over the lifetime of a well. This leakage occurs during hydraulic fracturing and during drill out following fracking. The study refers to modeling that indicates methane has a far greater impact on global warming than previously believed when the indirect effects of methane on atmospheric aerosols is taken into account. Over 20 years, **methane has a 'global warming potential' 105 times that of an equivalent amount of carbon dioxide, reducing to 33 times over a 100 year timeframe[45].** Therefore the warming impact of the methane that escapes from the wells, produced water, fittings and pipelines is considerable. Over a 20-year period, means that **leakage of even 1% more than doubles the environmental cost of CSG fired power**. The **credible leakage figures for CSG start at about 4%.**

A study by Atkinson on the hazards of coal seam gas mining supports this assertion by stating[46]:

'*In September 2004, within a fortnight of the beginning of gas testing, a coal bed methane well north of Newcastle, NSW, was shut down as several boreholes up to 300m away began to blow off methane gas. This was the first reported case of a serious migration of methane gas from coal bed methane operations in New South Wales.'*

Atkinson also notes that[47]:

> *'…long experience in the USA, and more recent experience in New South Wales shows that once the head of water is removed, the coal gas, mainly methane, is mobile and can migrate by uncontrolled pathways to the surface, or to nearby openings such as water wells. In surface*

methane seepages through soil, the methane displaces the soil oxygen, the soil becomes anoxic leading to total death of the vegetation.'

Blow outs and seepage at AGL and Dart Energy CSG drilling sites, referred to earlier, add to this body of evidence. The AGL incident resulted in a warning letter from the NSW DECCW[48].

4.3.2. Entrained methane in produced water

CSG extraction requires water to be pumped from the well throughout its operating life. This produced water, generally saline and laced with contaminants, also contains methane, mostly "entrained" as gas bubbles. In Australia, the usual practice is to pipe this water to evaporation ponds. How much methane reaches the atmosphere this way? **Engineers working on CSG technologies in Wyoming have found that the amount lost as entrained gas varies from 2% to 30% of total well yield**[49].

4.3.3. Methane in underground systems

When coal seams are de-watered and gas is released, any that is not captured 'can migrate by uncontrolled pathways to the surface, or to nearby openings such as water wells'[50]. This can happen along groundwater aquifers, fractures in bedrock and through permeable soils[51].

4.4. Air pollution

CSG mining generates air pollution from the earliest stages of extraction and this continues throughout the extraction and processing cycle. This is graphically illustrated in the photos below.

PHOTOS: blow outs at an AGL production CSG wellhead in Camden NSW (left) and an Arrow Energy CSG wellhead near Dalby, Queensland (right) in 2011

In April 2011, the United States House of Representatives Committee on Energy and Commerce reported that:

> *'Between 2005 and 2009, the hydraulic fracturing companies used 595 products containing 24 different hazardous air pollutants. Hydrogen fluoride is a hazardous air pollutant that is a highly corrosive and systemic poison that causes severe and sometimes delayed health effects due to deep tissue penetration. Absorption of substantial amounts of hydrogen fluoride by any route may be fatal. One of the hydraulic fracturing companies used 67,222 gallons of two products containing hydrogen fluoride in 2008 and 2009. Lead is a hazardous air pollutant that is a heavy metal that is particularly harmful to children's neurological development. It also can cause health problems in adults, including reproductive problems, high blood pressure, and nerve disorders. One of the hydraulic fracturing companies used 780 gallons of a product containing lead in this five-year period. Methanol is the hazardous air pollutant that appeared most often in hydraulic fracturing products. Other hazardous air pollutants used in hydraulic fracturing fluids included formaldehyde, hydrogen chloride, and ethylene glycol.'*[52]

Given the concentration of water catchments and other state protected zones in the Northern Illawarra, and CSG mining's potential to generate air pollution, this is an unsuitable activity for the region.

4.5. THREATS TO THE ABOVE GROUND ENVIRONMENT

SCSGI is also very concerned about the above ground impact of CSG mining in PELs 442 and 444.

4.5.1. EXPLORATION

The 15 approved drilling sites for PELs 442 and 444 will result in significant deforestation and damage to the protected environment of the Northern Illawarra. Each exploration well will require a large area of forest to be cleared, as show in the photo below. We estimate the footprint per well head to be at least one hectare, with further substantial forest clearing required for the construction of access roads, pipelines and fire breaks.

PHOTO: Example of a CSG exploration wellhead site

It is the view of SCSGI and other interested local stakeholders, such as Otford Eco, that such **clearing for CSG mining will irrevocably damage and most likely destroy the native bush and swamp lands of the upper escarpment, which are so vital to local water supplied and eco systems**.

4.5.2. PRODUCTION

If CSG production mining is allowed in the Northern Illawarra there will, according to APEX Energy, be **between 140 and 190 wells across PELs 442 AND 444 at intervals of approximately 400-800 metres**. Given the topography of the area, well locations (and the distance between them) will be greatly influenced by the terrain of the area, with a likely concentration of wells along ridge lines.

Each wellhead will have a pipeline for gas and either a storage pond (or tank) to hold produced water, a wide, underpinned road capable of handling vehicles heavily laden with plant and equipment (such as drilling rigs and associated machinery such as mud pumps, separators, generators and booster compressors) and frequent daily truck movements to remove the separated water. There will be a need for gas compressor and pumping stations throughout the area that will operate continuously and emit noise (and possibly methane gas).

Figure 5 below shows how the 190 production well pads could be distributed across the Northern Illawarra, given its topography. Each white dot represents one well head with a cleared area of approximately 100m x 100m (excluding roadways gas pipelines and fire trails). **Clearing well beyond the perimeters of the pad, which is likely to protect the wellheads from bush fires, could result in the loss of up to four hectares of forest per pad**.

FIGURE 7: OVERLAY IMAGE SHOWING POTENTIAL IMPACT OF PRODUCTION WELLS ON PELS 442 & 444

Note: This model was compiled from data collected on known APEX drill sites and using mostly existing fire trails, superimposed on Google Earth. It is therefore, in all probability, substantially understated.

What can be seen from this image is that **the Northern Illawarra will change from an area of outstanding beauty and protected lands to a huge roofless industrial gas production** and distribution

centre. This in an area predominantly comprised of the Sydney Water Catchment Special Areas, National Parks, a designated National Park, and State Conservation Areas. **Areas that are critical for Sydney's water security, the health of two of its major rivers, public amenity and tourism, and that are extremely fire prone.**

4.5.3. DESTRUCTION OF LARGE AREAS OF FOREST

It is inevitable that large scale destruction of forest will occur to accommodate the CSG drilling pads and their associated infrastructure – such as compressors, pumping stations, storage tanks for produced water, access ways and pipelines. Wide, well constructed roads will be required to bring in the heavy CSG plant and equipment. **Existing fire trails that have been developed to minimise destruction of the bush will need to be greatly widened and a network of new roads created**. There will be **further clearing to lay the high pressure gas distribution pipe network required[53], for other production and gas distribution infrastructure, and for creating suitable fire breaks – methane is a highly combustible gas!**. The photo below is of a Dart Energy drilling site and gives a good idea of the minimum amount of forest that will need cleared for each exploration and production site. [54] The size of the trucks and other equipment in the photo indicate the extent to which wide access to sites and commensurate clearing of forest will be necessary.

PHOTO: An aerial shot of a Dart Energy CSG exploration drilling pad[55]

PHOTO: A Gas collection pipeline laid out along an easement in forest area prior to trenching and installation – note the bush clearance width

4.5.4. IMPACT ON BIODIVERSITY

The Illawarra Escarpment and the adjacent areas constitute one of the most biodiverse regions in New South Wales. They containing upland swamps, sedgeland heath, creek-centred wetlands and various forms of native forest. In the adjacent Dharawal Nature Reserve, over 500 plant species occur, and the O'Hare Creek catchment alone is home to 17 species listed as vulnerable, rare or threatened. Animal life is equally diverse, with the area supporting broad-headed snakes, koalas, long-nosed potoroos and rare frog species. The swamplands are home to swamp wallabies, eastern wallaroos, marsupial mice, New Holland honeyeaters, rare frogs and crayfish, to name a few. Both Maddens and O'Hare creeks and the surrounding wetlands are home to over a dozen different species of native frogs, which are a measure of the environmental health of the area.

The impact of the proposed CSG mining on the natural environment will be enormous. There will be considerable destruction of the largely pristine habitat by land clearing in both the exploration and production stages, significant ongoing heavy traffic movements with attendant risks to wildlife and the increased likelihood of the introduction of weeds. As discussed below, **CSG mining will greatly increase the risk of bush fires** and the devastation to flora and fauna that would result.

4.6. POTENTIAL FIRE RISKS OF CSG MINING

4.6.1. OVERVIEW

There are a number of fire risks associated with CSFG mining (Table 2).

TABLE 2: FIRE RISKS ASSOCIATED WITH CSG MINING

Risks	Cause
Blow out of gas at a well head and subsequent fire	• During construction drilling • Mechanical failure of the well head • Vehicle Impact • Earthquake • Wildfire
Gas leak from pipeline infrastructure	• Faulty valve • Faulty flange/seal • Earthquake
Worker Accomodation area fire involving combustible construction, LPG or diesel	• Electrical fault • Naked Flame • Hot oil or surfaces in kitchen
Diesel fire involving mobile fuel tanker, earth moving equipment, forestry equipment and water removal trucks. Shorting from pumping, separator, compressor and other equipment	• Vehicle engine fire as an ignition source to the fuel tank • Naked flame • Vehicle collision, crash into trees or roll over • Sparks

There are now numerous examples of CSG operations creating a fire hazard. In February 2011, for example, Cheasapeake Energy experienced a flash fire and explosion in on-site CSG storage tanks at one of its CSG drilling sites in Pennsylvania[56]. According the US EPA, the event happened while gas condensate produced at the wells was being transferred into storage tanks[57].

PHOTO: The fire at Chesapeake Energy's well head storage facility, February 2011

In June 2011, Queensland Gas Company admitted CSG leakages at five sites that represented a real fire risk. A Queensland Government review also found a further 27 minor gas leakages that represented a lower level risk[58]. **The CSG well head blow outs at Tara in Queensland and Camden in NSW created similar CSG fire risks**.

4.6.2. Vulnerability of areas to Severe Bush Fires

Large tracts of the Northern Illawarra are prone to bush fires, such as the Dharawal State Conservation Area. Bush fire prone land is land that can support a bush fire or is likely to be subject to bush fire or ember attack. **All of the area affected by the proposed CSG mining under PELs 442 and 444 is highly bushfire prone**.

The Catchment Area

On 25 December 2001 a series of lightning strikes initiated several wildfires in Sydney's drinking water supply catchments managed by the Sydney Catchment Authority. These eventually burned over 225,000 hectares of forested catchment[59]. A number of impact studies have been conducted since this major fire event in order to assess the fires impacts. Amongst the findings of these studies are that:

- the severity of the fire and any following rainfall events directly determine the size of the sediment and nutrient loads that move through the drainage network and streams into the catchment . The more severe the fire and the larger the subsequent rainfall events, the greater the erosion and delivery of loads to the drainage network.[60]
- following severe wildfire events, the post-fire recovery period of soil stability is 1-4 years.[61]. During this recovery phase, above average rainfall events will lead to erosion and subsequent downstream deposition of sediments and nutrients[62].

The Illawarra Escarpment and Adjacent areas

Major fires have occurred in 1939, 1968, 1980, 1994, 1976 and 2001[63]. Wildfires occur somewhere within the area every year. **Fires west of the Illawarra Escarpment pose** a **major risk to the coastal communities in Wollongong.** This is illustrated by the 1968 fire event where numerous spot fires

were ignited on the escarpment by embers blown by strong blustery winds from the adjacent plateau. These spot fires then ran north along and up the face of the escarpment, destroying large areas of residential property in the Bulli, Austinmer and Coledale areas. [64]

THE UPLAND SWAMPS

The upland swamps are a particularly flammable vegetation community and an important location for fire ignition. The fire risks associated with GSC mining and identified below will substantially increase the likelihood of bushfire ignition. [65]

Several different fire regimes threaten the diversity of flora and fauna within Coastal Upland Swamp in the Sydney Basin bioregion: These include substrate fires of recurring short or long intervals. **Under extreme fire weather conditions the peaty substrate is flammable. Substrate fires are extremely difficult to extinguish and their effects may be long-lasting**, as they consume the peaty substrate, causing the mortality of soil seed banks and fauna, lignotubers, rhizomes and other underground organs that would otherwise survive surface and canopy fires. They result in extensive erosion that may be amplified when followed by intense rainfall events, resulting in the flushing of large areas of swamp sediments and vegetation from headwater valleys. Intense rainfall events are not infrequent within the distribution of Coastal Upland Swamp. **An increased frequency of extreme fire weather projected for south-eastern Australia in the 21st century is likely to promote the risk of more frequent and more extensive substrate fires**.

4.7. GEOLOGICAL DAMAGE AND SEISMIC RISKS

4.7.1. GEOLOGICAL DAMAGE

Discussions with local geologists have revealed their concerns for the geological integrity of the escarpment behind the Illawarra due to the extensive coal mining operations. There is already documented evidence of destruction of roads and the wholesale escape of gas through the Woronora River.

Although CSG extraction has less apparent structural impact on the rock strata than mining, there is nevertheless significant impact. The extraction of water always results in a change of ground wate volume. This will inevitably cause fracture of the local strata, creating pathways for the flow of water and gas. Control of this is out of the miner's hands.

The is a real risk that CSG extraction operations and especially the effects of hydraulic fracturing and other coal seam stimulation techniques, will cause subsidence or other seismic events. This could result in:

- damage to structures such as buildings, dams and roads
- drainage of rivers and dams into the subsurface water table
- increased leakage of methane gas both from natural flows and also from gas liberated from the coal seam bed but not captured for external use
- drainage of aquifers in close proximity to the mining horizon where strata caving and extensive fracturing occurs into the mine workings. Deep aquifer impacts have recently been noted in Area 2 of the Dendrobium Coal Mine[66] and subsidence caused by Long wall mining at Appin Colliery, which is close to the western edge of PEL 444. Broughtons pass weir has had significant loss of water flow coincident with reports of cracking as a result of mining operations[67].

4.7.2. SEISMIC RISKS

Fracking has been directly implicated **in geological effects such as earthquakes**. The United Kingdom's only shale gas drilling project was suspended earlier this year after the British Geological Survey (BGS) recorded a 1.5 magnitude quake with the epicentre within two kilometres of a CSG exploration site near Blackpool, Lancashire. This followed a 2.3 magnitude quake that occurred close to a drilling site near Preston in the UK. According to the BGS, while it could not conclusively say that the first earthquake was linked to fracking, it states on its website that: *'Any process that injects pressurised water into rocks at depth will cause the rock to fracture and possibly produce earthquakes*.'[68]

The Arkansas Geological Survey (AGS) and the Centre of Seismographic Information and Research at the University of Memphis conducted a study of the thousands of earthquakes that occurred in Faulkner County in Arkansas, United States, over the course of over a year. On February 27, 2011, the area was hit with a 4.7 magnitude earthquake[69]. Researchers from AGS concluded that while there is no discernible link between earthquakes and gas production, there is *'strong temporal and spatial evidence for a relationship between these quakes and the injection wells'*. **Seismic activity has almost ceased since the fracking stopped**.

These incidents demonstrate that the geological impact of fracking may be significant, although it has yet to be accurately assessed. Such events can open up additional avenues for the migration of fugitive methane gases, polluted water, natural and fracking carcinogens, for some distance around the a CSG well head. This is exacerbated by the current practice of horizontal drilling, which allows CSG drilling (and fracking) to occur within a radius of several kilometres from the well head.

This is a major potential problem for the Illawarra Escarpment, which has large areas of geological instability. The number and size of major slippages on the escarpment could be greatly increased by the seismic impact of fracking across scores of wells, coupled with horizontal and/or radial drilling that extend drilling and fracking operations kilometres from the wellhead.

PHOTO: RECENT SLIP ALONG THE FACE OF THE ESCARPMENT AT WOMBARA

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NATIONAL TOXICS NETWORK SUBMISSION
Inquiry into the impacts on health of air quality in Australia

Air pollution related to unconventional gas exploration and production

It has long been known that urban air pollution levels are associated with increased mortality and cardiorespiratory morbidity and that these health effects occur even at exposure levels below those stipulated in current air-quality guidelines, and it is unclear whether a safe threshold exists.[1]

While air pollution in Australia has historically been sourced to motor vehicle emissions, heavy industry, home heating using wood and electricity generation from fossil fuels, unconventional gas (UG) including coal seam gas activities provides a new and serious source of air pollution.[2]

Unconventional Gas (UG) refers to natural gas from unconventional sources such as shale deposits, coal seams, tight sandstones and methane hydrates. Natural gas consists of methane with other hydrocarbons, carbon dioxide, nitrogen and hydrogen sulfide. UG wells differ from conventional gas in that many wells need to be drilled to extract the gas, many will incorporate horizontal drilling and that the hydraulic fracturing process is likely to be used a number of times over the life of a well.

UG Industry Sources of Air Pollution

The US National Library of Medicine notes that operations at gas fields emit a wide range of pollutants including nitrogen oxides, volatile organic compounds (VOCs), carbon monoxide, sulfur dioxide, and particulate matter. Air emissions come from several sources in gas fields, including equipment engines, drilling rigs, pumpjacks, boilers, heaters, generators, combustion flares, storage tanks, injection pumps, dehydrators, vehicles, and oil and gas skimmers. They note that one of the major sources of air emissions at gas fields are compressor stations that move natural gas through pipelines and gas processing plants.[3]

[1] Tord E Kjellstrom, Anne Neller and Rod W Simpson, Air pollution and its health impacts: the changing panorama *Med J Aust* 2002; 177 (11): 604-608.
[2] UNEP Global Environmental Alert system Gas fracking: can we safely squeeze the rocks? http://na.unep.net/api/geas/articles/getArticleHtmlWithArticleIDScript.php?article_id=93
[3] http://toxtown.nlm.nih.gov/text_version/locations.php?id=150

Gas Processing, which is required to remove impurities before natural gas can be used as a fuel, produces by-products including ethane, propane, butanes, pentanes and higher molecular weight hydrocarbons, hydrogen sulphide, carbon dioxide, water vapor and sometimes helium and nitrogen. These are vented to the atmosphere, providing an important point source of air pollution from the industry.

Flaring (the burning off of natural gas from a new well) is a common practice in the gas fields and represent a direct release of pollutants to air. The emissions include hydrogen sulfide, methane and BTEX chemicals,[4] as well as dioxins and metals such as mercury, arsenic and chromium.[5] The US EPA due to air pollution concerns has banned flaring associated with UG activities after January 2015. [6]

Volatile Organic Compounds (VOCs)

Of particular concern are the VOCs, which are released at all stages of UG production. Raw natural gas contains many toxic non-methane hydrocarbons that surface with the methane and are released during venting and in fugitive emissions at all stages of natural gas production and delivery. Mobile and stationary equipment release VOCs, as well as NOx, CO and particulate matter through exhaust and evaporative emissions. Pit fluids and holding ponds are also a source of VOCs, including the break-down products and mixtures of chemicals that cannot be predicted. Volatile chemicals are used during cleaning and maintenance of well pads and equipment. Volatile chemicals are also injected underground during drilling and hydraulic fracturing (fracking) a percentage of which eventually surfaces.

Many VOCs are toxic. Some are known to cause cancer in animals (eg methylene chloride), or in humans (eg formaldehyde) or are suspected human carcinogens (eg chloroform and bromodichloromethane). VOCs are also key ingredients in forming ozone (smog), which is linked to asthma attacks, and other serious health effects. VOCs help form fine particle pollution (PM2.5). VOC exposure may result in eye, nose, and throat irritation; headaches, visual disorders, memory impairment, loss of coordination, nausea, damage to liver, kidney, and central nervous system.[7]

Benzene, Toluene, Ethylbenzene, Xylene or BTEX are both components of drilling fluids and natural VOCs released from the coal seam. Their short term health effects include skin, eye / nose irritation, dizziness, headache, loss of coordination and impacts to respiratory system. Chronic exposure can result in damage to kidneys, liver and blood system. Benzene is strongly linked with leukemia [8] and other diseases such non-Hodgkin's lymphoma (NHL).

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[4] http://www.hsph.harvard.edu/research/niehs/files/penning_marcellusshale.pdf

[5] Birnur Buzcu-Guven, Robert Harriss, Donald Hertzmark *Gas Flaring And Venting: Extent, Impacts and Remedies* Institute For Public Policy, Rice University , September 2010 http://www.bakerinstitute.org/publications/CARBONFlaring%20paper%20Birnur%20FINALwith%20cover%20secured.pdf ; Also see Canadian Public Health Association, Background to 2000 Resolution No. 3 www.climatelaw.org/cases/country/nigeria/cases/casedocuments/nigeria/report/section7/doc7.1.pdf

[6] http://www.epa.gov/airquality/oilandgas/pdfs/20120417presentation.pdf

[7] http://www.epa.gov/iaq/voc.html

[8] Rinsky, R.A Benzene and leukemia: an epidemiologic risk assessment. *Environ Health Perspect*. 1989 July; 82: 189–191.

The USEPA 2012 presentation on new emissions standards for the gas industry stated that the oil and gas industry is the largest industrial source of VOC emissions in the U.S. Once considered a summertime pollutant, ozone had now become a problem in winter in areas with significant natural gas production. They concluded that air toxics from the oil and gas industry could cause cancer and other serious, irreversible health effects, such as neurological problems and birth defects.[9]

A 2012 study,[10] carried out over 12 month detected 44 hazardous air pollutants at UG drilling sites. The study found a wide range of air toxics including methane, methylene chloride, ethane, methanol, ethanol, acetone, propane, formaldehyde, acetaldehyde and PAHs including naphthalene. They noted a great deal of variability across sampling dates in the numbers and concentrations of chemicals detected. Notably, the highest percentage of detections occurred during the initial drilling phase, prior to hydraulic fracturing on the well pad.

Australia Research

Research by the Southern Cross University[11] used atmospheric radon (^{222}Rn) and carbon dioxide (CO2) concentrations to measure fugitive emissions in the CSG fields of the Tara region, Queensland. They measured a 3 fold increase in maximum ^{222}Rn concentration inside the gas field compared to outside. They suggest that CSG activities may change the geological structure and enhance diffuse soil gas exchange processes. The study notes that emissions include greenhouse gases such as CO2 and methane. While not harmful to human health at low concentrations, methane is a powerful greenhouse gas with a global warming potential 25 times that of CO2 over a 100-year time horizon. These emissions should be accounted for when estimating the net greenhouse gas footprint of CSG operations. The presence of these gases also suggests the release of other gaseous substances, such as VOCs, which can be very harmful to human health.

Impacts On Human Health

A Human Health Risk Assessment of air emissions around US UG activities,[12] concluded that residents closest to well pads i.e., living less that 1/2 mile from wells, have higher risks for respiratory and neurological effects based on their exposure to air pollutants; and a higher excess lifetime risk for cancer. The study took 163 measurements from fixed monitoring station, 24 samples from perimeter of well pads (130-500 feet from center) undergoing well completion and measured ambient air hydrocarbon emissions. Emissions measured by

[9] Reducing Air Pollution from the Oil and Natural Gas Industry EPA's Final New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants
April 17, 2012 http://www.epa.gov/airquality/oilandgas/pdfs/20120417presentation.pdf

[10] Colborn T, Schultz K, Herrick L, and Kwiatkowski C. 2012 (in press). An exploratory study of air quality near natural gas operations. *Hum Ecol Risk Assess*

[11] Douglas R. Tait, Isaac Santos, Damien Troy Maher, Tyler Jarrod Cyronak, & Rachael Jane Davis Enrichment of radon and carbon dioxide in the open atmosphere of an Australian coal seam gas field *Environ. Sci. Technol.* http://pubs.acs.org/doi/abs/10.1021/es304538g

[12] Lisa M. Mckenzie, Roxana Z. Witter, Lee S. Newman and John L. Adgate, Human health risk assessment of air emissions from development of unconventional natural gas resources. *Science of the Total Environment* March 21, 2012

the fenceline at well completion were statistically higher ($p \leq 0.05$) than emissions at the fixed location station (inc. benzene, toluene, and several alkanes.) The assessment was based on the US EPA guidance to estimate non-cancer and cancer risks for residents living greater 1/2 mile from wells and residents living equal to or less than a 1/2 mile from wells. The study may have underestimated risks to human health as it did not measure ozone or particulates. USEPA methods may also underestimate health risks of mixed exposures.

Some have attempted to dismiss this study stating that Australian CSG does not emit the same hydrocarbons however, sampling around CSG activities have shown the presence of BTEX including benzene on which the cancer risk was primarily based. (See VOCs in Tara, Queensland)

A US Health Survey [13] investigated the extent and types of health symptoms experienced by people living near UG in Pennsylvania. Environmental testing was conducted on the properties of a subset of survey participants (70 people in total) to identify the presence of pollutants that might be linked to both gas development and health symptoms. Test locations were selected based on household interest, the severity of symptoms reported, and proximity to gas facilities and activities. In total, 34 air tests and 9 water tests were conducted at 35 households in 9 counties. VOCs were detected in air including 2-Butanone, Toluene, Acetone, Chloromethane, Carbon tetrachloride, Benzene, Trichlorofluoromethane, Methylene Chloride, Dichlorodifluoromethane, n-Hexane, Tetrachloroethylene, 1,2,4-Trimethylbenzene, Ethylbenzene, Trichloroethylene, Xylene and 1,2-Dichloroethane**.** A range of symptoms were reported in the 108 surveys including nasal & throat irritation (60%), sinus problems (58%), eyes burning (53%), shortness of breath (52%), difficulty breathing (41%), severe headaches (51%), sleep disturbance (51%), frequent nausea (39%), skin irritation (38%), skin rashes (37%), dizziness (34%). While the study did not prove that living closer to UG facility causes health problems, they did suggest a strong association, as in general, the closer to gas facilities respondents lived, the higher the rates of symptoms they reported.

Residents of Tara Queensland, adjacent to extensive CSG activities report similar symptoms including severe headaches, nausea, vomiting, nose bleeds, rashes, eye and throat irritations and severe skin irritations. They also report 'stench events'

VOCs in Tara Queensland

While there has been no comprehensive monitoring of air pollutants in the Tara community near gasfields, one-off samples of ambient air around homes have detected a range of VOCs. These include ethanol, acetone, benzene, toluene, xylene, ethylbenzene, dichlorodifluoromethane, 1,2,4-trimethylbenzene, naphthalene, phenylmaleic anhydride, methyl ethyl ketone, phenol, butane, pentane, and hexane. While this sampling is clearly inadequate to assess emissions and pollution, the detection of VOCs near

[13] Gas Patch Roulette: How Shale Gas Development Risks Public Health In Pennsylvania, October 2012 Earthworks' Oil & Gas Accountability Project www.earthworksaction.org

residences and adjacent to residential water bores indicates the overwhelming need for a comprehensive sampling program to assess air releases. Toluene, a neurotoxin was detected in the air around at least eight Tara homes and in the air over a private bore. In the latter, the level was simply dismissed (by the report's authors) as below levels of concern,[14] yet it is well above the 'Chronic Reference Exposure Limits' used by many states in the USA (eg California, Massachusetts, Michigan) for assessing the impacts of long term exposure.

Community Sampling

Community sampling activities have also detected volatile and semivolatile compounds in water samples taken around Queensland UG activities. VOCs change easily from liquid form to vapor. A sample taken from the top of the well-head, a day after the well had been 'fracked', demonstrated the presence of VOCs, eg bromodichloromethane, bromoform, chloroform, dibromochloromethane, benzene.[15] The US Hazardous Substances Data Bank[16] lists dibromochloromethane as having an estimated half-life of 8.4 months in air, indicating that long-range global transport is possible. The International Agency for Research on Cancer has concluded that chloroform and bromodichloromethane are possible human carcinogens.

Air Testing by NTN in cooperation with local communities took three air samples from around gas extraction activities over an 8-hour period, including one taken adjacent to a residential water bore. The samples were analysed by the National Measurement Institute and were shown to contain ethanol and chlorofluorocarbons (CFCs).[17] Once used as refrigerants and aerosol spray propellant, because of their adverse impact on the ozone layer, CFCs were either banned or heavily regulated under the Montreal Protocol on Substances That Deplete the Ozone Layer. Dichlorodifluoromethane, commonly known as Freon-12 was detected in all samples, as was trichlorofluoromethane (Freon-11), which has the highest ozone depletion potential of any refrigerant. Both these CFCs are recognised as substances that may be formed in natural processes, hence the source of these CFCs remains unknown.

Naturally occurring radioactive materials

NORMs are found in both coal seams and shale, eg uranium, thorium, radium-228 and radium-226.[18] The radioactive material can be released through the drilling process in drill cuttings/muds, flowback water and air emissions. Radon-222 is the immediate decay product of Radium-226 and preferentially follows gas lines. It decays (through several rapid steps) to Pb-210, which can therefore build up as a thin film in gas extraction equipment.

[14] Simtars Investigation of Kogn Water Bore (RN147705) -16 October 2012
[15] Labmark Environmental Laboratories, Certificate of Analysis, Report 331850-W Composite: Roma Water Analysis, Mar 26, 2012
[16] http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB
[17] Australian Government National Measurement Institute, Report of Analysis of Air Canisters Low Level, Report No. RN900555 (2 Feb 2012), Report No. RN893233 (16 Dec 2011), Report No. RN893232 (16 Dec 2011)
[18] Fact Sheet FS-163-97 October, 1997 Radioactive Elements in Coal and Fly Ash: Abundance, Forms, and Environmental Significance, USGShttp://pubs.usgs.gov/fs/1997/fs163-97/FS-163-97.html

The level of reported radioactivity varies significantly, depending on the radioactivity of the reservoir rock and the salinity of the water co-produced from the well. The higher the salinity the more NORM is likely to be mobilized. Since salinity often increase with the age of a well, old wells tend to exhibit higher NORM levels than younger ones.[19] Radium is a known carcinogen[20] and exposure can result in increased incidence of bone, liver and breast cancer. Radon, a decay product of radium can cause lung cancer. Despite the increased rate of radon detected by the SCU study inside the gas fields, there has been no radionuclide analyses or testing for radon in the communities surrounding gas fields.

Particulates and Silica

UG activities result in the formation and distribution of particulate pollution from a range of sources including diesel engines and the use of proppants in hydraulic fracturing. Up to 50,000 kg of proppants may be used per hydraulic fracturing. These consist of either silica or manufactured ceramic polymer spheres based on alumino-silicates, which are injected as part of the fracturing fluid mixture and intended to remain in the formation to hold open the fractures once the pressure is released. Breathing silica can cause silicosis, and exposure to silica dust is a known cause of lung cancer and a suspected contributor to autoimmune diseases, chronic obstructive pulmonary disease and chronic kidney disease.[21]

The US National Institute for Occupational Safety and Health (NIOSH) recently released a Hazard Alert, identifying exposure to airborne silica as a health hazard to workers conducting hydraulic fracturing operations.[22]

NIOSH identified seven primary sources of silica dust exposure during hydraulic fracturing operations:

- dust ejected from thief hatches (access ports) on top of the sand movers during refilling operations while the machines are running (hot loading);
- dust ejected and pulsed through open side fill ports on the sand movers during refilling operations;
- dust generated by on-site vehicle traffic;
- dust released from the transfer belt under the sand mover;
- dust created as sand drops into, or is agitated in, the blender hopper and on transfer belts;
- dust released from operations of transfer belts between the sand mover and the blender; and
- dust released from the top of the end of the sand transfer belt (dragon's tail) on sand movers.

NIOSH acknowledges the serious lack of information on occupational dust exposure in the gas industry, including exposure to diesel particulates. Diesel

[19] http://www.world-nuclear.org/info/Safety-and-Security/Radiation-and-Health/Naturally-Occurring-Radioactive-Materials-NORM/#.UTlc2qXfCcM
[20] http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=790&tid=154
[21] NIOSH Hazard Review, Health Effects of Occupational Exposure to Respirable Crystalline Silica. National Toxicology Program [2012]. Report on carcinogens 12th ed. U.S. Department of Health and Human Services, Public Health Service.
[22] www.osha.gov/dts/hazardalerts/hydraulic_frac_hazard_alert.htm

exhaust is classified as a Group 1 carcinogen by the International Agency for Research into Cancer.[23]

Proppants based on ceramic polymers may also add to air pollution. According to Haliburton's patent[24] acrylic polymers, consisting of 85% of the human carcinogen, acrylonitrile are used for proppant spheres. Acrylonitrile has been detected in US air sampling of gas sites at high levels. Acrylonitrile is also a respiratory irritant, causing degeneration and inflammation of nasal epithelium. Levels of acrylonitrile in the five samples exceeded the level set by USEPA for risk of increased noncancer health effects from long term exposure by 3 to 15 times.[25]

Vulnerable Populations

There are many children living in communities in close proximity to UG activities and at risk from air pollutants.

"Children are not little adults: they have special vulnerabilities to the toxic effects of chemicals. Children's exposure to chemicals at critical stages in their physical and cognitive development may have severe long-term consequences for health. Priority concerns include exposure to air pollutants, pesticides and persistent organic pollutants (POPs), lead, mercury, arsenic, mycotoxins and hazardous chemicals in the workplace." [26]

The unique vulnerability of children to hazardous chemicals is well recognized by WHO, UNICEF and UNEP [27] and newborns can be much more vulnerable than adults to the commonly-used chemicals, eg., up to 164 times more sensitive to the organophosphate pesticides chlorpyrifos.[28] Children's bodies are still developing, their detoxification systems are immature and their protective biological barriers such as the blood-brain barrier are still developing.[29] They are also more at risk because they have higher respiration and metabolic rates than adults, they eat and drink more per bodyweight, and they live life closer to the ground, crawling, digging in dirt and putting objects in their mouths. Being unaware of chemical risks, children are less able to

[23] http://www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213_E.pdf
[24] Halliburton Patent 7799744, Polymer-Coated-Particulates, www.docstoc.com/docs/58860687/Polymer-Coated-Particulates---Patent-7799744
[25] Citizen Investigation of Toxic Air Pollution from Natural Gas Development July 2011, Global Community Monitor, www.gcmonitor.org
[26] World Health Organisation (WHO), International Labor Office (ILO), United Nations Environment Program (UNEP) 2006. Helping to Protect Children from the Harmful Effects of Chemicals. International Program on Chemical Safety. http://www.who.int/ipcs/en/
[27] World Health Organization / Children's Environmental Health. http://www.who.int/ceh/en/
Also see IFCS Children and Chemical Safety Working Group. 2005. Chemical Safety and Children's Health: Protecting the world's children from harmful chemical exposures - a global guide to resources, October.
[28] Furlong, C. E., N. Holland, R. J. Richter, A. Bradman, A. Ho and Brenda Eskenazi. 2006. PON1 status of farmworker mothers and children as a predictor of organophosphate sensitivity. *Pharmacogenetics and Genomics* 16:183-190.
[29] Landrigan, P J et al. 1998. Children's health and the environment: A new agenda for prevention research. *Environmental Health Perspectives* 106, Supplement 3:787-794.

protect themselves from exposures and higher skin absorption rates may also result in a proportionally greater exposure.[30]

Maternal exposure to air pollutants is also very important as the placenta is not an effective barrier to chemical transfer from mother to the foetus, and toxins can be transferred through breast milk as well. The timing of chemical exposures is significant. Research has shown that babies and children experience particular "windows of susceptibility" in their development.[31] If exposures occur during critical times, it may contribute to health problems much later in life; for example, exposure to dioxin in utero can produce disabilities in neurological function and learning ability well into childhood.[32] Similarly, early exposure to other endocrine disruptors can affect an individual's immune function or ability to reproduce. Early exposure to carcinogens can increase the risk of developing cancer later in life.[33]

Some VOCs are endocrine disrupting chemicals and can cause adverse effects at very low-concentrations, eg polycyclic aromatic hydrocarbons (PAHs). Babies with elevated PAHs in their umbilical cord blood were much more likely to eventually score highly on the anxiety/depression scale than those with low PAH levels in cord blood. [34] PAHs were detected in the air around Tara residences, where many children live, yet there has been no assessment of the impact of air pollutants on this most vulnerable population.

Conclusions

Australian guidelines and standards currently do not take into account low-level, chronic exposure associated with endocrine and epigenetic impacts. Nor do they address the impacts of exposure to real world mixtures of air pollutant. To assess the full impacts of UG development, this is essential and needs to be addressed as a priority. Comprehensive health impact assessments taking into account all exposure routes must be carried out before any approval is given for UG activities. Mandatory baseline air quality testing and on-going monitoring of both particulate matter and VOCs during UG activities is crucial. Background levels of existing methane must also be established before any UG activities are undertaken.

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[30] Lloyd-Smith, Mariann; Sheffield-Brotherton, Bro, 'Children's Environmental Health: Intergenerational Equity in Action—A Civil Society Perspective' *Annals of the New York Academy of Sciences*, Vol. 1140:1, pp. 190-200(11) 2008

[31] Olin, S. R. & B. R. Sonawane. 2003. Workshop to Develop a Framework for Assessing Risks to Children from Exposure to Environmental Agents, September 2003. *Environmental Health Perspectives* 111/12: 1524-1526

[32] Pluim, H.J., J.G. Koppe, K. Olie, J.W. van der Slikke, P.C. Slot, & C. van Boxtel. 1994. 'Clinical laboratory manifestations of exposure to background levels of dioxins in the perinatal period*. Acta Paediatrica* 83: 583-587.; OIlsen A., J.M. Briët, J.G. Koppe, H.J Pluim, & J. Oosting. 1996. Signs of enhanced neuromotor maturation in children due to perinatal load with background levels of dioxins*. Chemosphere*: 33(7), 1317-1326.

[33] Barton, H. A., V. J. Cogliano, L. Flowers, L. Valcovic, R. W. Setzer & T. J. Woodruff. 2005. Assessing Susceptibility from Early-Life Exposure to Carcinogens. *Environ. Health Perspect. 13(9): 1125–1133*

[34] Perera, Frederica P.; Tang, Deliang; Wang, Shuang; Vishnevetsky, Julia (2012). "Prenatal Polycyclic Aromatic Hydrocarbon (PAH) Exposure and Child Behavior at age 6-7". *Environmental Health Perspectives*. doi:10.1289/ehp.1104315. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3385432

The National Environment Protection Measure (NEPM) process is woefully inadequate to address air pollution in Australia. Standards rather than guidelines need to be implemented for a full range of VOCs, criteria pollutants and particulates based on precaution rather than economic convenience. These standards must reflect world's best practice and provide maximum protection for the most vulnerable in our community.

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Submission No 407

INQUIRY INTO COAL SEAM GAS

Name: Ms Camel Flint

Organisation: Nature Conservation Council of NSW, Northern Inland Council for the Environment, North Coast Environment Council and Armidale Action on Coal Seam Gas

Date received: 14/09/2011

North Coast Environment Council

Nature Conservation Council of NSW
The voice for the environment since 1955

NORTHERN INLAND COUNCIL for the ENVIRONMENT

Please accept this as a submission to the NSW Legislative Council Inquiry into Coal Seam Gas being conducted by General Purpose Standing Committee No 5.

This submission is provided on behalf of the following groups: the Nature Conservation Council of NSW, the Northern Inland Council for the Environment, the North Coast Environment Council and Armidale Action on Coal Seam Gas.

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SUMMARY

There is substantial evidence to indicate that coal seam gas represents a severe and growing threat to rural and metropolitan landscapes in NSW. The sheer scale of the proposed industry, with more than a quarter of the state (amounting to almost 20 million hectares of land) already covered by exploration licences, is a major cause for concern. It is apparent that this industry could expand rapidly to involve tens of thousands of wells and tens of thousands of kilometres of pipeline within a very short timeframe, as has been the case in Queensland and in America.

We have no doubt that there is no other modern industry which represents such an extraordinary threat to vast areas of rural NSW. If allowed to proceed this industry will convert large swathes of NSW into industrial zones and pose a severe risk to our water resources, our farmlands, our natural assets, our communities and our way of life.

We have not attempted to exhaustively address all the Terms of Reference relevant to this Inquiry, but instead in the submission below aim to address in detail the core issues relating to the environmental impact of coal seam gas mining and its regulation in NSW.

In summary, the key points that we would like to make are that:

1. Coal seam gas mining represents a serious threat to groundwater and surface water resources that cannot be effectively mitigated.
2. More than 1.3 million hectares of crown lands that permit mining are located within current petroleum exploration licences.
3. Coal seam gas mining on public lands will drastically undermine the use of Crown Lands for recreation, will limit the areas to which the public has access, and will have major environmental impacts on high conservation value areas including protected areas.
4. Coal seam gas mining on public lands is a form of privatisation by stealth, which

transforms the public interest in shared natural resources into a private interest held by large companies for profit to the detriment of the community.

5. Coal seam gas companies are preferentially exploiting public lands due to the inadequate constraints relating to access rules and the political support for the industry making access approvals easy to obtain.
6. Coal seam gas mining represents a serious threat to native vegetation, biodiversity and threatened species due to the severe impacts which it causes including direct clearing of bushland, fragmentation, spread of invasive species and increased fire risk.
7. The farming community is disenfranchised and threatened by coal seam gas mining, rural communities facing growing social discord, and the promised economic outcomes do not accrue to the regional communities who bear the costs.
8. Current statutes and regulations are completely inadequate to control coal seam gas exploration and mining, and substantial strong reforms are urgently needed.
9. There is inadequate public transparency in decision-making, insufficient legal rights for the community and local government is under-utilised in regulation and control of CSG.
10. Current proposed reforms by the NSW Government are inadequate to address all of these issues and impacts, and the rapid and on-going spread of the industry while the reforms are still being developed dramatically undermines their utility.

In view of these matters, we would like to see the Inquiry recommend a full moratorium on all forms of coal seam gas drilling until the environmental, social and health impacts have been rigorously and independently assessed. If this evidence indicates that it is possible to conduct some form of CSG mining safely in NSW, then that should only proceed if:

- Coal seam gas exploration and mining is made subject to all relevant environmental legislation, including the native vegetation and water management laws in their entirety.
- The community is provided full legal standing to challenge and enforce environmental

laws under which coal seam gas companies are operating.

- Landholders are provided a right in the Petroleum (Onshore) Act to refuse consent for coal seam gas exploration or production on their land.
- A prohibition is placed on coal seam gas exploration and mining in important bushland, valuable farmland, groundwater aquifers, residential areas and public lands.
- All chemicals that are used in coal seam gas drilling or fracking are assessed by the chemical regulator for safety and health impacts prior to their approval for use.
- Measures are put in place to assess and prevent cumulative impacts and to ensure that full proposals are properly considered from the outset.

THE ENVIRONMENTAL AND HEALTH IMPACT OF CSG ACTIVITIES

Effect on ground and surface water systems

There is a wide and growing body of evidence that coal seam gas extraction represents a severe threat to both groundwater and surface water resources. The findings of a number of relevant Australian studies and reviews are summarised below.

National Water Commission[1]

According to the latest statement released by the the NWC, the coal seam gas industry '*risks having significant, long-term and adverse impacts on adjacent surface and groundwater systems*'. It also notes that the '*potential impacts of CSG developments, particularly the cumulative effects of multiple projects, are not well understood*'. It identifies the following risks to water management from coal seam gas:

- Extracting large quantities of water from systems that are already over-allocated
- Depressurisation of the coal seam altering water availability in adjacent aquifers,

[1] National Water Commission, 'The Coal Seam Gas and water challenge', August 2011.

reductions in connected surface water flows and land subsidence over large areas

- Release of produced water altering natural flow patterns and reducing water quality
- Use of hydraulic fracturing leading to induced connection and cross-contamination between aquifers
- The reinjection of waste water changing beneficial use characteristics of associated aquifers

The NWC notes that "*Current projections indicate the Australian CSG industry could extract in the order of 7,500 gigalitres of co-produced water from groundwater systems over the next 25 years, equivalent to ~300 gigalitres per year. In comparison, the current total extraction from the Great Artesian Basin is approximately 540 gigalitres per year*".

Geosciences Australia[2]

In their 2010 advice to the Australian Government on the potential impacts of coal seam gas extraction on the Surat and Bowen Basins in Queensland, Geosciences Australia stress that there is major uncertainty in relation to the cumulative impacts of CSG development. They state that "*we consider that the overriding issue in CSG development is the uncertainty surrounding the potential cumulative, regional scale impacts of multiple developments. The information provided in the assessed EIS documents is not fully adequate for understanding the likely impacts of widespread CSG development across the Surat and Bowen Basins; nor will any level of information or modelling that can be provided by individual proponents*".

They go on to state that "*We consider that a regional-scale, multilayer groundwater flow model which incorporates data from both private and public sector sources is necessary to inform this understanding. We emphasise, however, that no matter how thorough a model or detailed the underlying data, any modelled outcomes will be accompanied by high inherent uncertainties*

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until sufficient CSG production data is available to calibrate the groundwater model".

Water Group Advice on EPBC Referrals[3]

The Water Group reviewed the QGC and Santos-Petronas coal seam gas project referrals to the Federal Environment Minister and identified significant concerns with the likely impacts on water resources. Specifically, they summarised their concerns as follows:

"a) the general level of uncertainty associated with these proposals, and the inability of proponents to accurately quantify their individual and collective impacts over the life of their projects (which is in the order of 30 years);

b) the lack of surety that this represents for the Minister for Environment in making decisions;

c) the potential for significant impacts on MNES, particularly the listed Threatened Ecological Communities of The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin;

d) the volume of groundwater to be co-produced with CSG, particularly:

i. impacts on groundwater systems and their structural integrity,

ii. pressure and volume impacts on GAB aquifers;

iii. changes to the water chemistry of GAB aquifers;

iv. the very significant recovery times for groundwater systems to return to pre-CSG conditions once extractive operations cease,

v. the volume of salts and heavy metals associated with CSG coproduced water, and the uncertainty around mechanisms for their disposal, and

vi. impacts on surface water hydrology from the discharge of CSG coproduced water into the Condamine and / or Dawson Rivers;

e) land subsidence;

[3] Water Group. 2010. Water Group Advice on EPBC Act Referrals QGC Referral 2008/4399 and Santos-Petronas Referral 2008/4059 and comments on AP LNG Referral 2009/4974.

f) impacts on highly productive agricultural land;

g) impacts on Indigenous cultural and spiritual values;

h) broader impacts on Commonwealth and national policy initiatives such was the National Water Initiative, the CoAG Water Reform agenda, and the Great Artesian Basin Sustainability Initiative;

i) broader impacts on the Murray-Darling Basin and implementation of the Water Act 2007 and the Basin Plan".

The Water Group noted that *"it can be concluded from the proponents' modelling that the legacy effects of the CSG developments are considerable, with at least 1,000 years passing before this part of the GAB will return to pre-CSG levels".*

Moran and Vink 2010[4]

Moran and Vink (from the Centre for Water in the Minerals Industry) were engaged by the Australian Government to undertake a desktop study to determine the impacts of the proposed CSG operations in Queensland on the connectivity of groundwater systems, surface water and groundwater flows and water quality in the Murray-Darling Basin. The study was commissioned in order to comply with s255AA of the Water Act 2007.

In relation to hydrological connections between aquifers and coal seams, Moran and Vink state that *"Hydraulic connectivity between the Central Condamine Alluvium and both the Walloon Coal Measures and some GAB aquifers has been demonstrated by analysis of bore water levels and water quality data (KCB, draft in review; Hillier, 2010). Current hydraulic relationships between the alluvium and the underlying units may be altered by dewatering of the coal measures".* They also noted the risks from subsidence, stating that *"...even small changes to*

[4] Moran and Vink. 2010. Assessment of Impacts of the Proposed Coal Seam Gas Operations on Surface and Groundwater Systems in the Murray-Darling Basin. A report commission by SEWPAC.

the land surface due to subsidence may alter overland flow paths initiating new erosion features in susceptible areas. Additionally, subsidence may also change or cause fracturing in aquifers which may alter the hydraulic connectivity".

In terms of the inadequacies of the hydraulic models that have been used to estimate CSG impacts, Moran and Vink note that *"Loss of water availability from the Central Condamine Alluvium due to direct or indirect induced leakage caused by dewatering of the coal seams could not be separately assessed due to lack of sufficiently detailed numerical model outputs and measurements from current operations".*

They also state that *"Localised drawdown effects are likely to be significantly different to the predicted regional average drawdown owing to the spatial variability in hydraulic connectivity between the coal measures and aquifers, rates of water movement, depth of the coal seam and the thickness confining layers. No proponents have considered the effect of faulting or fractures in their models. These preferential flow features can alter local drawdown. Data on hydraulic properties is scarce. More spatially explicit hydraulic data should be collected and incorporated into models on an on-going basis".*

Study of the Walloon Coal Measure[5]

A recent study by Hillier of groundwater resources in Queensland found that there was hydraulic connectivity between the Walloon coal measures and the alluvial groundwater, and that there was a substantial risk that de-watering of the coal measure would lead to movement of water from the alluvium to the coal measure.

Specifically, Hillier concluded that:

[5] Hillier, John. 2010. Groundwater Connections Between the Walloon Coal Measures and the Alluvium of the Condamine River. A report for the Central Downs Irrigators Ltd.

- *"The alluvium of the Condamine River is incised into the Walloon Coal Measures*
- *The groundwater levels in the alluvium are generally falling, and have been trending downwards for the past 40 years*
- *The water levels in the alluvium are lower than those in the Walloon Coal Measures*
- *Water quality information points to a transfer of water from the Walloons to the alluvium*
- *If water can move from the Walloons to the alluvium, if the gradient is reversed, groundwater will move in the other direction*
- *There is insufficient information available on the likely dewatering level or the hydraulic conductivity of the beds between the coal seams and the alluvium for volumes of flows to be calculated.*
- *Because of the very real likelihood of movement of groundwater from the alluvium to the Coal Measures, more data is required to allow the calculation of the volumes that could be involved.*
- *A program should be instigated to obtain the data required - the permeability of the various strata that lies between the alluvium and the coal seams, water levels in the Walloon Coal measures, volumes that will be pumped etc".*

In order to obtain the data required to reliably assess the likelihood of groundwater movement from the alluvium to the coal measure, Hillier advised that there needed to be a comprehensive monitoring network established to obtain heads at various depths in the Walloon Coal Measures, and that there needed to be a detailed study to determine the horizontal and vertical permeability of various beds in the Walloon Coal Measures.

Hydro-geological Study in the Wyong Valley[6]

The application of a conceptual hydraulic model to the Central Coast water catchments, by Northern Geoscience in 2005, found that de-watering of the coal seams in the valleys would impact on the overlying groundwater resource.

Miscellaneous References

The risks to groundwater are confirmed further by various sources which indicate that there are genuine concerns as to the quality and longevity of well casings. Well failure has been identified as a major problem with 50-100 year old wells in New York State in America[7] and studies have concluded that the integrity of gas wells cannot be guaranteed due to the failure of cement drill casings over time[8]. There is inadequate supervision and monitoring of drilling procedures during coal seam gas drilling compared to standards applied to water drilling[9]. Experts have confirmed these problems[10].

The risks of cross-contamination of aquifers from artificial chemicals in fracking or drilling fluids or from naturally occurring occurring toxins held in coal seams is also acknowledged as a risk. There have now been at least four cases of BTEX chemicals recorded in CSG wells or bores in Queensland[11].

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6 Northern Geosciences. 2005. Report on Hydro-geological Investigations Dooralong and Yarramalong Valleys, Wyong Central Coast NSW. A report prepared for the Australian Gas Alliance.

7 Ibid.

8 Mavroukis 2010

9 Gasrush, Four Corners Program.

10 http://news.ninemsn.com.au/national/8214369/gas-wells-could-leak-chemicals-into-water

11 http://www.smh.com.au/environment/toxins-found-at-third-site-as-fracking-fears-build-20101118-17zfv.html, http://www.lngworldnews.com/australia-arrow-finds-traces-of-btex/,

Summary

Therefore, the major issues with water that have been identified in the literature and through experience with CSG in Queensland and overseas can be summarised as follows:

1. Drawdown and/or contamination of aquifers, with impacts that may occur many decades after the drilling
2. Very long time frames for groundwater recharge
3. Subsidence leading to increased connectivity between aquifers, and cracking/draining of creeks and swamps
4. Increased pressure on over-allocated systems
5. Cumulative impacts that are poorly understood
6. Groundwater modelling techniques that are inadequate
7. Impacts on surface water hydrology and water quality from discharge of produced water
8. Chemical pollutants affecting water sources in various stages of the process
9. Problems with disposal of brine and other wastes

In NSW, CSG extraction is likely to pose a major threat from all the problems outlined above. In the Pilliga, coal seam gas drilling risks depressurising important recharge aquifers of the Great Artesian Basin.

Already, during the exploration phase, spillage of saline water has led to extensive tree deaths (for example at Bohena 2 and Bohena 7 wells), disposal of water in unlined drill ponds has led to salt scalds and animal deaths, and disposal of treated water has altered the hydrology of a local creek system from an ephemeral system to a permanently saturated system for at least 500m (Bohena Ck). Drill ponds have been recorded overflowing during flood events (Dewhurst 8 complex) and there has been a recorded event of chemical spillage (Culgoora 2).

Presently, in the Pilliga, produced water that is treated with reverse osmosis is discharged into the Bohena Ck. Such water is still at risk of containing elevated salt levels compared to the creek water and may also still contain other contaminants that are not removed by reverse osmosis. Bohena Ck is an ephemeral creek with a shallow alluvial aquifer that discharges into the Namoi River, part of the Murray-Darling Basin. Eastern Star Gas claim that up to 1Ml per day is currently discharged into the creek, although flow rates at the discharge point suggest a far greater volume is likely to be discharging. There is no requirement for comprehensive monitoring to conducted of the quality of the water that is discharged nor of the impacts of the discharge on the ecological character of the creek. The only requirement contained in the Review of Environmental Factors is that ESG conduct 'visual' inspections of the creek. However, it is apparent that such discharge has the potential both to substantially reduce water quality and to dramatically alter the ecological nature of the creek from ephemeral to permanently saturated.

If Eastern Star Gas were to go to full production and place 1,100 well-heads in the Pilliga forest, there would be vastly increased volumes of water that are likely to be discharged into local creek systems, with major risks to the creek systems of the Murray-Darling Basin. Using the upper estimate of water production provided by ESG of 0.16ML per well per day, and applying it to the proposed 1,100 wells, results in an upper estimate of 176ML of water produced each day amounting to a total of 64GL per year. This is a vast quantity of water which will dramatically alter the ecology of the Bohena Ck system if it were discharged - it would change an ephemeral creek system into a permanent watercourse and dramatically alter the ecology of the area.

At Casino, coal seam gas drilling and saline water storage on the floodplain represents a threat to surface water health. In the Illawarra escarpment and the Tomago sandbeds, coal seam gas drilling represents a severe risk to drinking water supplies. In the Illawarra, the impacts of subsidence may lead to serious damage to surface water creek systems and heavy rainfall events

are likely to lead to erosion around roads and infrastructure and declining water quality. The Sydney Catchment Authority has strict controls on entry into catchment areas, prohibiting any access for recreational or other such purposes. It is extraordinary that people are excluded from walking in such sensitive areas but that coal seam gas companies are allowed in to sink wells and construct all associated infrastructure. In the Liverpool Plains near Gunnedah, coal seam gas drilling threatens shallow alluvial aquifers that are crucial to food production.

It is apparent that the hydrological impact assessment and modelling that is currently conducted prior to CSG extraction is inadequate to properly assess the risks at an appropriate scale. We have been advised that there are new groundwater assessment techniques, that are being utilised in the United States, that involve electro-kinetic methods that can provide far more reliable maps of aquifers and the connectivity between them. We believe that there should be a mandatory requirement for the application of the newest and best available technologies to assess and model the likely impacts of coal seam gas extraction. The work should be conducted independent of the companies - as experience shows that consultants working for the proponents are inherently captured and cannot provide independent studies.

Disposal of waste

There are major issues pertaining to disposal of waste in CSG activity, and there is a lot of uncertainty with regard to how waste is currently being disposed of from CSG exploration activities. There are three major types of waste produced, for example, by Eastern Star Gas in the Pilliga: cuttings produced during drilling, sludge produced from drilling and concentrated brine derived from treatment of produced water.

At the moment, there is no clear reporting as to how these wastes are being dealt with, or certainly none that we have been able to find in any official documents. At present it seems that cuttings are buried in the drill ponds when they are filled, with unknown environmental

consequences. There is no information on how or where the highly toxic drilling sludge is disposed of, and there is equally no information on how the concentrated brine held in a storage pond is being dealt with or will be dealt with in the future. Given the volume and toxicity of these waste products, it is extraordinary that there is not a strong regulatory system in place to control their management. In the Pilliga, for example, if the full proposal for the Narrabri Coal Seam Gas Project goes ahead, we estimate that it will produce up to 52ML of concentrated brine per day, which would equate to 18GL each year that would have to be disposed of. This is based on 30% of treated water remaining as concentrate after reverse osmosis, which is given as the likely recovery rate by ESG (2006), when they state that "*Preliminary modeling of the treatment process suggests that the rate of recovery will approximate 70%; that is 70% of the production water passed through the treatment unit will be recovered as permeate for reuse and discharge and the remaining 30% as concentrate for storage and further evaporation*".

The fact of the matter is that there is no long-term solution to the waste that is produced from CSG mining. That is evident in the Northern Rivers, with Metgasco recently applying to the Richmond Valley Council to build a second temporary holding pond to store wastes, with no long-term plan for its disposal.

Another approach that has been proposed and is apparently being trialled in Queensland CSG projects[12] and utilised in the US[13] is re-injection of produced water or brine back into aquifers. Re-injection is energy intensive and expensive[14] and it poses a risk of contaminating other aquifers with saline water or brine[15].

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[12] Australia Pacific LNG Project Talinga/Orana Environmental Management Plan http://www.aplng.com.au/pdf/talinga/Talinga_Att_5_Talinga_aquifer_injection_trial_management_plan.pdf

[13] Farag et al 2010, "Potential effects of coal bed natural gas development on fish and aquatic resources" p.7 from http://www.uwyo.edu/wycoopunitsupport/docs/Potential%20Effects%20of%20Calbed%20Natural%20Gas.pdf

[14] Warrence and Bauder, 2008

[15] Australian Government National Water Commission, 'The Coal Seam Gas and water challenge', August 2011

Effects on Crown Lands including Travelling Stock Routes

The coal seam gas industry poses a major threat to Crown Lands in NSW. An analysis of current exploration and production licences indicates that petroleum titles in NSW currently cover an area of 1.3 million hectares of State Forests, State Conservation Areas and Travelling Stock Routes. All of these titles are available for exploration and coal seam gas production.

Map 1 shows the distribution of mapped public lands in NSW which overlap with current petroleum titles. Additional areas of Vacant Crown Lands and Crown Reserves which are not currently readily available in mapped form are also at risk.

Table 1 below provides a summary of the areas of each public land tenure listed above within existing petroleum titles in NSW. In total, some 39% of these tenures are located within existing petroleum titles in NSW.

Table 1. Public lands available for mining within petroleum titles in NSW

Category	Area in Petroleum Titles (hectares)	Total Area in NSW (hectares)	Percentage at risk
Travelling Stock Route	215797	482288	**45.00%**
State Conservation Area	373207	713871	**52.00%**
State Forests	747453	2212396	**34.00%**
Total	**1336457**	**3408555**	**39.00%**

It is apparent that the ease with which miners can obtain access to public lands means that they are increasingly targeting such lands as the first step in exploration. In north-western NSW, Eastern Star Gas has sought to establish its first exploration and production area in the State

Forests of the Pilliga and further north several coal seam gas companies have sought to drill preferentially on Travelling Stock Routes in the early phases of exploration. In the Illawarra, coal seam gas companies are drilling in public catchment areas. Coal seam gas mining will have a direct negative impact on both conservation and recreation on public lands.

State Conservation Areas are protected areas that are gazetted under the National Parks and Wildlife Act 1974, that form part of the National Reserve System and that are categorised as Reserve Category II by the International Union for the Conservation of Nature. The primary objective of IUCN II reserves is to '*protect natural biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation*[16]'. It is clear that the extensive surface disturbance caused by coal seam gas mining is completely incompatible with the objectives of IUCN conservation areas. The risks to State Conservation Areas from CSG are severe, with more than 52% of all SCAs in NSW already covered by petroleum exploration licences.

Travelling Stock Routes are well-recognised as some of the most valuable vegetation remnants left west of the Great Dividing Range. They are ribbons of green in a heavily cleared landscape and often contain the only intact native vegetation remaining in a landscape. They have outstanding natural and cultural heritage values, and are closely associated with the droving lifestyle that has been immortalised by a number of great Australian poets. They are still used for grazing and they often contain important watering points. Coal seam gas extraction is incompatible with both their current uses and with their natural and cultural values. CSG will alienate TSRs from use by stock, severely damage these sensitive environments and prevent many of the recreational uses that are currently allowed.

In a letter to the NSW Minister for Primary Industries, dated 2nd June 2011, the Chairman of the State Management Council of the Livestock Health and Pest Authority specified that LHPA

[16] http://www.iucn.org/about/work/programmes/pa/pa_products/wcpa_categories/pa_categoryii/

concerns with CSG mining refer to:

- *"Possible impacts on TSRs which are prime examples of natural ecosystems*
- *Possible impacts on underground water including the Great Artesian Basin and the*
- *threat this poses to water quality used by stock accessing TSRs*
- *Its core function is to safeguard agriculture in NSW*
- *TSRs will be targeted in areas where landholders oppose the development*
- *The activity occurring on TSRs where landholders oppose the development impacts on the LHPAs image of being there to assist landholders"*

The LHPA went on to request that the Minister consider the following recommendation:

1. *"That the State Government supports an indefinite moratorium on all CSG new mineral and extraction activity until satisfied through the provision of independent expert evidence that:*
    - *There will be no significant or irreversible impacts on the level and quality of aquifers, natural waterways, and the Great Artesian Basin.*
    - *There will be no detriment to or loss of neighbouring prime agricultural land, and*
    - *There is evidence that CSG does not pose a risk to human or animal health*
2. *That the environmental and agricultural benefit of the TSR will have priority over CSG exploration and extraction activity.*
3. *The LHPA be included in any negotiation relating to access to TSRs for CSG or extraction activity".*

These sensible recommendations by the LHPA State Management Council to the NSW Government seem to have been ignored. Unfortunately, the NSW Governments pre-election 'Strategic

Regional Land Use Policy' actually proposes to target crown lands for mining infrastructure. It states that *"An elected NSW Liberals and Nationals government will.....review existing arrangements for land access for mining and petroleum industries to ensure they achieve our goal of facilitating good relations and timely access. This will include promoting the use of crown land, such as Travelling Stock Routes, for pipeline routes where viable and the establishment of energy and transport corridors..."*

Such an approach is inconsistent with the outstanding values of TSRs and other Crown Lands and with the stated intentions of the LHPA. This is already a cause of concern, with the Eastern Star Gas pipeline from the Pilliga to the proposed LNG export facility at Newcastle passing through high conservation value Travelling Stock Routes.

State Forests are public lands that are managed under the Forestry Act 1916. Section 8A of the Act sets out the objects of the Forestry Commission in its management of State Forests as follows:

(1) *The objects of the commission shall be:*

(a) to conserve and utilise the timber on Crown-timber lands and land owned by the commission or otherwise under its control or management to the best advantage of the State,

(b) to provide adequate supplies of timber from Crown-timber lands and land owned by the commission or otherwise under its control or management for building, commercial, industrial, agricultural, mining and domestic purposes,

(c) to preserve and improve, in accordance with good forestry practice, the soil resources and water catchment capabilities of Crown-timber lands and land owned

by the commission or otherwise under its control or management,

(d) to encourage the use of timber derived from trees grown in the State,

(e) consistent with the use of State forests for the purposes of forestry and of flora reserves for the preservation of the native flora thereon:

(i) to promote and encourage their use as a recreation, and

(ii) to conserve birds and animals thereon, and

(f) to provide natural resource environmental services (whether within or outside of New South Wales).

Coal seam gas mining is directly incompatible with the objects of the Forestry Act 1916:

- It will have a detrimental impact on timber resources, through permanent clearing of significant areas of forests - for example, in the Pilliga, Eastern Star Gas plan to clear 2,400ha of vegetation for their proposed gas field.
- It will not preserve and improve the soil resources and water catchment capabilities of Crown Lands, but will instead represent a threat to both
- It will undermine and prevent the use of State Forests for recreation, as large areas of forest will be fenced off and the public will be excluded, as has already occurred in the Pilliga during exploration. Recreation options are dramatically reduced as a result of the change from a forested area to an industrial zone.
- It will threaten birds and animals and cause severe damage to their habitats, and will undermine natural resource environmental services such as clean water supply and carbon storage.

Impacts on National Parks

Even though coal seam gas mining is not allowed in National Parks, they are not immune from its impacts. At Putty, there are plans to explore just 500m from the World Heritage-listed Wollemi National Park, and at Poggy drilling is occurring on an inholding within Goulburn River National Park. At Mt Kaputar, exploratory wells have been located around the edge of the National Park, effectively ringing it. In the Northern Rivers, a major gas pipeline is proposed to be constructed along a road that passes through the World Heritage-listed Border Ranges National Park. There should be a major buffer around National Parks that prevents exploration anywhere in their vicinity to prevent negative impacts, and pipelines should not be allowed to pass through National Parks.

Summary

Coal seam gas mining on public lands is inappropriate and likely to have very severe environmental impacts. It seeks to transfer the public interest and turn it into private gain for a small number of largely multi-national companies. It will drastically undermine the use of Crown Lands for recreation, will limit the areas to which the public has access, and will have major environmental impacts on high conservation value areas.

Effects on the natural environment and biodiversity

There will be serious impacts on native vegetation and biodiversity from coal seam gas mining in NSW. This is an aspect that is often over-looked during discussion of its impacts.

Impacts on aquifers represent a major threat to wetlands, including Ramsar-listed wetlands, and to groundwater dependent ecosystems. Notably, a recent study for the Namoi Catchment Management Authority has identified most of the woodland vegetation in the Pilliga as having high potential as being a groundwater dependent ecosystem. Therefore, any impacts on

groundwater is likely to have substantial repercussions for those woodlands, and for the species which utilise them as habitat.

In the Maules Creek area, there are unique groundwater invertebrates, known as stygofauna, which are highly sensitive to any changes in groundwater. They are thought to play a role in filtering and cleaning groundwater. These fauna are very poorly researched and therefore their full distribution at this stage is unknown, but they are also likely to occur in other aquifers that have not previously experienced major changes in groundwater levels or chemistry. Macquarie Energy currently has an exploration licence over the Maules Creek area. It has to date, as part of that licence, drilled a string of wells right around the edge of Mt Kaputar National Park.

Groundwater impacts from coal seam gas mining has the potential to affect wetlands that are far removed from where the mining occurs. For example, approved coal seam gas projects in Queensland already represent a risk to wetlands in NSW, such as the Narran Lakes.

The impacts of coal seam gas extraction on native vegetation in the Pilliga are likely to be severe. The Pilliga is the largest temperate woodland left in eastern Australia, and one of our most important natural assets. It is 'a million wild acres', some 500,000 hectares in size, and it has recognised national and international conservation significance. It is located in a national biodiversity hotspot, the Brigalow Belt South, it is an internationally listed Important Bird Area, and it provides habitat for up to 30 listed matters of national environment significance and up to 48 threatened species and communities under NSW legislation.

The Pilliga is the largest remnant left in the Wheat-Sheep Belt of NSW. It is surrounded by largely cleared agricultural land. It is now a last stronghold for many species, including numerous bird species, that are now declining throughout their range. Of particular conservation significance is the fact that the Pilliga provides core habitat for:

- The only known population of the endemic and nationally vulnerable Pilliga Mouse
- The largest Koala population in inland NSW
- The only known Black-striped Wallaby population in inland NSW
- The recognised population stronghold for the nationally-vulnerable South-eastern Long-eared Bat
- The recognised population stronghold for the Barking Owl in NSW.

Experience in the Pilliga indicates that coal seam gas exploration and production leads to major clearing and fragmentation of native vegetation. Even during the exploration phase, the following impacts have occurred: clearing of up to 150 hectares of native vegetation, heavy fragmentation of 1,700ha of native vegetation, an increased footprint across 44,000ha of native vegetation. This has included clearing of habitat for NSW and nationally-listed species.

If the full production project that is proposed by Eastern Star Gas is approved, it would allow the clearing of at least 2,400 hectares of native vegetation and the fragmentation of an area of 85,000 hectares. Well-pads would be cleared to a size of 1.2 hectares, some 1,000km of pipelines would be cleared, and there would be additional clearing for roads, tracks and infrastructure. Well-pads would be placed on a 500m grid, effectively carving up the most intact patch of bush in western NSW into a highly fragmented industrial zone.

Numerous scientific studies have reviewed the impacts of fragmentation of bushland on native fauna. Fragmentation is likely to have a detrimental effect on fauna species that survive initial clearing. Fragmentation often leads to small, isolated populations that are prone to extinction. These small populations may be subject to loss of genetic variability and inbreeding depression, fixation of deleterious mutations, and are more likely to become extinct through stochastic environmental events such as fire.

Fragmentation may reduce food availability, increase predator abundance, and restrict normal adaptive behaviour[17]. Of particular concern is the impact of fragmentation on cooperative breeders (species where offspring of at least one sex remain on the natal territory to raise subsequent generations; an unusually high proportion of Australian species breed in this way) and other territorial species. Many Australian species maintain territories between years and generations and cannot relocate once that habitat is lost. Among Australian birds, for example, fragmentation has been shown to disturb the dispersal of cooperative breeders, contributing to the decline of some passerines that inhabit fragmented woodland[18].

The negative impacts of fragmentation, as described above, are a particular cause of concern in the Pilliga, because it is the size, integrity and connectivity of the Pilliga that gives it such ecological significance and why its preservation helps meet conservation objectives (e.g. *Pilliga Nature Reserve Plan of Management, NPWS 2003*).

There is already evidence from the exploration phase that coal seam gas extraction leads directly to increased weed invasion, which will degrade the entire ecological value of the Pilliga. Similarly, roads and tracks on a grid pattern are known to lead to the ingress of feral animals. The impacts of coal seam gas on native vegetation and biodiversity in the Pilliga will be severe, and similar impacts will occur in other parts of the state where coal seam gas extraction occurs in bushland areas. At particular risk are large areas of public land in the Clarence Moreton Basin in the northern rivers region.

Fire Risk

Coal seam gas extraction represents a substantial fire risk, especially in wooded landscapes,

[17] For a description of some of the impacts of fragmentation, see http://www.sciencedirect.com/science/article/pii/S0006320700001014

[18] For details on a study of the impacts of fragmentation on the Brown Treecreeper, see http://www.biol.vt.edu/faculty/walters/Publications/Cooper%20and%20Walters%202002a.pdf

from increased ignition sources, the extraction of a highly flammable fuel (methane) from deep underground to the surface, and the potential for underground fires in dewatered coal beds. American reports point to a high incidence of fires and explosions associated with wells[19], and also to fires associated with pipelines. These risks will be dramatically intensified in the Pilliga forest, because it is already prone to fast-moving high intensity burns. The introduction of a gas field into such an environment is irresponsible, and may well result in a catastrophic fire event.

Most fires in the Pilliga at present are caused by dry lightning strikes, and there are also issues about lightning interacting with coal seam gas infrastructure, including metal well heads. In America, there are serious concerns also about the potential for 'spontaneous combustion and continued burning of completely dewatered coal beds', which have been raised by the US Energy Justice Network[20]. They state that "*When water is pumped out of coal seams, coal becomes exposed to oxygen, and coal fires are possible*". The scale of this risk in NSW is unknown.

An increase in fire risk in the Pilliga is likely to lead to an increase in both frequency and intensity of fires. Given that the Pilliga area is already known for extremely hot burns that travel vast distances in short time frames, any increase in risk must be considered a potentially serious threat to both human safety and to native wildlife and biodiversity in the area. We believe the location of a gigantic gas field in such a fire prone environment may lead to catastrophic fire events, and consider the proposal both irresponsible and inappropriate for the location.

Volunteer firefighters should not be asked to risk their lives in the Pilliga to fight fires caused by placing a gigantic gas field in the middle of a tinder box.

Nature and effectiveness of remediation required under the Act

We do not believe that rehabilitation requirements are adequate or that there are any

[19] Fractured communities

[20] From http://www.energyjustice.net/naturalgas/cbm#173

meaningful methods to hold coal seam gas companies to account with regard to rehabilitation. Experience in the Pilliga has shown that well-pads become dominated by weeds and are not rehabilitated. Saline water spillages that have led to extensive tree deaths, albeit under a prior operator to Eastern Star Gas, have just been left as they are with no rehabilitation.

There has been little or no successful rehabilitation of abandoned drill holes in the Pilliga and there are numerous serious weed incursions at almost every corehole that has been drilled. Examples include Dewhurst 6c, Dewhurst 5, Bohena 2D, Bohena 7 and numerous other well-pads. The failure with regard to rehabilitation is despite the fact that the relevant REFs require 'the removal of imported materials and the rehabilitation of the site'. There has been no rehabilitation of areas which have been subject to tree deaths at Bohena 2D, 3, 4/4L, 5 & 7 and Dewhurst 5.

Effect on greenhouse gas and other emissions

Recent research from America[21] has indicated that fugitive methane emissions from shale oil gas which is very similar to coal seam gas extraction, when fully accounted for, render it much the same as coal with regard to life-cycle greenhouse gas emissions. There is currently no truth in accounting with regard to these emissions nor has there been sufficient research conducted in Australia. A rigorous set of criteria and detailed research project is urgently require to properly quantify the extent of fugitive emissions from coal seam gas in NSW, before the industry is to proceed any further here.

Howarth[22], in his study of emissions from largely shale gas operations in America, concludes that *"Methane contributes substantially to the greenhouse gas footprint of shale gas on shorter time scales, dominating it on a 20-year time horizon. The footprint for shale gas is greater than*

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[21] Howarth, Santoro and Ingraffea. 2011. Methane and the greenhouse-gas footprint of natural gas from shale formations. Climatic Change. http://graphics8.nytimes.com/images/blogs/greeninc/Howarth2011.pdf

[22] Howarth, Santoro and Ingraffea. 2011. Methane and the greenhouse-gas footprint of natural gas from shale formations. Climatic Change. http://graphics8.nytimes.com/images/blogs/greeninc/Howarth2011.pdf

that for conventional gas or oil when viewed on any time horizon, but particularly so over 20 years. Compared to coal, the footprint of shale gas is at least 20% greater and perhaps more than twice as great on the 20-year horizon and is comparable when compared over 100 years". This increase in emissions results from the fact that methane is released during the processes of drilling and fracking, and over the life of the well through venting and leaks. In the Pilliga, recent evidence has revealed leaking gas pipes and a water drain bubbling methane gas to the atmosphere. Venting of methane into the atmosphere has been observed at a number of wells in the Pilliga, as has flaring of gas. Fugitive emissions from methane are particular problematic with regards to global warming because when considered over a 20-year period the climate change force of methane is 72-times greater thean carbon dioxide."[23]

There are also numerous other sources of greenhouse gases associated with coal seam gas production. The full life-cycle emissions need to be properly assessed, and should include transport and machinery operation, reverse osmosis, extraction, pipeline transport, leakage, liquefaction, shipping, regasification and generation. Many of these stages, including liquefaction and reverse osmosis in particular, are very carbon intensive. This is particularly relevant as most coal seam gas in Australia seems destined for export, with the added carbon cost of liquefaction.

The fact is that coal seam gas is a fossil fuel with major greenhouse gas implications - that will produce 40 times the amount of greenhouse gases generated by genuinely renewable power sources such as solar and wind technologies. The coal seam gas industry in Australia and NSW is largely being developed for an export market, it is not being developed as a transition fuel for our country. The Eastern Star Gas proposal in the Pilliga is planning to export the gas from a proposed LNG export facility at Kooragang Island at Newcastle. The development of this industry in NSW is not about domestic gas production, and that is a very important distinction

[23] Fugitive emissions: what is the real footprint of coal seam gas?
http://theconversation.edu.au/fugitive-emissions-what-is-the-real-footprint-of-coal-seam-gas-2940

that needs to be made when considering its future. By bolting headlong into an export gas rush we will undermine the development of real renewable energy and create massive environmental problems that will last far longer then the short-term profits to a few lucky CSG companies. We should move directly to renewable energy, and not proceed with another fossil fuel with severe environmental and social impacts.

THE ECONOMIC AND SOCIAL IMPLICATIONS OF CSG ACTIVITIES

The coal seam gas industry has experienced rapid expansion in recent years. That industry expansion has come at the cost of not only environmental values, but the respect for socio-economic impacts. Citizens on the periphery - and often at the heart - of coal seam gas exploration areas are at great risk of losing control of their own property when they are denied their basic rights as land owners. CSG drilling companies are issued exploration and drilling permits against the express wishes of landholders, who have little recourse or legal options to defend their rights. A rural property that has been stripped of its natural vegetation and developed into a field of drilling rigs has lost its value to the owner. Unfortunately it has also lost much of its resale value; moving away is not an option for affected residents.

Australia's domestic food supply is of critical importance, not only to the population dependent upon it but to the farmers who produce it. Food security is threatened by CSG mining practises which do not take into account the value of the land, only the value of what lies beneath it. Grazing land is rendered unusable when it becomes a gridwork of pipelines, supply roads and wellheads. Again, this land loses resale value, leaving farmers with no means to escape the situation CSG mining companies have forced upon them.

Communities are also put at risk from the common practise of hiring outside labour to work drilling fields. Workers brought in from elsewhere have little attachment to the community or the land and do not contribute to the local economy on a long-term basis. The influx of outsiders

often drives up rent, food and fuel prices. Locals do not see an increase in employment to offset these higher costs of living. Evidence also shows an increase in crime rates and violence in these areas.

Considering the consequences for these communities, it is particularly unconscionable that they are largely excluded from the planning processes of CSG mining companies. Even local governments are left in the dark, often not aware of plans to explore for CSG until the land is already being cleared. Current legislation and legal recourse is totally inadequate, the public voice is nearly nonexistent, and CSG mining companies would prefer it remain that way.

History has taught us countless harsh lessons about what happens when companies who stand to make a great deal of money from natural resources are allowed to operate unchecked.

THE INTERACTION OF THE ACT WITH OTHER LEGISLATION AND REGULATIONS

The current legal framework

There are major problems with the legal framework within which coal seam gas exploration and mining is regulated. It is beset by inadequate legal constraints, exemptions from key environmental statutes and provisions, lack of public transparency, exclusion of local authorities from decision-making powers, and poorly considered interactions between various statutes and planning policies.

The problems with the Petroleum (Onshore) Act 1991 and associated regulations, including the Petroleum (Onshore) Regulation 2007 and the SEPP (Mining, Petroleum Production and Extractive Industries) are manifold. Firstly, the PA provides gas companies with the power to serve notice on landholders which requires them to negotiate an access agreement and which forces them to attend arbitration or face the Land and Environment Court if an agreement cannot be reached.

The Act should be amended to provide landholders with the right to directly refuse access to coal seam gas companies who want to explore for or produce gas on their lands.

The controls on exploration in the PA and associated statutes are very weak. Experience in the Pilliga shows that commercial production of gas is allowed under an exploration licence and assessment lease. The SEPP makes exploration an activity that is permissible without development consent under the NSW Environmental Planning and Assessment Act 1979, apparently regardless of whether that exploration is being used to fuel gas production. This represents a major loophole in the laws. It allows companies to conduct excessive work which equates to production under the guise of exploration, however the constraints imposed on it and the approvals required are far less rigorous. This is particularly evident in the Pilliga, where in the so-called exploratory phase Eastern Star Gas has undertaken:

- The drilling and on-going management of more than 92 coal seam gas bores and coreholes
- The conduct of 482km of seismic surveys
- The construction and management of 56.6km of gas and water gathering pipelines
- The development and management of five pilot production gas fields, encompassing 35 pilot production bores
- The construction and management of a gas-fired power station at Wilga Park, including an upgrade of the station from 10MW to 40MW
- The construction and operation of 1 reverse osmosis unit
- The construction and management of 13 major water treatment dams/impoundments and numerous drill ponds
- The discharge of at least 1ML per day of treated produced water into the Bohena Ck, part of the Murray-Darling Basin.
- The bull-dozing of numerous roads and tracks to facilitate the construction and operation of works listed above.

All of these works have been undertaken without obtaining a production licence, but have been accommodated within exploration and assessment leases. The concept of 'pilot production' that is widely used by coal seam gas companies during exploration, has no standing at law and appears to be a loophole that is used to conduct production under the guise of exploration.

The other major problem with the PA is the weak provisions surrounding the granting of petroleum titles. There is no requirement for any meaningful environmental considerations prior to the granting of a title and there is no public exhibition or consultation requirements. Similarly, title renewals are equally problematic with no clear objective tests which the Minister must apply and no public consultation requirements. There should be a rigorous process introduced to apply before titles are granted with full public transparency. To provide an idea of the scale of the problem, at present in NSW there are 5.5 million hectares of petroleum exploration titles that have expired. No-one knows anything about the status of these titles or how they are being assessed for renewal by the NSW Government. In the mean time, exploration work is allowed to continue unhindered in these areas despite the fact that the title has effectively expired. There appears to be no limit to how long such a situation may continue, with some expired titles now at least 7 months old. Map 2 shows the distribution of expired petroleum titles in NSW at the time of writing.

During exploration there are no requirements for public exhibition of either licences or of any other approvals prior to works being undertaken. The only substantive approvals that are required at the exploration stage are Reviews of Environmental Factors under s111 of the NSW EP&A Act 1979. These are not made available to the public until after they have been approved and often a lengthy time after the activities have actually been undertaken. There are no legal avenues for the community to challenge these consents.

In addition, in NSW coal seam gas exploration is exempt from numerous key environmental statutes that are placed on agricultural industries, including the Native Vegetation Act 2003 and sections of the Water Management Act 2000.

Petroleum exploration is exempt from the requirement to obtain a water access licence under the Water Management Act 2000, if the volume obtained is up to a maximum of 3ML per year. This has improved due to recent amendments that imposed the 3ML maximum, however those amendments also allowed existing exploration activities to continue without an access licence. This means that Eastern Star Gas operations in the Pilliga, which are extracting large volumes of groundwater, still do not have a water access licence. The exemption is contained in section 18 (1) of the Water Management (General) Regulation 2011. Coal seam gas exploration is also exempt from s 91B (1) of the Water Management Act 2000 which requires approval to be sought for a water supply work, and they are exempt from the requirement to advertise the application for an approval under Part 3 of Chapter 3 of the Act. These exemptions are also contained in the Water Management (General) Regulation 2011.

Section 25 of the Native Vegetation Act 2003 specifies that "*This Act does not apply to the following types of* clearing *of* native vegetation: *....(m) any* clearing *authorised under the* Petroleum (Onshore) Act 1991". Furthermore, this exemption also covers clearing for petroleum production, so that even full-scale coal seam gas developments are not subject to the NV Act. In addition, the Native Vegetation Act 2003 does not apply to Crown Lands or State Forests, which were excluded because they were not considered to be threatened by any form of broadscale landclearing. However, with the expansion of coal seam gas mining on to public lands, that is clearly no longer the case. Therefore, all of the vegetation that has been cleared for CSG exploration to date in the Pilliga has been cleared without an approval under the Native Vegetation Act 2003.

Part 3A of the NSW EP&A Act 1979, and its replacement in the form of transitional planning provisions applying to state significant development, is flawed and inadequate to protect the environment or the community from negative impacts of coal seam gas development. State significant development is effectively exempt from a number of pieces of important legislation and requires that other approvals must be granted once a planning approval is given. Particularly concerning is the fact that the transitional provisions require the provision of an environment protection licence under the Protection of the Environment Operations Act once planning approval is granted for state significant development. This is likely to have major implications relating to the discharge of produced water into creek systems in NSW. When approvals are granted for state significant development by a Planning Assessment Commission the community loses legal rights to appeal those decisions in a court of law. The public deserves full third party legal standing to challenge coal seam gas developments, at both the exploration and production stage, in NSW. Substantial reform is required to the NSW EP&A Act 1979, along the lines recommended by the NSW Environmental Defenders Office, to provide a far more rigorous approval process for large scale infrastructure such as mines.

There are major issues with compliance and enforcement of environmental regulations when it comes to coal seam gas exploration and mining. It is apparent that the vast scale of the footprint of CSG makes it almost impossible for regulators to keep up. In fact, experience in the Pilliga is that regulators have virtually no understanding of what is happening and that they have neither the resources nor the will to hold coal seam gas companies to account. The types of concerns with regard to compliance that have arisen in the Pilliga include:

- Failure to line drill ponds - at wells such as Bohena 7, Bibblewindi 16, Bibblewindi 22
- Water leakage and salt scalds around wells - at wells such as Dewhurst 2, Bibblewindi 16 and Bibblewindi 21H
- Spillage/leakage of saline water leading to tree deaths - at wells such as Bohena 2, 3, 4,

5 & 7, Dewhurst 5 and adjacent to the water treatment facility.

- Water pipes from highly saline ponds leading directly to vegetation and creek systems - Bohena evaporation ponds
- Waste water released directly into a creek system - Mollee Ck
- Overflow of drill ponds into surrounding vegetation during a rainfall event - Dewhurst 8 complex
- Spillage of chemicals during a flood event - Culgoora 2
- Gas leakage from a pipe at Bohena 3 and a from a water drain at Bibblewindi
- Reported animal deaths near drill ponds and reported fencing failures and inadequacies at numerous wells
- Concerns about excessive clearing reported at Dewhurst 8 complex, Wilga Park water treatment works and for access roads.

The current 66 exploratory and pilot production wells in the Pilliga are spread out across a large area. In fact, the external footprint of all seismic work and exploratory wells within the Pilliga is at least 44,000 hectares. The compliance issues identified above simply would not be identified by a government agency checking a couple of wells once a year, or less. Proper monitoring requires regular and detailed investigations of CSG operations, which requires vast resources given the scale of the impact.

After much community concern and state-wide media attention, we understand that the NSW Government has recently finally conducted some form of compliance audit of Eastern Star Gas operations in the Pilliga forest. The full results of that audit should be made publicly available as soon as possible. However, ad hoc audits triggered by extensive community opposition is not an appropriate way to regulate such a damaging industry. If the Government cannot allocate the full resources required to implement a rigorous and regular compliance and monitoring regime, then the CSG industry should not be allowed to proceed.

Another major compliance issue has arisen in relation to the application of the Federal Environment Protection and Biodiversity Conservation Act 1999 to exploration activities. A detailed review and analysis conducted by a number of environment groups has revealed that Eastern Star Gas has conducted all of its exploration activities in the Pilliga to date without ever referring the matter to the Federal Government for an approval under the EPBC Act 1999[24]. This is despite the fact that the activities have cleared significant areas of native vegetation in habitat for nationally threatened species. The cumulative impact of the clearing of each different exploration activity does not seem to have ever been taken into account. The Federal Government is currently conducting an investigation into the activities, releasing a statement in response to the report by environment groups which said that[25] *"Eastern Star Gas is co-operating with the Department of Sustainability, Environment, Water, Population and the Community in an investigation of potential non-compliance with the Environment Protection and Biodiversity Conservation Act in relation to existing coal seam gas infrastructure"*.

Another major legal problem is the fact that coal seam gas companies look set to follow the lead of coal companies, by gaining initial approvals to commence operations and then expanding them out over far larger areas and modifying them in various ways such that the final project looks nothing like the one that was first presented to the community. This completely undermines the functioning of the EP&A Act 1979 which is based on an assessment of the significance of environmental impacts. If only a small project is put up initially, and it is determined not to have a significant impact, then it doubles or triples, the assessment of impact on the extensions would be different to that for the whole project. However, under the current rules, the full impact would never have to be considered. For example, in the Pilliga forest, the current production proposal is for 1,100 wells and 1,000km of pipeline. However, extrapolating that proposal out across the whole Eastern Star Gas exploration licence (PEL238), where there is

[24] TWS, NCC, NICE. 2011. Under the Radar: How Coal Seam Gas Mining in the Pilliga is Impacting Matters of National Environmental Significance.

[25] Statement is quoted in the story at http://www.abc.net.au/rural/telegraph/content/2011/s3274724.htm

high and moderate coal seam gas potential, indicates that the full proposal might ultimately amount to 7,100 wells

This estimate was derived by using data developed by the Department of Mineral Resources in 2002 which included a map of coal seam gas potential across the Brigalow Belt South bioregion[26], which covers the Eastern Star Gas Narrabri exploration area. This information allows an analysis to be conducted of the likely extent of the full Eastern Star Gas Narrabri coal seam gas project, based on the size and intensity of the current proposal for the small portion of the petroleum licence that is covered by their current 'project area' for which a development application has been lodged. Map 3 shows the mineral potential across the region, and within both the Eastern Star Gas Narrabri exploration licence and the current Eastern Star Gas Narrabri 'project area'.

Analysing that map in a Geographic Information System, environment groups have derived the following statistics:

	Total Area	Coal Seam Gas Potential (Mod-High)	Vegetated Coal Seam Gas Potential (Mod-High)
ESG Narrabri Petroleum Titles[27]	821,875 hectares	486,538 hectares	216,950 hectares
ESG 'Project Area'	85,000 hectares[28]	74,655 hectares	65,101 hectares

Therefore, the total area of moderate to high coal seam gas potential available to Eastern Star Gas in the exploration licence is 6.52 times the size of moderate to high potential in the current 'project area'.

Assuming that the density of drill holes will be the same, this can be used to extrapolate from 1,100 drill holes proposed in the project area to an estimated 7,172 drill holes that are likely to be sunk across the total licence area.

[26] NSW Department of Mineral Resources. 2002. Mineral and Petroleum Resources Potential, NSW Western Regional Assessments; Brigalow Belt South. A project undertaken for the Resource and Conservation Assessment Council NSW WRA, Project Number WRA/20.

[27] PEL238, PAL2 & PPL3

[28] As described in the Preliminary Environmental Assessment for the project

With regard to native vegetation, the total vegetated area with moderate to high coal seam gas potential available to Eastern Star Gas in the exploration licence is 3.3 times the size of the vegetated area with potential in the current 'project area'. Assuming that the intensity of impact on native vegetation will be the same, this can be used to extrapolate from 2,400 of native vegetation proposed for clearing in the current proposal, to an estimated 7,998 hectares of likely vegetation clearing across the total licence area.

The fact that such an expansion is likely is given further credence by the fact that ESG are currently exploring and operating pilot production wells within areas that are not in their current production proposal area. Legal reforms are needed to prevent the endless variations, modifications and expansions to proposals that undermine the application of the law and that mislead the community.

Review of reforms currently proposed by the NSW Government

Current reforms, both those already implemented and those proposed, by the NSW Government are not adequate to address the problems identified with CSG mining in this submission.

In fact, they clearly will not prevent the worst impacts of the coal seam gas industry on water resources, biodiversity and communities in NSW. Specifically, some of the key failings are that:

1. The emphasis on more administrative procedures, applied with considerable discretion, rather then strict prohibitions based on objective tests - for example, it seems that the Aquifer Interference Regulation is likely only to require an additional regulatory approval before drilling through an aquifer. In contrast, we believe the Aquifer Interference Regulation should prohibit CSG in all important aquifers, and that there should be no ministerial discretion to vary that.

2. There is a proposal to ban evaporation ponds, which is presumably to be implemented as part of the Aquifer Interference Regulation. However, there are many types of ponds that pose major environmental risks during CSG exploration and production - namely drill ponds, holding ponds and storage ponds. In the Pilliga, the exploration phase alone has involved the development of 13 major water storage impoundments, and only 2 of those would probably qualify as regular evaporation ponds. Most of the risks to the environment from toxic saline water will remain regardless - including the risks posed during extraction of the water from the seams due to leakage and soil contamination around the boreholes, the storage of the water in drill ponds, the transport of the water in pipes, and the storage of the water in impoundments which are at risk from overflow during rainfall events and which pose a hazard to wildlife. Therefore, merely changing the nature of the ponds that are allowed will not substantially address the problems with produced waste water from CSG.
3. The emphasis on more impact statements that are prone to being ignored and that do not contain objective tests. The NSW Government has promised to introduce Agricultural Impact Statements which require an assessment of impacts on agriculture from coal seam gas drilling, but again there is no clear objective test that will be applied to determine whether an activity will be approved. Experience shows that impact statements are routinely used as a basis on which to approve close to 100 per cent of developments.
4. They still do nothing to address the problems created by the fact that the proponents engage and employ environmental consultants, which creates a strong bias in favour of finding that there is no significant impact from the proposed actions.
5. The Strategic Regional Land Use Planning process is still an unknown. The concern is the length of time that it looks likely to take to roll out, and the fact that there are already close to 40 major mines in NSW that are in the planning process and will be dealt with under Part 3A anyway. Important areas at high risk from CSG, such as the Clarence Moreton Basin, are not included in the SLRUP areas.

6. The Namoi Water Study has been developed to provide a detailed hydrological model of the Namoi Catchment and to better quantify the cumulative impacts of mining on water resources. However, despite being located in the Namoi Catchment, the Pilliga is not included within the area that is being modelled for the Namoi Water Study. This is a major oversight that needs to be addressed, given the importance of the Pilliga as the southern recharge area of the Great Artesian Basin.
7. Future reforms to the EP&A Act 1979 are still unknown and their efficacy in addressing the many regulatory failings and inadequacies of the current system are in question.

THE IMPACT SIMILAR INDUSTRIES HAVE HAD IN OTHER JURISDICTIONS

In deciding on the feasibility of coal seam gas mining in our local area we can only draw on past and present examples in the interest of doing so accurately. Almost half of the 58 wells tested in May last year at QGC Kenya gas fields were found to be leaking. One was well over the explosive limit. This alone is unacceptable. A more recent state-wide audit of CSG wells in Queensland was undertaken where the results of which, according to Mining Minster Stirling Hinchliffe, showed that "98% of wells were safe". Another way of putting this is 2% were unsafe. When we consider the proposed magnitude of growth of the CSG industry and consider the sheer number of wells proposed for NSW alone, the surprisingly modest figure of 2% is suddenly a substantial number of wells, and represents a very real danger.

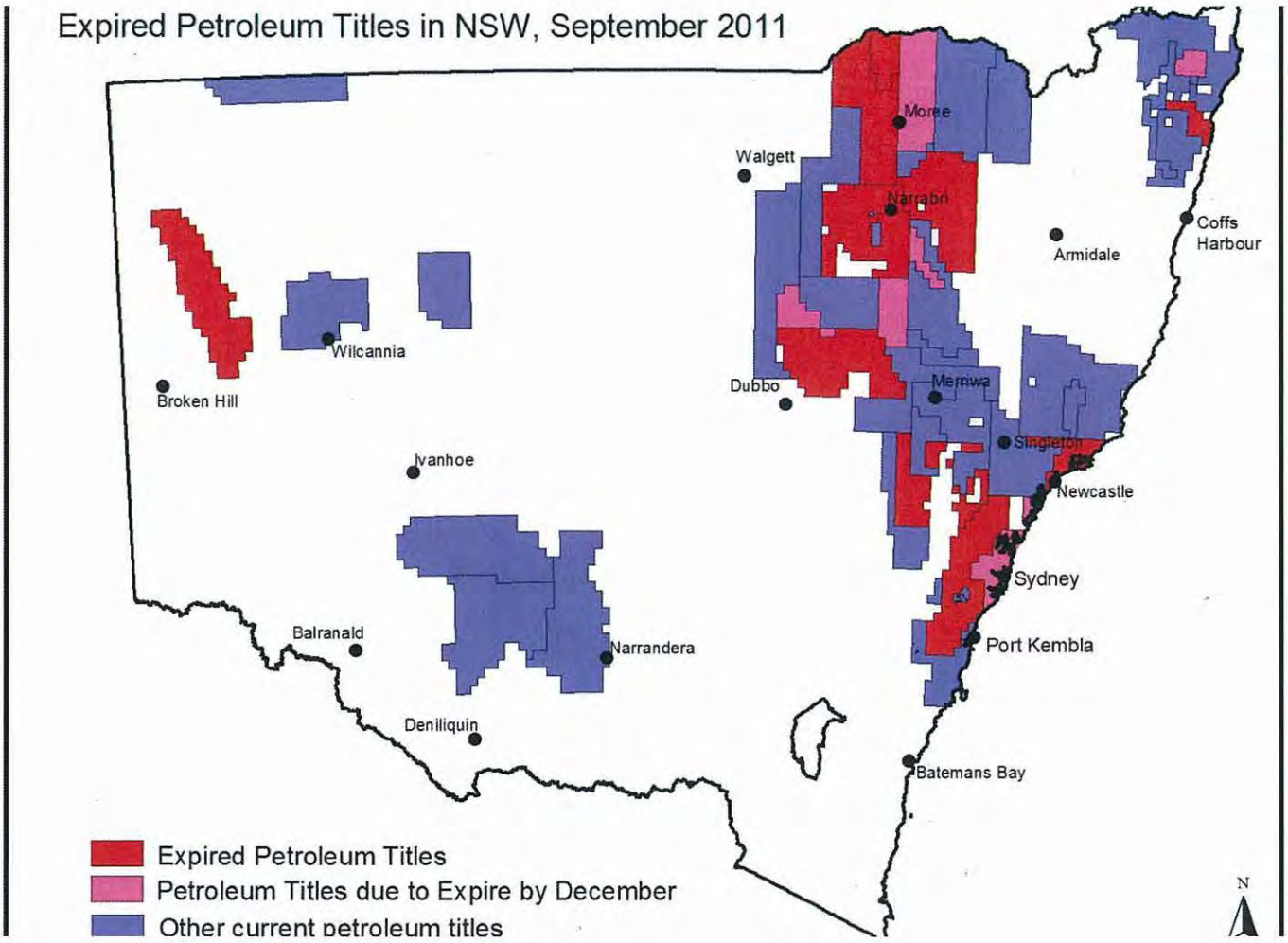
Any mining activity that infringes on the basic ownership rights of legitimate landholders and forces itself onto their property should be expected to be 100% safe. Clearly this is not the case. In May this year a well in Dalby exploded on the property of a farmer, Tom O'Connor. Tom O'Connor runs an irrigated and dry-land grain and cattle growing operation, including a feedlot. Saline water and gas, which has the potential to destroy his crops and contaminate his cattle feed, were shot ninety meters into the air. This was the fourth incident in five years on Mr O'Connor's property, which contains twelve CSG wells. This hardly fits the model of a safe

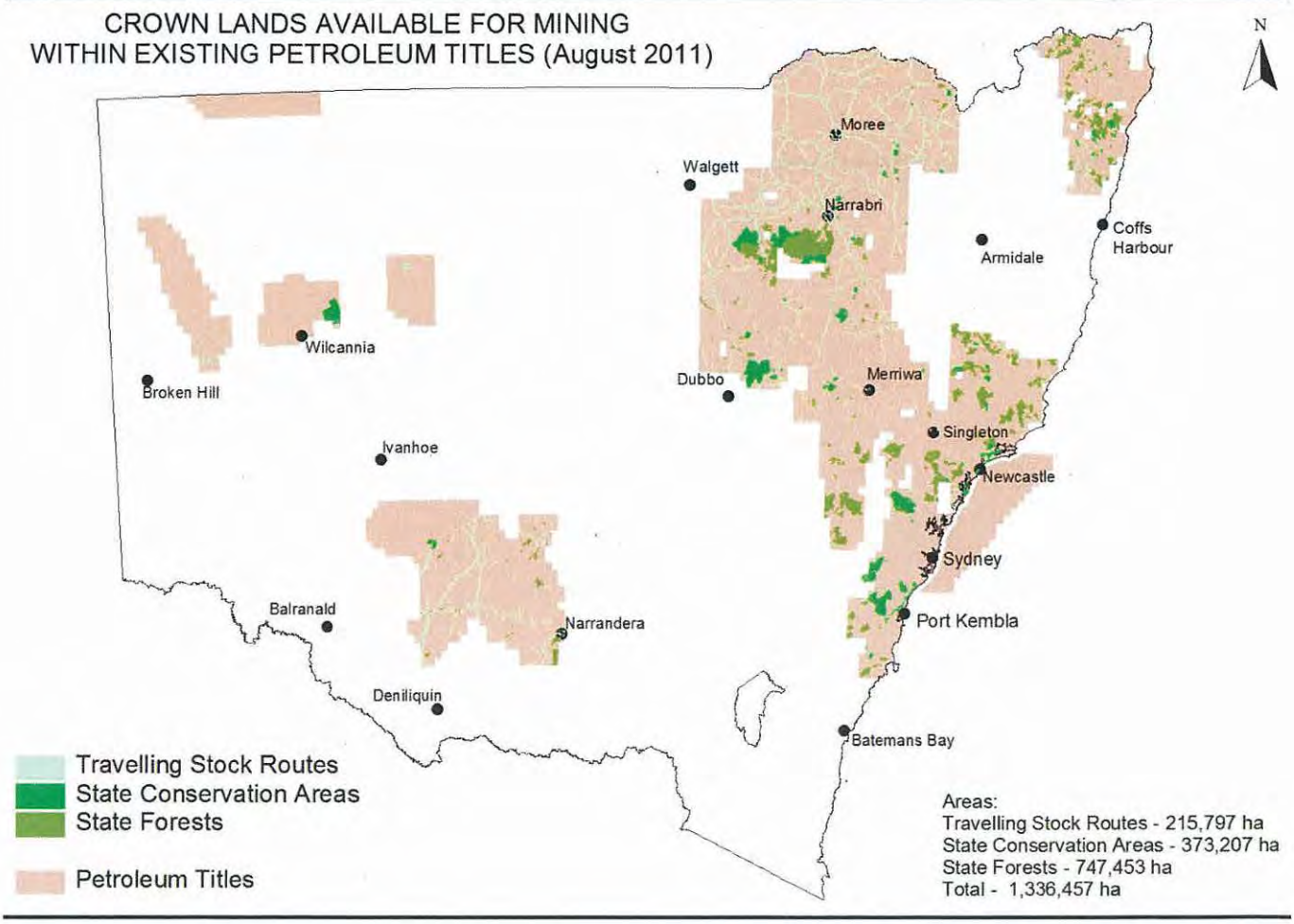
industry.

Based on the relatively long running CSG industry in Queensland, we can see a growing feeling of disempowerment among farmers and land owners who feel their communities and properties are at the mercy of CSG companies. The clearing of bushland and fragmentation of farmland is not only a physical erosion of landscape but leads to an erosion of the fabric of these communities. A pattern of growing social discord emerges wherever CSG mining is established.

CSG mining is a relatively new industry in Australia, but if we draw on examples from countries such as the United States, who have been mining in this way for several decades, we see a long history of social and environmental catastrophes. Frequent wellhead explosions are perhaps the most graphic and disturbing of these, but no less disastrous are the incidences of contaminated drinking water, dropping aquifer levels, soil erosion and contamination, air contamination, poisoned livestock, poisoned communities and land eventually rendered completely unusable.

We are lucky that we have decades worth of information from other nations to provide us with a valid base on which to take a far stronger stance on CSG mining in this country. We must learn from those mistakes and put a moratorium in place until there is scientific evidence to prove that it is safe and that the recognised impacts can be avoided.


Expired Petroleum Titles in NSW, September 2011
Moree
Walgett
Narrabri
Armidale
Coffs Harbour
Wilcannia
Broken Hill
Dubbo
Merriwa
Singleton
Ivanhoe
Newcastle
Sydney
Balranald
Narrandera
Port Kembla
Deniliquin
Batemans Bay
Expired Petroleum Titles
Petroleum Titles due to Expire by December
Other current petroleum titles
N


CROWN LANDS AVAILABLE FOR MINING
WITHIN EXISTING PETROLEUM TITLES (August 2011)
N
Moree
Walgett
Narrabri
Armidale
Coffs Harbour
Wilcannia
Broken Hill
Dubbo
Merriwa
Singleton
Ivanhoe
Newcastle
Sydney
Balranald
Narrandera
Port Kembla
Deniliquin
Batemans Bay
Travelling Stock Routes
State Conservation Areas
State Forests
Petroleum Titles
Areas:
Travelling Stock Routes - 215,797 ha
State Conservation Areas - 373,207 ha
State Forests - 747,453 ha
Total - 1,336,457 ha

Map 1: Coal Seam Gas Resource Potential in the Brigalow Belt South

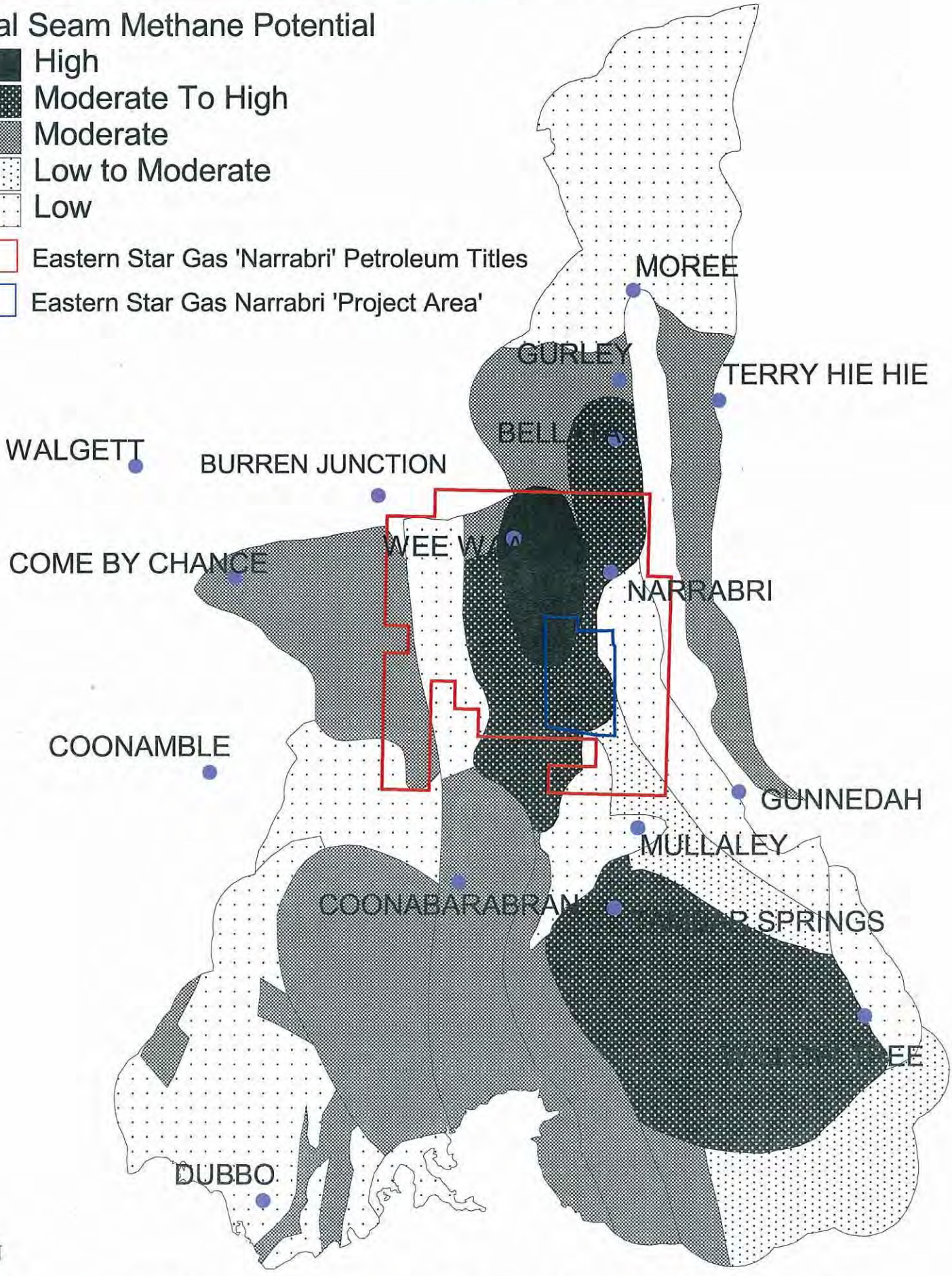
60 0 60 120 Kilometers

Coal Seam Methane Potential

- High
- Moderate To High
- Moderate
- Low to Moderate
- Low

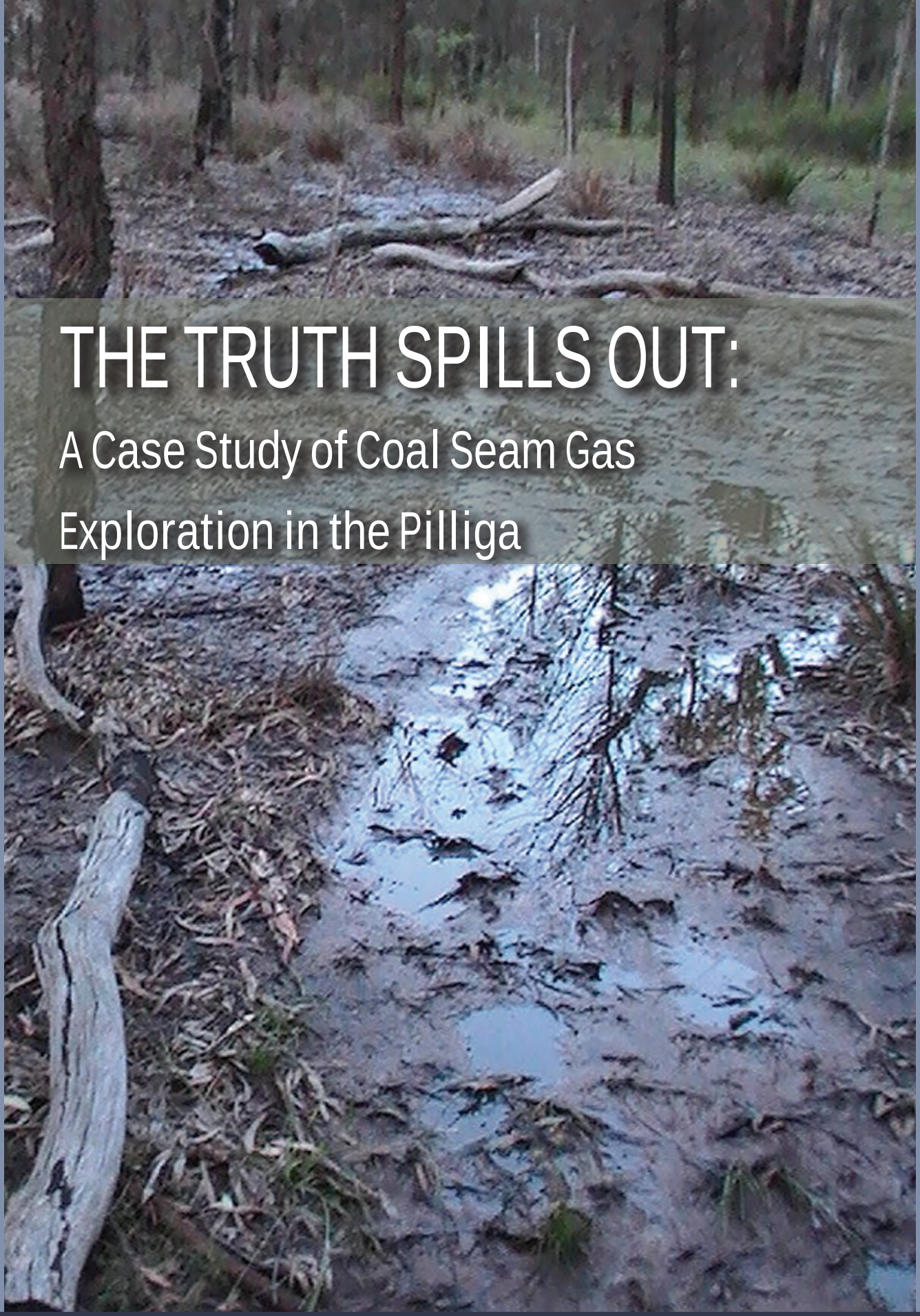
Eastern Star Gas 'Narrabri' Petroleum Titles

Eastern Star Gas Narrabri 'Project Area'



N

CSG Potential Data obtained under licence from DMR. Petroleum titles obtained from DMR via MinView.



THE TRUTH SPILLS OUT:

A Case Study of Coal Seam Gas Exploration in the Pilliga

Northern Inland Council for the Environment

THE WILDERNESS SOCIETY

THE TRUTH SPILLS OUT:

A Case Study of Coal Seam Gas Exploration in the Pilliga

23rd May 2012

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Executive Summary

The Pilliga Forest is an outstanding biodiversity icon that is now severely threatened by coal seam gas exploration and mining. Over the last 12 months, there have been numerous environmental incidents arising from coal seam gas operations in the Pilliga which have been exposed by community groups operating on a voluntary basis.

This report compiles and analyses all empirical data that is available on the environmental harm caused by coal seam gas operations in the Pilliga over the last nine months, from June 2011 to February 2012. It also develops a detailed chronology of events which includes relevant public statements from gas companies, governments and the community as well as conducting an audit of events against legal requirements. It is a preliminary report that will be supplemented with additional sampling results and freedom of information documents when they become available.

This report provides detailed evidence to show that the coal seam gas operations in the Pilliga to date have resulted in harm to the environment, including water pollution and soil contamination. It alleges the licence holder has not complied with the provisions of the *Petroleum (Onshore) Act 1991* or the conditions of the licence.

The report shows that:

- There is evidence of systemic and serious breaches of laws and regulations in the Pilliga Forest which have only been revealed as a result of community pressure.
- The NSW Government has repeatedly relied on inaccurate information provided by gas companies in their public statements instead of collecting their own information.
- Despite claiming to be undertaking a comprehensive investigation of coal seam gas operations in the Pilliga from early August 2011, the NSW Government failed to identify or act on the major breaches that were reported by environment groups after that date.
- The NSW Government response to any substantive public complaint is to 'announce' that it is investigating, but such investigations in many cases appear to be nothing more than a tokenistic request for gas companies to respond to the complaint.
- In fact, there have been up to seven different investigations 'announced' into coal seam gas operations in the Pilliga over the last nine months. The scope and nature of those investigations has not been explained to the community and there is no public transparency in relation to them.
- None of those investigations has yet led to any regulatory action against the companies involved.
- The delay and inadequacies in Government responses means that it has not collected vital information relevant to properly investigate the matters in a timely manner.
- There is evidence of a disturbing pattern of denial and blame-shifting by coal seam gas companies and governments when responding to genuine community complaints.
- Statements made by Santos and Eastern Star Gas on a number of occasions do not match the facts as later revealed.

As a result of all these factors, the community can have no confidence in the coal seam gas industry or into the so-called investigations by the NSW Government that are now underway.

The information contained in this report confirms that the concept of self-regulation by coal seam gas companies is flawed. By referring matters to companies to self-regulate, the NSW Government provides opportunities for companies to cover-up incidents and to hide evidence. It means that any Government investigations are so delayed as to miss out on opportunities to collect solid evidence in a timely manner. This has occurred on a number of occasions in the Pilliga as set out in this report.

The interim report by Santos into Eastern Star Gas (ESG) operations, released in February 2012, effectively seeks to shift the blame of environmental incidents to the previous operator and downplays the environmental impacts to date. However, it is important to note that Santos itself had a major financial stake in the prior operator.

Furthermore, there are a number of problems with the Santos report. It omits important information on water quality, does not provide any sampling information of contaminated surface water, compares soil sample results to benchmarks based on urban areas that are not relevant to a sensitive environment like the Pilliga, provides no information whatsoever on the four spills which it has admitted since taking on full ownership in November and does not provide an adequate ecological risk assessment of the damage that has occurred to date. The media release associated with the report misrepresents the results of sampling data commissioned by environment groups.

Contrary to Santos media statements, there is sufficient evidence contained in the water and soil samples commissioned by both Santos and environment groups to indicate genuine ecological risks from the admitted environmental incidents in a high conservation value area such as the Pilliga, as this report outlines. The NSW Government should not rely on Santos self-reporting in this important matter, but should now require a thorough independent review of existing data and collection of additional information relevant to assessing the environmental impact of all aspects of PEL238 and PAL2. A full ecological risk assessment should now be conducted as a matter of urgency.

This report will allege that there have been several major and very serious breaches of the petroleum titles under which Santos operate, and at least one breach of the Petroleum (Onshore) Act 1991 itself. The alleged breaches are documented in detail in this report, with evidence provided to support them. The most substantial of these have included contamination of soils, pollution of waters, commercial production of gas from an exploration licence and failures to notify the department of these and other breaches.

There are likely to have been a number of breaches of other environmental laws in the Pilliga, most notably the Protection of the Environment Operations Act 1998 and the Contaminated Lands Management Act 1997. However, the NSW Environmental Protection Agency (EPA) is investigating only one matter and there are concerns that the EPA is not entitled to utilise its full regulatory powers in relation to the coal seam gas industry.

Further, the regulatory failures in the Pilliga as revealed in this report are broad and range from flawed monitoring requirements, to inadequate compliance and enforcement and poor complaint handling processes. The severity and extent of these problems in the Pilliga warrants a full investigation by an independent authority.

The mismanagement of coal seam gas exploration in the Pilliga, the environmental damage incurred and the documented regulatory failures reinforce the need for an urgent moratorium on all coal seam gas operations in NSW. Nothing less is warranted given the revelations contained in this report.

Recommendations

The events of the last 12 months in the Pilliga forest have led to a crisis of confidence in the ability of the NSW Government to protect the environment against coal seam gas mining.

The legislative system and the regulatory framework are broken and no amount of tinkering or secret investigations can restore public confidence in the NSW Government and its management of this industry.

We make five major recommendations below that we believe are required to properly respond to the scale and nature of the environmental failings that have been uncovered and the heightened level of community concern.

We believe that nothing less than full implementation of these five recommendations would represent an adequate response to the serious environmental impacts of mismanagement in the Pilliga and the loss of public trust associated with the reporting failures and denials.

If the NSW Government does not act now to cancel the petroleum titles at issue and implement the recommendations below, then it will simply legitimise the poor practices of the coal seam gas industry and entrench a culture that is clearly unacceptable to the vast majority of people of NSW.

We recommend that:

1. The Minister for Resources should now immediately utilise his powers under the *Petroleum (Onshore) Act* 1991 to:
   - Cancel PEL238 and PAL2 in accordance with s22 of the Petroleum Act.
   - Forfeit all securities to the Crown (amounting to $878,000) in accordance with s16A of the Petroleum Act and utilise those funds to commission a thorough independent ecological risk assessment of the impacts of coal seam gas activities to date in PEL238 and PAL2.
   - Commence legal action against Santos for all major and minor breaches identified in this report.

2. The NSW Government should urgently commission the following independent scientific assessments of the impact of coal seam gas activities in the Pilliga, within an ecological risk assessment framework:

- A site investigation of all contaminated areas in accordance with the contaminated site guidelines of the Environment Protection Authority, which is then subject to review by an accredited site auditor.
- Thorough eco-toxicology assessments of the impacts of contamination to date and the development of regional ecologically-based investigation levels relevant to the region and to the sensitive environment of the Pilliga.
- Independent testing of the integrity of all coal seam gas wells in PEL238 and PAL2 (including de-commissioned wells) to determine if damaging impacts have occurred in operations below-ground.
- A forensic investigation into the water treatment plant and whether there was a large, unreported spill in the vicinity in December 2011.
- A detailed assessment of the distribution and full extent of vegetation clearing and resultant impacts on wildlife habitat.

3. There should be a Special Commission of Inquiry (under the NSW Special Commissions of Inquiry Act 1983) established into all aspects of coal seam gas operations in PAL2 and PEL238 to provide one single and far-reaching investigation into the matter. This should include, but not be limited to, the following:
   - The entire operation of PEL238 and PAL2 to date including all incidents revealed in the Santos report into Eastern Star Gas, all complaints by the community and all incidents that have occurred since Santos took on 100% ownership.
   - The production of gas for commercial purposes within an exploration licence at the Tintsfield pilot production, including an analysis of the approvals process for the Review of Environmental Factors which allowed it to proceed.
   - All potential breaches of environmental laws for which the Environment Protection Authority is the appropriate regulatory authority, including those which the EPA has not investigated to date.
   - Recommendations for prosecution which have arisen from the investigation across all relevant legislation.
   - Recommendations for a thorough overhaul of the legal framework regulating coal seam gas operations in NSW.

4. The NSW Government should refer to the matter to the Australian Securities Investment Commission to investigate whether there have been any breaches of the Corporations Act 2001, in particular whether the actions of the directors or officers have been reckless, or intentionally dishonest and have not exercised their powers or discharged their duties in good faith in the best interests of the company or for a proper purpose, in accordance with s184.

5. The NSW Auditor-General should be requested to:
   - Investigate the failings of coal seam gas regulation in the Pilliga including self-regulation by gas companies, flaws in monitoring, compliance and enforcement by government agencies and the interaction between coal seam gas companies and government authorities.
   - Make recommendations for thoroughly restructuring compliance and enforcement of coal seam gas operations and community complaint procedures and for adequate resourcing of regulatory authorities.

Introduction

The Pilliga Forest is located near Narrabri in northwest NSW. It is the largest temperate woodland left in eastern Australian and the southern recharge areas of the Great Artesian Basin. It is home to numerous threatened species, including the endemic Pilliga Mouse and the nationally threatened South-eastern Long-eared Bat. The Pilliga Forest is largely State Forest tenure, but also includes some Nature Reserves and State Conservation Areas. The Nature Reserve is the only tenure from which coal seam gas mining is excluded.

There are two petroleum exploration titles over the area - Petroleum Exploration Licence 238 (PEL238) and Petroleum Assessment Lease 2 (PAL2). PEL238 covers a vast area of approximately 790,000 hectares (ha) covering most of the Pilliga Forest as well as large areas of farmland around Burren Junction, Wee Waa and Narrabri. PAL2 covers an area of approximately 26,000ha which is mostly located in the Pilliga Forest but also includes some adjoining properties. Map 1 provides a map of the Pilliga Forest and the petroleum titles that currently cover it.

Coal seam gas exploration commenced in PEL238 approximately ten years ago. Since then, there have been approximately 92 wells drilled, of which 56 are located in the Pilliga Forest and the remainder on surrounding farmland.

The operations in PEL238 and PAL2 to date, although only qualifying as 'exploration', have also involved:

- the construction and management of a gas-fired power station at Wilga Park;
- the development and management of five pilot production fields encompassing 35 production bores;
- the construction and management of 13 major water treatment dams/impoundments and numerous drill ponds;
- the construction and management of 56.6km of gas and water gathering pipelines;
- the construction and operation of one reverse osmosis unit;
- the discharge of treated produced water into the Bohena Creek (part of the Murray-Darling Basin);
- the bull-dozing of numerous roads and tracks to facilitate the above; and
- the use of hydraulic fracturing (fracking) on at least 15 occasions.

Eastern Star Gas has been the primary operator since 2002. In mid-November 2011, Santos took over 100% ownership of the operation. Prior to that, Santos held a 35% interest in the operation. Over the last 12 months there have been numerous problems revealed with coal seam gas operations in the Pilliga, as the community has unveiled major environmental problems and failings which have, after much community agitation, finally been disclosed by the gas companies involved. This report reviews in detail the events of the last nine months in particular, and uses the Pilliga as a case study to explore how coal seam gas companies operate, how they respond to the community, and how they interact with governments and regulatory authorities.

Despite the fact that this report focuses on the near past, it is important to note that there is a much longer history of environmental damage from coal seam gas in the area, with a saline pond bursting in 2001 and causing substantial tree dieback, and extensive vegetation dieback associated with a number of wells from 2001/02. This document does not purport to provide a full coverage of coal seam gas damage in the area, but focuses instead on the damage incurred and documented in detail over the last nine months. The more extensive damage over a ten year period warrants more detailed analysis and documentation.

There is a current Santos proposal which has been lodged with the NSW Government to develop the *Narrabri Gas Field* in the Pilliga Forest. This would involve an industrial gas field across an area of 85,000 hectares which includes 1,100 gas wells and 1,000km of internal pipelines, plus numerous roads and various other associated infrastructure. **The damage described in this report from the operation of just 56 wells over a nine month period highlights the enormous environmental risk posed by a major industrial gas field in this area**.

Dead Trees adjacent to the Bibblewindi Treatment Plant, Pilliga Forest, February 2012

Chronology of Events

This chronology focuses on the matters of the known and documented coal seam gas water spills and treated water discharges in and around the Bibblewindi Water Treatment plant in the Pilliga Forest, with an emphasis on the events of the last nine months.

January 2011 - Concerns raised about Bibblewindi Water Treatment Plant by local resident Tony Pickard, who reports a hole in the liner at Pond Number 2 to the Department of Resources and Energy in Maitland. No response was ever received from the Department.

25 June 2011 - Eastern Star Gas spills 10,000L of produced coal seam gas water from the Bibblewindi Water Treatment Plant but does not notify authorities.

30 June 2011 - Environment groups submit a report to the Federal Environment Minister Tony Burke and his Department alleging that activities in the Pilliga have never been referred under the Federal Environment Protection and Biodiversity Conservation Act 1999 despite being likely to impact on matters of national environmental significance.

13 July 2011–NSW Resources and Energy Minister Chris Hartcher announces a state-wide audit of all coal seam gas exploration licences involving a desktop analysis of existing licences to *'identify areas of non-compliance*'. Audit process is due to be completed by November.

17 July 2011 - Mr Pickard sends a list of complaints about Eastern Star Gas operations in the Pilliga to DTIRIS, EPA and Forestry NSW investigators (see Appendix 1). No response has ever been received to the list.

21 July 2011 - Cate Faerhman MLC writes to three departments, including the Department of Primary Industries, identifying a list of alleged environmental incidents in the Pilliga including leaking gas pipes, dead animals and vegetation dieback (see Appendix 2).

21 July 2011 - Federal Government announces an investigation of potential non-compliance with the Environment Protection and Biodiversity Conservation Act 1999 by Eastern Star Gas in relation to existing coal seam gas infrastructure in the Pilliga[1].

21 July 2011 - Jeremy Buckingham MLC films a gas pipe adjoining the Bohena 3 coal seam gas well hissing as gas is released and another low point drain on a gas pipeline near Bibblewindi 21 bubbling methane gas.

29 July 2011 - *7.30 NSW* interviews Jeremy Buckingham MLC about the leaking gas incidents and Minister Chris Hartcher responds, referring to the leaking gas drain as 'sabotage' and states, "*It shows that there are people out there who are malicious and who are anxious to cause serious*

[1] http://www.abc.net.au/rural/telegraph/content/2011/s3274724.htm

damage because this could cause serious damage and it's a wake-up call to all of us that these people are out there."[2]

"*I don't know who did it. I am only relying on the information supplied to me by the company. It hasn't been independently verified by the office of Resources and Energy. It was clearly done by somebody of ill intent, but who it was I can't say.*"[3]

7.30 NSW advised, "*The NSW Government has launched an investigation into leaks of methane gas from coal seam gas pipes in the states north-west.*"

1 August 2011 - Eastern Star Gas claims that the low point drain has never been operated by ESG and has been 'tampered with'. In regard to Bohena 3, ESG claims that "*On Friday a gas detector was used to check for the presence of leaking gas. The equipment did not register any leaking gas*". Eastern Star Gas rejects allegations relating to the EPBC Act 1999.

2 August 2011 - Eastern Star Gas licence, PEL 238, expires and local groups call for it not to be renewed.

8 and 9 August 2011–NSW Department of Trade Investment Regional Infrastructure and Services (DTIRIS) commence investigations of the alleged infringements notified by Ms Faerhman and presumably Mr Buckingham. These are described by the Department as follows:

> "*Field inspections were undertaken by the Department's environmental inspectors, assisted by investigators from the Office of Environment and Heritage. Additionally, regional managers from Forests NSW also attended where the alleged infringements were located within the State Forest estate*"[4].

8 and 9 August 2011 - Local landholder Tony Pickard hands a list of complaints to DTIRIS, EPA and Forestry NSW investigators.

24 September 2011 - Cate Faerhman MLC receives a response from DTIRIS to her letter of the 21st July stating that an investigation is underway. The letter states, *"These investigations are complex, extensive and ongoing. A full report will be prepared on their completion*".

11 October 2011 - Federal Government finds that exploratory and pilot production operations in the Pilliga are unlikely to have impacted significantly on matters of national environmental significance.

28 October 2011– Northern Inland Council for the Environment (NICE) makes a complaint to the EPA in relation to the presence of dead vegetation adjoining the Bibblewindi Water Treatment Plant, and dead frogs in a sump at the Bohena 2 coal seam gas well. The EPA refer the matter to DTIRIS.

[2]http://www.abc.net.au/local/stories/2011/08/01/3282726.htm
[3]http://www.abc.net.au/local/stories/2011/08/01/3282726.htm
[4]Letter from Mr Mark Paterson, Director General DTIRIS to Ms Cate Faerhman MLC dated 24 September 2011

7 November 2011 - A response was received to the NICE complaint via email from Mr Greg Summerhayes, Principal Environment Officer with Resources and Energy, on 7 November 2011. DTIRIS concludes that:

> "*ESG is currently in compliance with operating conditions...There is no evidence to date of a pollution discharge event. This is not considered to be significant environmental harm."*

DTIRIS also advise that:

> "*NSW Soil Conservation Service (SCS) were commissioned to test and assess the soil and possible association with the water treatment plant (WTP) with some evidence of crusting*."

30 November 2011 - EPA respond to NICE complaints stating that:

> *"The EPA does not have a formal statutory approval or regulatory role under the Protection of the Environment Operations Act 1997 until the production stage of gas development. Therefore, the complaint was referred to DTIRIS...*
>
> *The advice DTIRIS has provided to the EPA from the investigation conducted at Bibblewindi Water Treatment facility is that the tree dieback is most likely a result of an historical flooding event and that there is no evidence of a subsequent pollution discharge".*

8 December 2011 - Environment groups release water samples of treated coal seam gas water which is being discharged into Bohena Creek in the Pilliga by Santos. Results from independent tests show elevated levels of seven compounds including ammonia, cyanide and boron compared to upstream samples.

Matthew Doman from Santos, in response states, "*All I can say is that any water discharged into the Namoi River meets the requirements of the New South Wales Government"*[5].

9 December 2011 - DTIRIS 'launches its own investigation' into creek pollution and the EPA says it will 'follow up on the investigation'[6]. DTIRIS advise environment groups that they are investigating creek pollution and will visit the Pilliga during the week of 12 December to collect water samples. DTIRIS staff advise NICE verbally over the phone that results from SCS soil tests from the WTP are not yet available.

The Australian[7] reports the Santos response as follows:

> '*Santos points out discharged water is tested on a monthly basis and all recent results have met NSW* requirements' the company said. '*Santos is confident it is not in breach of its authority or having any adverse impact on water resources in the area'.*

[5] http://www.abc.net.au/am/content/2011/s3386203.htm
[6] http://www.smh.com.au/environment/water-issues/tests-reveal-contaminated-water-near-gas-site-20111208-1oldj.html#ixzz1oQPtzzmy
[7] http://www.theaustralian.com.au/national-affairs/minister-urged-to-act-on-claims-of-creek-pollution/story-fnaxx2sv-1226217655484

15 December 2011 - Santos shuts down the reverse osmosis plant in the Pilliga, later describing the reasons as follows: "*because of various concerns about the water treatment plant, Santos took the decision to scale-back operations in the Pilliga, including ceasing operation of the water treatment plant pending a full review of its adequacy and integrity*"[8].

23 December 2011 - DTIRIS advise environment groups that no water samples were collected from creek discharge due to the fact that the Santos reverse osmosis plant was 'malfunctioning'.

30 December to 2 January 2012 - Local landholder Tony Pickard contacts media outlets to report extensive tree deaths and black sludgy water pooling in areas adjoining the Bibblewindi Water Treatment Plant, including areas where tree deaths have previously been reported by NICE.

2 January 2012 - Santos spokesman Sam Crafter tells the ABC in response to Mr Pickard's complaint that[9], "*Narrabri has had a lot of rain lately but there's not been any leaks at any of our sites..."Eucalypts react with the water,"* he said*. "It creates a murky colour."*

The ABC notes the following response from DTIRIS[10]: "*The Department of Primary Industries has issued a statement, saying it has already inspected the site. The statement says the water is natural water pooling and the department has ordered Santos to fix the drainage."*

4 January 2012 - Mr Pickard takes Santos staff Sam Crafter and Mr Mark Rodgers on a tour of sites of concern in the Pilliga, including the Bibblewindi Treatment Plant and adjoining vegetation dieback and pooled coal seam gas water. Mr Pickard notifies Department of Resources and Energy in Maitland (via email) of the location and extent of the vegetation dieback.

6 January 2012 - The Northern Daily Leader provides the following response from Sam Crafter of Santos[11]: "*He said rainfall before Christmas had caused water to pool in the area, and previous soil testing had revealed eucalyptus was a problem.*"

6 January 2012 - Environment groups commission a local ecologist collects soil and water samples from the contaminated site adjoining Bibblewindi Water Treatment Plant, and a reference sample from uncontaminated areas. The samples are sent for testing to the independent ALS Laboratory Group.

Late evening, 6 January 2012 - Santos advise DTIRIS of a previous discharge of 10,000L of produced coal seam gas water from the Bibblewindi Water Treatment Plan which they alleged occurred under Eastern Star Gas operation of the plant on 25 June 2011[12]. Neither Santos nor the Department go public with this admission[13].

[8] Santos report on Eastern Star Gas Operations, http://www.santos.com/library/120222_report_into_ESG_operations_attachments.pdf
[9] http://www.abc.net.au/news/2012-01-02/greens-claim-csg-mine-poisoning-trees/3755362
[10] http://www.abc.net.au/news/2012-01-02/greens-claim-csg-mine-poisoning-trees/3755362
[11] http://www.northerndailyleader.com.au/news/local/news/general/pilliga-kill-sites-investigation-under-way/2411478.aspx?storypage=2
[12] http://www.dpi.nsw.gov.au/aboutus/news/recent-news/minerals-and-petroleum/saline-water-leak
[13] http://www.dpi.nsw.gov.au/aboutus/news/recent-news/minerals-and-petroleum/saline-water-leak

12 January 2012 - The NSW Minister for Western NSW, Kevin Humphries, tours the Pilliga coal seam gas wells with Santos, and promotes publicly the work that is being done by Santos in 'rehabilitating' five wells.

13 January 2012 - Late on Friday, both Santos and DTIRIS go public at the same time with information that there has been a 10,000L spill from the water treatment plant in the Pilliga.

DTIRIS advise that, "*The Department of Trade & Investment is pursuing enforcement actions on this discharge, including the potential for prosecution, and continuing to work with the Environment Protection Authority to further investigate the incident*".

18 January 2012 - Santos admits that 250 litres of algaecide had spilled *"after a pipe ruptured at its Bibblewindi water treatment plant in the state forest, near Narrabri, on December 22 last year"*[14].

31 January 2012 - EPA advise environment groups that they have not collected any water samples from treated coal seam gas water produced from the reverse osmosis plant, but that they are investigating the matter.

8 February 2012 - Environment groups reveal results of water and soil samples from the contaminated zone near Bibblewindi Water Treatment Plant which show high levels of heavy metals, petrochemicals and salt, compared to baseline uncontaminated reference sites.

9 February 2012 - Santos admit to three more spills of coal seam gas water in the Pilliga. *''There have been three subsequent, smaller leaks of water from coal seams within Eastern Star's Pilliga operations in the weeks immediately following Santos' acquisition of the company,*'' a spokesman said[15].

16 and 17 February 2012 - Department of Resources and Energy finally (and very belatedly - almost four months after it was first reported by community groups and five weeks after admissions by Santos) conduct a site inspection of the Bibblewindi Water Treatment Plant and adjoining contaminated area[16]. It is unknown as to whether any soil or water samples were collected, but the delay means they are probably of limited utility in any case.

22 February 2012 - Without any community consultation or notification, Santos obtains permission from DRE to pipe 60ML of produced coal seam gas water from Bibblewindi Water Treatment Plant to saline holding ponds near Narrabri at the Tintsfield site (approx 39km away).

In the Review of Environmental Factors, Santos admits, *"Bibblewindi Pond 3 is within 40cm of the overflow pipe and a significant rain event could cause the pond to overflow"*. The community does not learn of the approval until a month later.

[14]http://news.ninemsn.com.au/national/8405026/chemical-spill-at-csg-site-in-nsw-forest
[15]http://www.smh.com.au/environment/water-issues/arsenic-and-lead-found-in-contaminated-water-leak-at-coal-seam-gas-drill-site-20120209-1rx7s.html#ixzz1m1ifmWkM
[16] The Hon Duncan Gay MP, response to Question Without Notice, 23rd January 2012 http://www.parliament.nsw.gov.au/Prod/parlment/hanstrans.nsf/V3ByKey/LC20120223/$File/551LC069%20%5B230212%5D.pdf

23 February 2012 - Santos releases a report on Eastern Star Gas operations, stating that "*The Santos report has identified an unacceptable culture in Eastern Star of accepting minor spills, failures in reporting and the possibility of unapproved land clearing on some sites".*

This appears to be a substantial understatement, given that the report revealed the following:

1. An additional major leak from the Bibblewindi Water Treatment Plant prior to June 2011;
2. Some 20 environmental incidents recorded in total, including a kangaroo dead in a coal seam gas pond;
3. Possible over-clearing of vegetation at some 39 sites;
4. Discharge of treated water exceeded salinity limits on numerous occasions; and
5. Saline water ponds over-flowed on at least one occasion.

23 February 2012 - The Hon Duncan Gay MP, representing the Minister for Trade and Investment in the NSW Legislative Council, describes the compliance action occurring in the Pilliga as follows:

> "*Following notification of the spill, the Department of Resources and Energy commenced a full investigation into the incident and the apparent failure to report the incident in a timely manner. The investigation team conducted a site inspection on 16 and 17 February 2012. The Department of Resources and Energy also will investigate whether any other incidents of that nature have occurred and any other related circumstances*"[17].

6 March 2012 - The Federal Government informs environment groups that it has re-opened investigations into coal seam gas exploration in the Pilliga and compliance with the EPBC Act 1999.

3rd April 2012 - The Division of Resources and Energy sends Mr Tony Pickard a letter, drafted in September 2011, responding to his complaints from July 2011. DRE has issued 3 formal warning notices and 2 penalty infringement notices for non-compliance in relation to the incidents listed. Warning notices relate to over-clearing and failure to rehabilitate.

5th April 2012 - The NSW Government releases its report on the audit of coal and petroleum exploration licences in NSW. PAL2 had not been audited. There were no significant non-compliances identified with PEL 238, and just one low risk non-compliance.

Ponds of untreated coal seam gas water spilt from the Bibblewindi Treatment Plant, February 2012

[17] Ibid

Events - Summary and Conclusions

- Over the last six months, the NSW Government has announced at least eight separate audits and investigations into coal seam gas operations in the Pilliga Forest. Every time that a failure is exposed in the Pilliga, the Government has 'announced' an investigation.
- There is little or no information available publicly on the scope or purpose of those investigations, and none of them have as yet led to any action against the companies involved. The investigations are conducted in secret without any obvious opportunity for public input.
- In August, the NSW Government claimed to be commencing an extensive investigation into all aspects of CSG operations in the Pilliga.
- For five months that investigation ignored evidence of a major spill at the Bibblewindi Treatment Works, despite it being reported by environment groups.
- Over that same period, the investigation failed to collect a single sample of the water being discharged from the Bibblewindi Treatment Plant into the Bohena Creek system, creating a serious pollution risk. Even now, we understand that no government agency has collected and comprehensively analysed a sample from the water treatment works.
- Over a six month period, NSW Government Ministers have defended the coal seam gas companies involved, and even spruiked their environmental credentials publicly despite knowing that they were soon to admit to a major spill.
- NSW Government agencies have failed on all fronts to conduct either timely or comprehensive assessments of non-compliance events, and have instead parroted the statements of coal seam gas companies and relied heavily on their representations.
- The last nine months of coal seam gas exploration in the Pilliga reveal:
    - That denial is generally the first response of coal seam gas companies and Governments to community complaints, even when there is the strongest possible evidence to support them - i.e. large areas of vegetation dieback with pools of toxic water.
    - That self-regulation has been a major failure, confirming once and for all that gas companies cannot be trusted to police their own operations honestly.
    - That the NSW Government is often complicit in the excuses peddled by gas companies and appears to have neither the will nor the capacity to enforce compliance with even the most basic environmental laws.
- Coal seam gas companies when finally held to account tend to seek to shift the blame. In the Pilliga Forest, coal seam gas companies have pointed the finger at previous operators, farmers, and unknown third parties.
- The NSW Government audit of PEL 238 did not identify any significant problems despite the fact that it was completed after Santos had exposed numerous problems with ESG and after DRE had responded to Mr Tony Pickard acknowledging several non-compliances. It is inexplicable why these other sources of information were not considered by the audit.
- In light of the severe environmental mismanagement and the reporting failures revealed in the Pilliga, it seems likely that initial claims by Eastern Star Gas in relation to all other matters that have occurred over the last 12 months such as leaking gas pipes and low water drains may also be spurious and should be reviewed.

Preliminary Complaints, Admissions and Investigations

On the 28th October 2011, the Northern Inland Council for the Environment reported the presence of dead trees within and adjoining the Bibblewindi Water Treatment works in the Pilliga to the EPA via email (Mr Joshua Gilroy). Concerns were raised that the vegetation dieback had been caused by a spill or leaking pipe from the treatment works. The EPA subsequently referred the matter as a complaint to DTIRIS later on the same day, 28th October 2011.

A response was received via email from the Department of Resources and Energy, on the 7th November 2011.

The response stated that the Department of Resources and Energy (DRE) had, on the 28/10/2011, directed ESG to report to them on the incidence of tree deaths adjoining the water treatment works, and that ESG had provided an Interim Incident Report on the 3/11/2011. DRE go on to state that:

> "*ESG is currently in compliance with operating Conditions. The tree dieback in vicinity of the Bibblewindi Water Treatment Plant (WTP) has been previously reported by ESG and is limited to approximately 0.55ha. This is under further assessment of possible cause and remediation. There is no evidence to date of a pollution discharge event. This is not considered to be significant environmental harm.*
>
> *ESG has reported that tree dieback has been observed in the area of Bibblewindi Water Treatment Plant (WTP) since the flooding events of 2010. A treed area of approximately 50m x 50m was affected by water logging of rainfall run-off collecting in the area due to inadequate drainage affected by the WTP access road. ESG had in consultation with NSW Forests decided to remove the trees but this has not occurred due to ongoing wet conditions prohibiting heavy machinery access. An additional area of approximately 0.3ha was observed affected by irregular dieback adjacent to the WTP road.*
>
> *NSW Soil Conservation Service (SCS) were commissioned to test and assess the soil and possible association with the WTP with some evidence of crusting. NSW SCS are advising ESG on best practice remediation work which will mediate the dieback affected areas by soil treatment and drainage improvement*".

As this excerpt reveals, DRE accepted that there had been no failures in compliance and repeated the Eastern Star Gas claims about water-logging prior to getting the results of the soil samples that had apparently been commissioned. This suggests an over-dependence on self reporting by coal seam gas companies and a failure in basic investigative procedures. **It is important to note that this failure occurred at the time when DRE were supposed to be conducting 'complex, extensive and on-going investigations' into activities in the Pilliga, which had commenced in August 2011.**

The final section of the DRE report stated that, in relation to further follow-up action, they were:

> *Awaiting results of further soil and water sampling with supplementary incident report from ESG. ESG to continue standard operations to P&A well Bohena 2/2D, then progress well site rehabilitation. ESG to initiate corrective action; drainage and soil amelioration according to SCS test results and recommendations".*

The Northern Inland Council for the Environment spoke to the DTIRIS over the phone on the 9th December and again on the 23rd December seeking advice on the soil and water sampling supposed to have been conducted by the SCS. DTIRIS advised that the results were not yet available. It is notable that soil and water samples commissioned by environment groups took just ten days to be analysed and the results returned. There is no obvious feasible explanation as to why DRE did not have the results to hand in early November. **To date, April 2012, there have still been no samples released by DRE in relation to the 28th October 2011 complaint or any related spill.**

On December 30th 2011, Mr Tony Pickard found black, sludgy pools of water adjoining the Bibblewindi Treatment Plan and further extensive vegetation dieback, which he filmed and photographed. This information was reported to DRE by Mr Pickard on 4th January 2012, with associated media coverage in early January. Both Santos and DRE then went public, stating again that there had been no leaks and that the black sludge was caused by eucalyptus leaves. The details of these statements are provided below.

On the 2nd January, the ABC reported[18]: *But Santos spokesman Sam Crafter denies there has been a leak. "What we have here is a gathering from the recent rain and that water hasn't dissipated yet," he said. "Narrabri has had a lot of rain lately but there's not been any leaks at any of our sites."*

Mr Crafter says eucalyptus leaves are making the water turn black. "Eucalypts react with the water," he said. "It creates a murky colour." The Department of Primary Industries has issued a statement, saying it has already inspected the site. The statement says the water is natural water pooling and the department has ordered Santos to fix the drainage.

On the 2nd January 2012, the Sydney Morning Herald reported as follows[19]: *Santos spokesman Sam Crafter blames rain for the excess water, which he says has been blackened by eucalyptus leaves."It [the rainwater] gathers in an area in the forest; it doesn't move easily," he told AAP. He said regular maintenance work was being conducted at one of the company's dams in the area but there had been "no release of water or any leaks at any of our sites"...*

According to the same SMH story, "*A recent investigation by the Department of Primary Industries had found no leak from the dam, a department spokeswoman said in a statement*".

On the 4th January Mr Pickard led two Santos staff on a tour of environmental problems in the Pilliga exploratory gas field. In particular, he showed them the vegetation dieback and obvious contaminated water pooling in areas adjoining the Bibblewindi Water Treatment Plant.

[18]http://www.abc.net.au/news/2012-01-02/greens-claim-csg-mine-poisoning-trees/3755362
[19]http://www.smh.com.au/environment/coal-seam-gas-miner-denies-poisoning-trees-20120102-1phza.html

The flow of untreated coal seam gas water spill from the Bibblewindi Treatment Plant, Feb 2012

According to the *Northern Daily Leader*, on the 6th January, Sam Crafter from Santos responded to the concerns as follows[20]: "*He said rainfall before Christmas had caused water to pool in the area, and previous soil testing had revealed eucalyptus was a problem*".

Therefore, up until the 6th January, both DRE and Santos continued to deny the occurrence of any leaks and promulgated excuses relating to water logging, rainfall and eucalyptus leaves. There are questions as to whether they did so in the full knowledge that samples had shown that there had been a spill or without having conducted or analysed any tests despite lengthy notice that such tests were required.

Finally, on the 6th January Santos advised DTIRIS of a previous discharge of 10,000L of water adjoining the Water Treatment Plant which they alleged occurred under Eastern Star Gas operation of the plant on 25th June 2011, and which had caused the vegetation dieback. Neither Santos nor the Department went public with this admission[21].

On the 12th January, Santos took the NSW Minister for Western NSW, Kevin Humphries, on a tour of the Pilliga coal seam gas wells. On that day and the following morning, the Minister spoke publicly about the work Santos were doing in 'rehabilitating' five of 40 wells in the Pilliga and telling media,

[20]http://www.northerndailyleader.com.au/news/local/news/general/pilliga-kill-sites-investigation-under-way/2411478.aspx?storypage=2
[21]http://www.dpi.nsw.gov.au/aboutus/news/recent-news/minerals-and-petroleum/saline-water-leak

"*These guys are in the process of monitoring as they go, it's been a tried process for quite some time where you've got sensitive areas and where you're looking to put in a larger number of bores*"[22].

Late on Friday 13th January, Santos went public with the fact that there had been a 10,000L spill of coal seam gas water by Eastern Star Gas on 25th June 2011 that had never been reported to authorities. DTIRIS went public at approximately the same time with the same information, placing a notification on its website which read as follows:

> *The NSW Department of Trade & Investment has been made aware of the discharge of 10,000 litres of saline water, in June 2011, at the Narrabri Coal Seam Gas Project, in the middle of last year, which was operated at the time by Eastern Star Gas.*
>
> *The incident was brought to the attention of Departmental officers last Friday evening by Santos, which took over Eastern Star Gas in November 2011.*
>
> *A Santos review of Eastern Star Gas records has identified that a pipeline failure occurred on June 25, 2011, which resulted in a discharge of 10,000 litres of saline coal seam gas water.*
>
> *The incident was not reported to Government authorities by Eastern Star Gas at the time. The company is obliged under conditions of its Petroleum Exploration Licence, to report such incidents, in accordance with the Petroleum Onshore Act 1991.*
>
> *At the time of the incident, Eastern Star Gas was conducting coal seam gas exploration within the Pilliga East and Bibblewindi State Forests south of Narrabri.*
>
> *The Department of Trade & Investment is pursuing enforcement actions on this discharge, including the potential for prosecution, and continuing to work with the Environment Protection Authority to further investigate the incident.*

However, from the evidence available it would seem that the Department of Resources and Energy did not conduct a site inspection at that time. It would seem that it was to be another five weeks before they visited the site, according to statements made in the NSW Legislative Council by Duncan Gay MP[23], raising serious questions about the utility of any information that they might collect after such a long delay. It is difficult to find an explanation as to why the primary regulatory authority did not immediately attend the site to collect evidence after notification of a major spill and following community complaints about the current state of the site.

Despite having repeatedly stated in early January that there had '*not been any leaks at any of our sites'*[24], Santos then went on to admit to four more spills over the following month[25]. The date of

[22] http://www.abc.net.au/news/2012-01-13/pilliga-csg-wells-to-be-rehabilitated/3771330
[23] The Hon Duncan Gay MP, response to Question Without Notice, 23rd January 2012 http://www.parliament.nsw.gov.au/Prod/parlment/hanstrans.nsf/V3ByKey/LC20120223/$File/551LC069%20%5B230212%5D.pdf
[24] http://www.abc.net.au/news/2012-01-02/greens-claim-csg-mine-poisoning-trees/3755362
[25] http://blogs.abc.net.au/nsw/2012/02/0830-abc-new-england-north-west-news-10022012.html

the spills were given as the 22nd December 2011 in the case of the algaecide spill[26], and *'in the weeks immediately following Santos' acquisition of the company*' in the case of the three other spills[27].

It wasn't until 23rd February 2012, that Santos released a report on the operations of Eastern Star Gas, which revealed an additional major leak from the Water Treatment Plant prior to June 2011 and a total of up to 20 environmental incidents including numerous small leaks. The NSW Government has not explained in detail how it intends to respond to the report, has yet to release any information itself, and has not explained whether the report has changed the scope or nature of its various ongoing operations.

The Santos report did not provide any useful information on the four leaks which had occurred since Santos had taken on 100% ownership of the project. The only information available on those leaks to date is provided in brief media statements made by Santos. DRE has made no comment on these matters and it is unknown whether any investigations are occurring.

In relation to the 250L spill of algaecide caused by a ruptured pipe, Santos stated, "*While we are not required to report such a minor spill, Santos immediately advised the NSW government of it and the clean-up actions*"[28]. However, the seriousness of a spill is determined not only by its size but also by its toxicity, which in this case is likely to be significant.

We have been advised by Dr Mariann Lloyd-Smith of the National Toxics Network that,

> *The CSG industry does uses a range of quite toxic algaecides, which usually also function as biocides or microcides. Prior to this chemical spill being dismissed as 'minor', it is essential that the identity of the algaecide is released. Some examples of commonly used algaecides and biocides available to the CSG industry include brominated substances which are both very toxic and often break down into more persistent and toxic substances[29]. Aldacide G is a product which contains the biocide glutaraldehyde. It is harmful if inhaled or absorbed through the skin, is capable of causing permanent eye damage upon exposure, and can cause chemical pneumonia if lung tissue is exposed[30]. Harmful exposure levels for mammals can be as low as 50 parts per billion*[31].

Finally, all that is known of the three other additional spills acknowledged by Santos since taking over the Pilliga operation is the volumes involved. Santos has admitted to one spill of 2,500L, another of 1,000L and another of 150L. Few details are available, except that one had occurred at a drill site, another had resulted from a problem with a water filter and a third had been caused by a hose that had been left unattended[32]. Santos has acknowledged that all three spills *'were*

[26]http://www.theaustralian.com.au/national-affairs/new-spill-at-santos-csg-site/story-fnaxx2sv-1226246801889
[27]http://www.smh.com.au/environment/water-issues/arsenic-and-lead-found-in-contaminated-water-leak-at-coal-seam-gas-drill-site-20120209-1rx7s.html
[28]http://www.theaustralian.com.au/national-affairs/new-spill-at-santos-csg-site/story-fnaxx2sv-1226246801889
[29] Dr Mariann Lloyd-Smith, pers comm., 10th February 2010
[30] Ibid
[31] Ibid
[32]http://blogs.abc.net.au/nsw/2012/02/0830-abc-new-england-north-west-news-10022012.html

preventable'[33]. No other information is currently available. Full public transparency is warranted on these spills in relation to their nature, date and location and any response by Santos and the NSW Government, as well as a detailed assessment of their potential ecological toxicity.

Responding to a question in Parliament from the Hon Jeremy Buckingham MLC, Duncan Gay MLC representing the Minister for Trade and Investment stated:

> "*There have been a number of reported infringements within PEL238 and PAL2, the most significant of which was a discharge of saline water in June 2011. That discharge was only reported to the Department of Resources and Energy by new owners Santos on 6 January 2012. Following notification of the spill, the Department of Resources and Energy commenced a full investigation into the incident and the apparent failure to report the incident in a timely manner. The investigation team conducted a site inspection on 16 and 17 February 2012.* ***The Department of Resources and Energy also will investigate whether any other incidents of that nature have occurred and any other related circumstances***".

He went on to say, "*A preliminary investigation report to the director general is expected to be prepared by March 2012. All available enforcement responses will be considered when the full facts are known...*"

However, the statement appears to stop well short of committing to a full compliance assessment of all Eastern Star Gas and Santos operations in PEL238 and PAL2, merely stating that *'Santos also has investigated the compliance performance generally of Eastern Star Gas*'.

Sampling Commissioned by Environment Groups

On the 6th January 2012, a local ecologist visited the site of the coal seam gas water spill and collected the following samples:

- Three water samples - two from the contaminated zone and one from outside the contaminated zone; and
- Five soil samples - three from the contaminated zone and two from outside the contaminated zone.

The results are provided as Appendix 3 (water) and Appendix 4 (soil). A comparison of the results obtained in Water Sample 3 (uncontaminated zone) with Water Sample 2 (contaminated zone) are provided in Table 1. Professor Joe Bidwell from the University of Newcastle verified the data and described the results as follows:

> "*Two samples of standing water were collected from the site near the treatment facility and one sample of standing water was collected from a reference location. pH of the water from near the treatment facility was slightly elevated as compared to the reference sample. As seen for the soil samples, water collected from the suspected spill zone had higher electrical conductivity and levels of major cations and anions as compared to the reference sample. In*

[33] http://blogs.abc.net.au/nsw/2012/02/0830-abc-new-england-north-west-news-10022012.html

contrast to the soil, the water sample from near the treatment facility also had higher levels of total metals (arsenic, chromium, copper, lead, nickel, and zinc), phenol and methylphenols, and total and recoverable petroleum hydrocarbons than the reference water"[34].

Table 1. Comparison of contaminated and uncontaminated water sample results

Compound	Units	Un-contaminated Sample	Contaminated Sample	**Number of times higher in contaminated sample**
pH Value	pH Units	6.64	8.67	**1.3**
Electrical conductivity @25 degrees	uS/cm	29	2930	**101**
TDS	mg/L	19	1900	**100**
Total hardness as CaCO3	mg/L	<1	299	**299**
Total alkalinity as CaCO3	mg/L	11	1340	**121.8**
Chloride	mg/L	2	383	**191.5**
Calcium	mg/L	<1	67	**1**
Magnesium	mg/L	<1	32	**32**
Sodium	mg/L	3	792	**264**
Potassium	mg/L	3	30	**10**
Arsenic	mg/L	<0.001	0.021	**21**
Cadmium	mg/L	<0.0001	0.0004	**4**
Chromium	mg/L	0.005	0.187	**37.4**
Copper	mg/L	0.007	0.191	**27.3**
Lead	mg/L	0.002	0.05	**25**
Nickel	mg/L	0.001	0.171	**171**
Zinc	mg/L	0.006	0.094	**15.7**
Mercury	mg/L	<0.0001	0.0008	**8**
Fluoride	mg/L	<0.1	1.9	**19**
Phenol	ug/L	<1	12.5	**12.5**
2 Methylphenol	ug/L	<1	6.9	**6.9**
3- & 4 - Methylphenol	ug/L	<2	8.9	**4.5**
TPH C10-C36 Fraction Sum	ug/L	330	3700	**11.2**
TRH C10-C40 Fraction Sum	ug/L	190	3770	**19.8**
Phenol d6	%	17.9	43	**2.4**
2-Chlorophenol D4	%	36.2	43.6	**1.2**

[34] Professor Joe Bidwell, Pilliga Soil and Water Sample Data Summary, 7 February 2012

Appendix 5 provides the full advice from Professor Joe Bidwell on the results. Table 2 provides a comparison between the results for Soil Sample 5 in the uncontaminated zone and Soil Sample 3 in the contaminated zone.

Professor Joe Bidwell verified the soil data and described the results as follows:

> "*Analyses were conducted on three soil samples collected adjacent to the facility and two samples collected from a reference location. Soil samples from the suspected spill zone had higher average pH, electrical conductivity (70 times higher), and levels of sodium (39 times higher), chloride (90 times higher), sulfate, calcium, magnesium, and potassium than reference samples. There were no clear differences in levels of total metals, phenolic compounds, PAHs, total petroleum hydrocarbons or BTEX compounds in soil samples from the two locations*".

Table 2. Comparison of contaminated and uncontaminated soil sample results

Compound	Units	Un-contaminated Sample	Contaminated Sample	**Number of times higher in contaminated sample**
pH	pH Unit	5.3	9.9	**1.9**
Electrical Conductivity	uS/cm	11	1690	**153.6**
Sulphate as SO4 2-	mg/kg	6	20.5	**3.4**
Chloride	mg/kg	<10	850	**85**
Calcium	mg/kg	<10	80	**8**
Magnesium	mg/kg	<10	60	**6**
Sodium	mg/kg	<10	3510	**351**
Nickel	mg/kg	2	4	**2**
Zinc	mg/kg	<5	5	**>1**

Mr Tony Pickard collecting a sample from ponded coal seam gas water Pilliga Forest, February 2012

Professor Bidwell concluded:

> "*The range of ions, metals and hydrocarbons detected in the standing water near the treatment facility is consistent with constituents commonly found in untreated produced water. The elevated levels of salinity in soils and water within the suspected spill zone, in addition to the mixture of trace metals and measured organics in the standing water, could pose a risk to vegetation and soil organisms.*"

It was to be another two weeks after this information was released before Santos finally released some of its own information on the contaminated area.

Sampling Commissioned by Santos

Water Sampling

On the 22nd February, Santos released a report on Eastern Star Gas operations which included their own sampling commissioned of the contaminated site near the Water Treatment Plant. The report was accompanied by a media release which quoted the Santos Vice President Eastern Australia, James Baulderstone.

The report stated, *"Golder Associates has taken soil and water samples from the spill area and are analysing the sample"* and that *"analysis of these soil and water samples is being undertaken by ALS Group, an independent laboratory"*.

However, it is notably that there are no results provided in the document for those water samples and there is no other reference to them made in the report. The only data provided is soil samples.

In his media release, James Baulderstone states that:

> *"The extensive testing and analysis released today shows recent claims about dangerous toxicity levels in the Pilliga were misleading and have caused unnecessary concern in the community about CSG. The claims ignored the fact that the trace elements highlighted are naturally occurring in the Pilliga. In the impacted area around the Bibblewindi plant the trace elements remain at levels well within health and safety guidelines".*

However, the sampling commissioned by environment groups and verified by Professor Joe Bidwell did involve a comparison of contaminated areas with uncontaminated areas, and revealed levels of 'trace elements' up to 171 times naturally occurring levels for metals such as Zinc and numerous others including Lead, Arsenic and Chromium.

Whilst the comments by Mr Baulderstone are surprising, the broader failure by Santos to conduct, analyse or produce water samples is indicative of their apparent failure to grasp the nature of the environment in which they are operating. As their analysis of soil samples below illustrates, the benchmarks they have used relate to urban areas and not to important wildlife habitats like the Pilliga.

In the case of surface water pools, the quality of the water in those pools has serious implications for wildlife in the Pilliga, particularly given that samples commissioned by environment groups revealed such high levels of salts, heavy metals and petrochemicals compared to naturally occurring levels. The water quality of these surface pools is important information and crucial to assessing environmental risk in a forested area, but Santos either has not collected water data or not released it, and from their statements appear not to understand its significance.

Furthermore, the results from the water samples are likely to provide some important evidence as to the origins and timing of the spill. Detailed analysis of the signature of the total petroleum hydrocarbons, particularly if analysed over time, could shed considerable light on the origins of the current surface pools in the contaminated zone.

Lastly, Santos state in their report, "*the black substance on the ground adjacent to the water treatment plant (referred to in recent media reports) is not from a petroleum hydrocarbon source but is from natural organic material including eucalypt trees and grasses".*

This does not seem to match with results obtained by environment groups, which showed elevated levels of total petroleum hydrocarbons in surface water pools in the contaminated zone compared to pools outside the contaminated zone. If these levels were caused by 'eucalypt trees and grasses' then there should be no differences apparent between the samples.

Furthermore, there is other corroborating evidence to show that coal seam gas water in the Pilliga is often dark in colour and tarry in nature. Coal seam gas water in 1000 litre clear plastic containers at two well sites, Bibblewindi 24 & 25, from which gas is being vented, has been filmed and photographed on a number of occasions almost pitch black in colour.

The failure by Santos to either conduct or release water samples tends to lead to an understatement of the environmental impacts and uncertainty about the origins of the most recent spill. There is no information available as to whether the NSW Government has at any stage collected water samples from the contaminated zone, but it seems most likely that they have not. It would appear that, once again, the community is the only party that has collected the information that is required to assess the environmental impacts of the contamination that has occurred to areas adjoining the Bibblewindi Water Treatment Plant or to provide evidence as to what has occurred in the area.

Soil Samples

The results of the Santos soil samples show high levels of congruence with the soil samples commissioned by environment groups. Santos summarises the results as follows:

> "*The average concentrations of metals, TPH/TRH, pH, nutrients and salts in the upper surface samples collected from the affected area are generally greater than the average concentrations for background samples. This pattern is most pronounced for barium, strontium, manganese, iron and exchangeable sodium".*

However, Santos claim that the results of soil samples show that, apart from salts, there are no other health or ecological risks from the spill. The media release of the 22nd February states that '*Detailed investigations show soil samples well within relevant safety guidelines*' and that:

> *"Extensive soil tests undertaken by external scientific consultants demonstrate that the levels of trace elements and compounds in soil near the site, with the exception of salt, do not represent health or ecological risks."*

However, a closer inspection of the results actually obtained by Santos actually contradicts those statements. Firstly, the samples taken by Santos actually exceeded the National Environment Protection Measures (NEPM) guideline values for both Barium and Vanadium. Barium was recorded in one sample at 510mg/kg, whilst the EIL (Ecologically-based Investigation Levels) is set at 300mg/kg. Barium in some of its forms has significant toxicity and it was recorded at high levels in the upper soil samples where it would be most available to wildlife. However, the Santos report provides no analysis of the likely ecological impacts but instead apparently dismisses the matter as having no consequence.

Secondly, there are numerous problems with the NEPM guidelines used by Santos in the report and their relevance in a natural environment such as the Pilliga. The following points can be made:

1. The use of Ecologically-based Investigation Levels (EILs) to benchmark the soil results is inappropriate for assessing environmental impacts in a high conservation value natural area such as the Pilliga.

2. The NEPM[35] makes it quite clear that EILs are only interim guidelines for urban settings and that regional EILs would have to be developed relevant to regional flora, fauna and soils. The EILs used are not appropriate for assessing eco-toxicity of contaminants to native species.

3. For example, the NEPM states that[36]:

   "In the interim, EILs for an urban setting are provided based on considerations of phytotoxicity (copper, chromium, lead) and soil survey data (barium, phosphorus, sulfur) from four Australian capital cities...

   It is acknowledged that the EILs for an urban setting have not been derived to protect nominated ecological values and are somewhat arbitrary...

   In some circumstances, including the presence of a valued and sensitive species or coarse-grained, acidic soils, the establishment of more pertinent regional values should assume greater priority".

[35] http://www.ephc.gov.au/sites/default/files/ASC_NEPMsch__01_Investigation_Levels_199912.pdf
[36] http://www.ephc.gov.au/sites/default/files/ASC_NEPMsch__01_Investigation_Levels_199912.pdf

4. The NEPM makes it very clear that in circumstances where these EILs are not appropriate, more relevant EILs need to be developed. It states that:

   "*In addition, appropriate investigation and/or response levels need to be developed when:*
   - *Investigation values are not available for contaminants of concern and/or data are not available to enable the derivation of guideline values*
   - *Site conditions, receptors and/or exposure pathways differ significantly from those assumed in the derivation of HILs and EILs*
   - *There are significant ecological concerns (eg critical or sensitive habitat, threatened or endangered species, parklands and nature reserves)*"

5. Santos did not develop more appropriate EILs as required by the NEPM, and there is no consideration from Santos about the possible ecological impacts of a number of other compounds that showed elevated levels but for which there are no NEPM guidelines (such as Strontium).

6. As far as hydrocarbons are concerned, the criteria used for assessment are the NSW EPA service station guidelines, which are obviously not relevant to a sensitive natural area such as the Pilliga.

On ABC radio, Mr James Baulderstone of Santos described the results of the soil samples conducted by Santos as follows:

> "*There are no dangerous toxicity levels, the toxins that are alleged to be there are in fact naturally occurring trace elements and the soil samples we took and had analysed show* ***no real increase in those levels naturally occurring trace elements,*** *what is impacting vegetation in this area is salt*"[37].

This statement does not seem to be supported by the Santos document itself. The Santos report finds, "*the average concentrations of metals, TPH/TRH, pH, nutrients and salts in the upper surface samples collected from the affected area* ***are generally greater than the average concentrations for background samples****. This pattern is most pronounced for barium, strontium, manganese, iron and exchangeable sodium*". Furthermore, and as discussed above, the Santos report also admits that the levels of both Barium and Vanadium which they recorded were above NEPM guidelines.

In summary, the data presented by Santos and the criteria against which they are assessed are not adequate to support a conclusion that there are no 'health or ecological risks' associated with the contamination. On the contrary, there is sufficient evidence contained in the water and soil samples commissioned by both Santos and environment groups to indicate genuine ecological risks in a high conservation value area such as the Pilliga. Furthermore, the media conducted by Santos on the soil samples understates and/or misrepresents the significance of the results it obtained.

The limitations of the Santos soil assessment have been summarised by Professor Joe Bidwell, in a letter to The Wilderness Society (Appendix 6), as follows:

[37] http://www.abc.net.au/local/stories/2012/02/23/3438239.htm

"While chemical testing alone is effective at indicating what contaminants may be present at a site, they tell very little about true bioavailability or ecological risk. While the 'guideline' values used by the consultants that did the chemical testing on the soil are better than nothing, they were not derived as ecological action levels. I would also argue that the delays in analysing the samples may have lead to a reduction in the concentration of chemical residues that were measured, making comparison to guideline values even more problematic. Another key issue is that single chemical guideline values do not account for the interactions of chemicals that could occur in a mixture. These interactions could actually reduce the toxicity of some components or make it worse".

Additional Questions

There are numerous additional questions that remain unanswered in relation to Santos coal seam gas operations in the Pilliga and the spills of produced coal seam gas water in particular. There is still important information outstanding that is required to make a fully informed response, and the NSW Government should be urgently requesting this information.

One of the most important areas for further investigation is whether there has been a more recent, large spill at the Bibblewindi Water Treatment Plant. There is a considerable body of evidence to suggest that a more recent spill has occurred. This evidence includes:

1. **The increasing area affected by tree dieback between November 2011 and January 2012**: On 7th November, DRE advised environment groups in writing that the size of the spill was *'limited to approximately 0.55ha*'. However, by January 2012 the area of tree dieback as measured by both environment groups and Santos, was covering an area of approximately 1.2ha, more than double the size recorded in November.

2. **Observational information collected from the site**: When local landholder Tony Pickard reported the contamination on the 1st and 2nd January 2012, he commented on the appearance of seemingly **fresh pools of produced water collected on the surface which he thought unlikely to have remained in such a condition after seven months of heavy rainfall since June**. The 'tide mark' left by the passage of the water and the fact that the water travelled upslope in some areas suggested a large and rapid movement of water, which does not match with events as reported by Santos.

3. **The levels of semi-volatile petrochemicals recorded in contaminated water samples**: The water samples commissioned by environment groups revealed high levels of semi-volatile petro-chemicals (petroleum hydrocarbons >C10-C16) in the contaminated zone compared to the uncontaminated zone. Upon speaking with a range of scientists, it was deemed **surprising that these semi-volatiles had not fully evaporated after seven months** exposure to the atmosphere.
4. **The changes in the site since January**: Local resident Tony Pickard has been recording the site closely with photographic evidence since he first reported the incident in January 2012. **In that short two month timeframe, the surface pools in particular have changed**

dramatically, with the black tarry appearance dissipating and much of the water evaporating away completely. An area that was boggy and moist in early January is now almost entirely dry, despite considerable rainfall. The black ground stain has reduced markedly and in many cases almost completely disappeared over that time period. This adds weight to the theory that **the spill was far more recent than the alleged June 2011 spill date** as provided by Santos.

5. **The potential cause in the form of dam structural works on 30th December** - An excavator was working on the No. 2 pond at Bibblewindi Water Treatment Plant which adjoins the vegetation dieback in late December. It seems probable that this excavator working on the dam may have been the cause of a recent spill.

This mystery is heightened by the fact that Santos did not collect or release water samples from surface water pools in the contaminated area. It is currently unknown whether the DRE have collected any such samples.

Some of the media statements by Santos themselves throw doubt over their explanation in relation to the date of the last spill. In particular, in trying to downplay the environmental impact of the spills, Santos Vice President James Baulderstone stated that "*With the strong rainfall during that period of time and this salty saline water we're talking about, with it being diluted quite quickly, there has been minimal impact from those spills*'[38].

If the last spill occurred in June 2011, and heavy rainfall ensued which diluted it quickly, then why were there deep black pools of coal seam gas water with high levels of salts, heavy metals and petrochemicals still present six months later in January 2012?

The NSW Government should immediately release the results of any water sampling it has conducted in the contaminated zone at any time. It should also commission an organic chemist to investigate, in detail, questions relating to total petroleum hydrocarbons. A thorough and independent ecological risk assessment is required of the impact of all coal seam gas operations in PEL238 and PAL2 to date.

Spills - Summary and Conclusions

- The DRE and ESG both dismissed complaints of vegetation dieback adjoining the Water Treatment Plant as caused by water-logging.
- Despite being in the midst of an intensive investigation of operations in the Pilliga, DRE appears to have failed to collect and/or analyse soil or water samples which could be obtained on a 10 day turnaround and would have immediately disproved the water-logging claim.
- Santos repeatedly stated in early January that there 'had been no leaks', and has since apparently admitted four leaks prior to that date (after it assumed 100% ownership) and numerous leaks whilst Eastern Star Gas was still the operator.

[38] http://www.abc.net.au/local/stories/2012/02/23/3438239.htm

- There is still no information available on the four spills that have occurred since Santos assumed 100% ownership, including a potentially toxic spill of algaecide. The NSW Government has not stated whether it is investigating these spills.
- The report and associated media released by Santos into ESG:
    - Misrepresent the results obtained by environment groups, claiming that they did not contain a comparison with natural baselines, which is incorrect.
    - Did not collect or provide any water sample results from within the contaminated zone, thus potentially under-stating and obscuring its potential impact on wildlife.
    - Compared soil samples to standards used in urban areas which are not meaningful to wildlife habitat such as the Pilliga.
- Media statements by Santos in relation to the soil samples appear to substantially downplay the environmental impacts and even misrepresent the results of its own data.
- As a result of all the factors set out above, the Santos report understates the ecological risks associated with environmental incidents that have occurred in the Pilliga.

Given the high conservation significance of the Pilliga Forest, assessment of environmental risk requires, at the very least, a thorough eco-toxicological analysis. Professor Joe Bidwell has advised as follows:

> *"I would suggest a two-tiered biological assessment of soils from the site. First, a survey of the existing soil invertebrates from the spill zone as compared to reference sites could be done. This can easily be accomplished by collecting a sample of surficial litter from the site and using a Berlese funnel to extract the resident invertebrates. The numbers and types of invertebrates from each site could then be compared to determine if there were differences in community composition. Samples of the soils from the spill zone and reference sites could also be used for plant germination bioassays in the laboratory to see if germination is comparable between the two".*

Both state and federal governments should now commission such an assessment to be conducted as a matter of urgency. A full and independent ecological risk assessment is now required of all coal seam gas operations in the Pilliga to date.

Most importantly, whilst the events of the last nine months have exposed severe environmental failures in coal seam gas operations that are visible above-ground, there is no way of knowing what is occurring below ground. However, there is reason to be extremely concerned that similar basic failures in compliance have occurred which are likely to represent a severe risk to underground water resources, including the Great Artesian Basin. An urgent independent audit and testing regime is now required of all coal seam gas wells drilled by Eastern Star Gas in PAL2 and PEL238.

Dried sludge from the spill of untreated coal seam gas water, Pilliga Forest, February 2012

Discharge of Polluted Water into Bohena Creek

In 2011, certified agricultural and environmental consultants EastWest EnviroAg were commissioned by the Northern Inland Council for the Environment and The Wilderness Society to take samples of the water being discharged from the reverse osmosis plant into the Bohena Creek and to also collect a sample from further upstream for comparison purposes. Bohena Creek is an ephemeral creek with a shallow alluvial aquifer that discharges into the Namoi River.

EastWest EnviroAg visited the area and obtained two samples on 25th August 2011, one from the discharge and one from approx. 1km upstream. Bohena Creek was dry at the time sampling was conducted and Sample 2 was obtained by digging approx. 1m down to sample aquifer water.

EastWest EnviroAg provided the samples to the NASA certified ALS Group Laboratory. ALS Group conducted a comprehensive suite of tests which revealed that the discharge water contained elevated levels of ammonia, methane, cyanide, carbon dioxide, boron, bromide and lithium compared to the upstream sample. The results were provided to environment groups as Project No. EW 110647, and are attached as Appendix 7.

The comparison of results for the discharge and the upstream samples are provided in Table 3. Ammonia was detected at the discharge site at 1.56 milligrams per litre (mg/l), which is three times the Australian Drinking Water Guideline value of (0.5mg/l). It was detected at 0.03 mg/l in the upstream sample, well below the acceptable range for both drinking water and aquatic ecosystems. Advice received from Dr Marian Lloyd-Smith interpreting the results is provided as Appendix 8.

Table 3. Comparison of water at the discharge with the upstream sample

CHEMICAL	SAMPLE SOURCE		Increase
	UPSTREAM	DISCHARGE	
Ammonia (mg/L)	0.03	1.56	5200%
Lithium (mg/L)	0.001	0.023	2300%
Methane (µg/L)	10	68	680%
Bromine (mg/L)	0.1	0.6	600%
Total Carbon Dioxide (mg/L)	21	89	424%
Boron (mg/L)	0.05	0.26	520%
Total Alkalinity (mg/L)	22	94	427%
Cyanide (mg/L)	0.004	0.014	350%
Sodium (mg/L)	17	52	306%

Table 4 below compares the results with the ANZECC Guidelines for aquatic ecosystem protection in freshwater. This indicates that both Ammonia and Cyanide go beyond the trigger value for 90% protection in the discharge sample.

Table 4. Results of Bohena Creek discharge in relation to ANZECC guidelines

Chemical	Trigger values for freshwater (mg/L)				Bohena Discharge Test Results	
	Level of protection (% species)				Samples (mg/L)	
	99%	95%	90%	80%	Upstream	Discharge
Boron	0.09	0.37	0.68	1.3	0.05	0.26
Ammonia	0.32	0.90	1.43	2.3	0.03	1.56
Cyanide	0.004	0.007	0.011	0.018	0.004	0.014

The results were provided in full to DTIRIS via email on the 19th December 2011 and to the Environment Protection Authority via email on the 12th December 2011. In response to the release of this data publicly by environment groups, a Santos spokesperson stated that:

> "*But we do conduct and Eastern Star have been conducting regular testing on the water discharged from this facility. That discharge has been authorised by the New South Wales Government.....It's worth pointing out I think that the New South Wales Government has also under its Office of Water identified for some time that there are high nitrate levels in the Namoi River and has attributed those levels to the agricultural activities in the region.....All I can say is that any water discharged into the Namoi River meets the requirements of the New South Wales Government*"[39].

The company also said in a statement that "*Discharged water is tested on a monthly basis and all recent results have met NSW requirements"* and that *''Santos is confident it is not in breach of its authority or having any adverse impact on water resources in the area*[40]".

However, the monthly testing which Santos refers to was restricted to only 5 compounds and did not include ammonia. The reference to farming impacts and nitrates were both spurious, as the compound at issue was ammonia, not nitrates, and the catchment of Bohena Creek is located almost entirely in the Pilliga State Forest so farming impacts are minimal.

We have been informed verbally by DTIRIS that they subsequently visited the site to conduct an investigation but did not obtain a water sample from the discharge point or from the reverse osmosis plant. Whilst DTIRIS claimed that they were not able to obtain a sample due to

[39] http://www.abc.net.au/am/content/2011/s3386203.htm

[40] http://www.smh.com.au/environment/water-issues/tests-reveal-contaminated-water-near-gas-site-20111208-1oldj.html

malfunctioning of the plant, the Santos report suggests that a deliberate decision was made to shut-down the plant following the media revelations about pollution.

Santos state in their recent report into Eastern Star Gas operations (page 4): "*In any event, in December 2011, because of various concerns about water treatment plant,* ***Santos took the decision to scale back operations in the Pilliga, including ceasing operation of the water treatment plant pending a full review of its adequacy and integrity***".

They also state that: "*A reverse osmosis plant installed and operated by Eastern Star appears to have given rise to a number of issues. The plant suffered from multiple leaks and incidents. Given the passage of time, Santos has been unable to determine the volume of water released as a result of these incidents. The plant has not been in operation since 15 December 2011, pending Santos' review of the operation and operating practices*".

We were advised by DTIRIS on 9th December that they were collecting samples from the plant the following week starting 12th December. However, they later informed us that they did not collect any samples, due to the fact that the treatment plant had been shut-down. However, the Santos report suggests that there were at least three days between 12th and 15th when they should have had an opportunity to take samples. We were informed verbally by the EPA on 31 January 2012 that they were conducting an investigation into the matter but they had not, as of that date, obtained a water sample from the reverse osmosis plant.

We believe an investigation is required into why neither DTIRIS nor the EPA has managed to collect a single sample from the reverse osmosis plant either in the general course of their regulation or in response to the results obtained by environment groups, which appears to have been operational up to and including the 15th December.

Despite the claims by Santos reproduced above that *'all recent results have met NSW requirements'*, there are two additional sources of evidence which were held by Santos at the time which confirm that is not the case and indicate that pollution was occurring. In late 2011, Eastern Star Gas provided two water samples from the Bohena Creek discharge to the Senate Inquiry into Coal Seam Gas in the Murray-Darling Basin which provided results for 37 compounds. The samples were dated June and July 2011. The samples reported Ammonia levels of 1.7mg/L and 1.2mg/L respectively which is commensurate with the results obtained by environment groups and which is several times drinking water standards. Therefore, these results appear to directly contradict Santos statements above that there is *'no adverse impact on water resources*' and that *'all recent results have met NSW requirements*'.

Furthermore, the information provided by Santos in their report into Eastern Star Gas reveals that the levels of total dissolved solids in the discharge water frequently exceeded the limit of 300 mg/L and that **Eastern Star Gas hid those findings from the Department of Trade and Investment in their biannual management reports**. However, the Santos report ignores the issue of ammonia in the discharge water and does not provide any comprehensive water testing results for other substances in relation to the discharge Bohena Creek.

The Santos report does not provide the two Eastern Star Gas water samples. Water pollution into Bohena Creek exposes serious flaws in regulation. There was no requirement in the Review of Environmental Factors for the water discharge relating to serious monitoring of water quality in the creek. The requirement for monitoring was restricted to just five measures (including pH, EC, TDS) plus a visual inspection. There was no requirement whatsoever for monitoring of an upstream sample for comparison purposes.

Environment groups recently submitted a freedom of information request for all water samples submitted by coal seam gas companies to government authorities over the last year. This revealed only five documents in total - the two water testing results already submitted by Eastern Star Gas to the Senate Inquiry and the information released in relation to TDS by Santos in their report on Eastern Star Gas operations. This was apparently the full extent of the information held by the DRE on the quality of treated coal seam gas water that was being discharged into Bohena Creek.

This monitoring inadequacy represents an inexcusable failure by the NSW Government in relation to CSG regulation as well as a major failure on the part of the gas companies themselves. The most basic monitoring requirements, covering all likely compounds and comparing the discharge with both an upstream and downstream sample, would have immediately alerted authorities to the water quality problems and could have prevented the pollution from occurring.

Discharge - Summary and Conclusions

This review of available data indicates that the discharge of treated coal seam gas water was polluting Bohena Creek. Evidence for this pollution is found in the water analysis results provided by Eastern Star Gas to the Senate Inquiry[41] and the independent water samples commissioned by environment groups.

The Santos report into Eastern Star Gas operations ignores the issue of ammonia and cyanide levels being discharged into Bohena Creek, and does not release the information collected by Eastern Star Gas or any analysis of its own in relation to such levels. This is a major oversight.

As far as we are aware, neither DRE nor EPA has collected a sample of water from the reverse osmosis plant after treatment. The decision by Santos to shut that plant down in early December, immediately following reports by environment groups, appears to be designed to prevent any such sample from being collected. **The failure of government agencies to collect basic samples from the discharge point, despite water having being discharged for at least 2 years, underscores an extraordinary regulatory failure at a time when they were supposed to be conducting a detailed and comprehensive investigation of the area.**

The pollution of Bohena Creek would not have occurred if a basic monitoring regime had been in place requiring ESG/Santos to analyse the discharge for a comprehensive suite of chemicals and comparing it to an upstream sample.

[41] Senate Inquiry into the effects of coal seam gas, Narrabri NSW, Tuesday 2nd of August 2011

Commercial Production from an Exploration Licence

Section 29 of the *Petroleum (Onshore) Act 1991* (Petroleum Act) provides an exclusive right to the holder of a Petroleum Exploration Licence to **prospect** for petroleum on the land comprised in the PEL. 'Prospecting' is defined under the Act as follows:

"..to carry out works on, or to remove samples from, land for the purpose of testing the quality and quantity of petroleum in the land and the potential to recover petroleum from the land, but does not include any activity declared by the regulations not to constitute prospecting".

It is apparent that the removal of gas for commercial purposes does not meet the definition of prospecting because it includes considerably more than removing 'samples' from land for the purpose of testing and instead includes the removal of gas for commercial purposes. There are several corroborating clauses within the Petroleum (Onshore) Act 1991 and the Petroleum (Onshore) Regulation 1991 which confirm that commercial production is not consistent with an exploration licence.

The hierarchy of use developed by the Petroleum Act 1991 specifically range from an exploration licence, to an assessment lease to a production licence. If commercial production were valid within an exploration licence there would be no purpose to such a hierarchy. This is further borne out by provisions contained in the Petroleum (Onshore) Regulation 2007, which defines commercial production as follows:

> ***"****Commercial production of petroleum means the use by, or supply to, any person (including the holder of a petroleum title or mining lease) of any petroleum extracted from an area of land to which a petroleum title or mining lease relates for any purpose (****other than for well assessment, flaring or equipment testing that does not result in the generation of energy or supply of petroleum for commercial purposes)****".* [Emphasis added]

The royalty provisions of the Petroleum Regulation provide further evidence that it is beyond power to produce commercial gas from an exploration licence. Clause 25 of the Regulation requires notification to the Director-General of dates on which commercial production commences for the purposes of royalties for assessment leases and production leases only, and not for exploration licences. If it were legally valid to commercially produce gas under the terms of an exploration licence, the entire royalty provisions of the Petroleum Act would be rendered ineffective as a title holder could commercially produce gas under an exploration title for the life of that title with no royalty implication.

The Santos Tintsfield pilot production field consists of 6 wells located within PEL 238 that are situated approximately 8km south-west of Narrabri. The Tintsfield CSG wells began production on or about 1st April 2011 with all CSG produced being piped to the Wilga Park Power Station for the commercial supply of electricity.

The Review of Environmental Factors for the Tintsfield wells states that *'All gases produced from the pilot will be preferentially consumed at the Wilga Park power station 5.5 km east northeast of the pilot*'. In April, 2011, Eastern Star Gas released a statement[42] announcing that "*operation of the Tintsfield lateral well project will begin today'*. That statement also indicated that "all *production from Tintsfield is piped to Wilga Park where water can be handled and gas used as fuel for generation of electricity*".

PEL 238 clearly does not confer authority on Santos to commercially supply CSG from its Tintsfield Wells to the Wilga Park Power Station or any other power station. The work program in PEL238 refers to pilot production but does not mention or authorise commercial production. **Commercial supply of gas from an exploration licence represents a breach of the Petroleum Act and would result in commercial gas production achieved without paying any royalties to the state of NSW.**

An urgent investigation is required into the Tintsfield pilot production field and the commercial supply of gas to Wilga Park Power Station.

[42] http://www.bourseinvestor.com/bi4/pdfnews/default.asp?d=01167244&f=20110401

Compliance with the Petroleum (Onshore) Act 1991

Requirements of Petroleum Titles

The petroleum titles held by Santos in the Pilliga include Petroleum Assessment Lease 2 and Petroleum Exploration Licence 238. These two titles are reviewed below in relation to the incidents covered in detail earlier in this report.

The earlier sections of this report provide detailed evidence to prove that coal seam gas operations in the Pilliga have resulted in harm to the environment, including water pollution and soil contamination. **The leaseholder has failed in its duty to prevent and/or minimise harm**, contained in the following clauses of the relevant petroleum titles:

> *PAL 2, Clause 1: The leaseholder must implement all practicable measures to prevent and/or minimise any harm to the environment that may results from the construction, operation or rehabilitation of any exploration activities.*
>
> *PEL 238, Clause 2: Operations must be carried out in a manner that does not cause or aggravate air pollution, water pollution, soil contamination or erosion.*
>
> *PEL 238, Clause 8a: Operations must be carried out in a manner which avoids pollution of any Catchment Area.*
>
> *PEL 238, Clause 18: Operations must be carried out in a manner that ensures the safety of persons and stock in the vicinity of operations.*

The leaseholder has failed to report either water pollution or soil contamination caused by its operations in the Pilliga, as outlined earlier in this report, which represents a serious breach of the following requirements of its petroleum titles.

> *PAL 2, Clause 4: The leaseholder must, in accordance with Department guidelines (if any), report any incidents causing or threatening material harm to the environment.*
>
> *PEL 238, Clause 23d: An Incident and Complaints report must be submitted to the Department as follows:*
>
> *i) The report is to be submitted within 24 hours of any serious environmental incident, breach of Conditions 1 to 27 or breach of other environmental regulations or a serious complaint from landholders or the public.*

The leaseholder has not buried all gas gathering pipes and the gas gathering system has not been maintained free of leaks. Evidence for this has previously been collected on video at the Bohena 7 gas well and at Bibblewindi 21, and is outlined in the chronology section of this report. This represents a breach of the following clauses:

> *PAL2, Clause 7g: All gas gathering pipelines must be buried with a detectable marker tape or wire or other approved means provided for locating the pipe.*

PAL2, Clause 7i: The gas gathering system must be maintained free of leaks while in operation and a program implemented to confirm this. Records to be maintained and made available to the inspector on request.

The acknowledged non-compliance in relation to over-clearing of Dewhurst 8 (letter for DRE to Tony Pickard, April 2012) and alleged **excessive clearing at up to 39 sites** identified in the Santos report into Eastern Star Gas operations, raising questions as to whether there has been a breach of the following requirement:

PEL 238, Clause 4. The licence holder must not cut, destroy, ringbark or remove any timber or other vegetative cover on any land subject of this licence except such as directly obstructs or prevents the carrying on of operations. Any clearing not authorised under the Petroleum (Onshore) Act 1991 must comply with the provisions of the Native Vegetation Act 2003.

There are a number of other requirements of the titles which appear to have been breached, based on the details provided earlier in this report and in the Santos report on Eastern Star Gas operations. These include:

PAL 2, Clause 5: The Licence Holder must rehabilitate all disturbed land to the satisfaction of the Director General. (Letter from DRE to Tony Pickard, April 2012)

PAL 2, Clause 6a: All operations must be carried out in conformity with the 'Schedule of Onshore Petroleum Exploration and Production Safety Requirements' published by the DPI, as amended from time to time.

PAL 2, Clause 10b: A well must not be plugged and abandoned except in accordance with the Schedule of Onshore Exploration and Production Safety Requirements, and any other guidelines in force from time to time. (Letter from DRE to Tony Pickard, April 2012).

PEL 238, Clause 5: The licence holder must take all protections against causing an outbreak of fire....

PEL 238, Clause 6: All refuse must be deposited in properly constructed containers. The licence holder must maintain the area in a clean and tidy condition at all times.

PEL 238, Clause 19d: Once any drill hole ceases to be used the land and its immediate vicinity is left in a clean, tidy and stable condition

It is apparent from the detailed information provided earlier in this report that the licence holder is not complying with the provisions of the *Petroleum (Onshore) Act 1991* or the conditions of the licence. The licence itself contains a provision for the DRE to direct that operations cease under such circumstances, as follows:

Clause 25a: If an inspector or an Environmental Officer believes that the licence holder is not complying with any provision of the Petroleum (Onshore) Act 1991 or any condition of this licence concerning the working of the licence, he may direct the licence holder to:

i) Cease working the licence, or

ii) cease that part of the operation not complying with the Act or conditions until in the opinion of the Inspector/Environmental Officer the situation has been corrected.

It is surprising that such a direction has not already been given for PEL238 given the failures that have been identified. DRE should immediately require that Santos stop working the licence.

Requirements of the Petroleum (Onshore) Act 1991

The Petroleum (Onshore) Act 1991 contains a clause which allows the Minister to cancel any licence as follows:

> ***22 Cancellation or operational suspension of titles***
> *(1) A petroleum title may be cancelled by the Minister if its holder, at any time during the term of the title:*
> *(a) fails to fulfil or contravenes any of the conditions of the title, or*
> *(b) fails to use the land comprised in the title in good faith for the purposes for which it has been granted, or*
> *(c) uses the land for a purpose other than that for which the title has been granted.*

It is apparent that there have been numerous contraventions of the conditions of PAL2 and PEL238 by Santos, which are described in detail earlier in this report, particularly relating to soil contamination and water pollution. Furthermore, the use of an exploration licence for commercial production appears to represent a breach of good faith under s 22 (1)b. These events taken together constitute a very strong trigger for the Minister to cancel the licences, and no lesser action ought to be considered sufficient given the number and scale of the contraventions which have occurred and the serious failures in notifications associated with them.

Furthermore, s16A of the Petroleum Act allows the Minister to require that the security associated with a petroleum title is forfeited to the Crown, as follows:

> ***16A Forfeiture of security***
>
> *(1) All or such part of any security in relation to a petroleum title as the Minister may determine is to be forfeited to the Crown if the holder of the title fails to fulfil the obligations imposed under or arising out of this Act in relation to the title.*
> *(2) Forfeiture is effected by the service of a written notice on the holder of the relevant petroleum title.*
> *(3) Money realised from the forfeiture of any such security is to be applied for the purpose of fulfilling the obligations arising under this Act in relation to the petroleum title.*

The security lodged for each title is contained in the titles themselves, and are set down as:

PAL2, Appendix 2: Sum of security to be lodged with the Director-General: $10,000

PEL238, Third Schedule: A security in the sum of $868,000 must be lodged with the Minister by the licence holder for the purpose of ensuring the fulfilment of obligations under the licence. If the licence holder fails to fulfil any one or more of such obligations the said sum may be applied at the discretion of the Minister towards the cost of fulfilling such obligations.

Given the serious and systemic failings of coal seam gas operations in the Pilliga and the failure to notify authorities as required, the security for both titles should now be forfeited to the Crown at the request of the Minister. These funds should then be used to conduct further detailed ecological risk assessments in relation to soil contamination and water pollution that has occurred in the area.

Compliance with other legal requirements

Protection of the Environment Operations Act 1997

Water Pollution

Section 120 of the POEO Act states:

> *120 Prohibition of pollution of waters*
>
> *(1) A person who pollutes any waters is guilty of an offence.*
>
> *(2) In this section:*
>
> *"pollute" waters includes cause or permit any waters to be polluted.*

Water pollution is widely defined in the Act as follows:

> *"(a) placing in or on, or otherwise introducing into or onto, waters (whether through an act or omission) any matter, whether solid, liquid or gaseous, so that the physical, chemical or biological condition of the waters is changed, or*
> *(b) placing in or on, or otherwise introducing into or onto, the waters (whether through an act or omission) any refuse, litter, debris or other matter, whether solid or liquid or gaseous, so that the change in the condition of the waters or the refuse, litter, debris or other matter, either alone or together with any other refuse, litter, debris or matter present in the waters makes, or is likely to make, the waters unclean, noxious, poisonous or impure, detrimental to the health, safety, welfare or property of persons, undrinkable for farm animals, poisonous or harmful to aquatic life, animals, birds or fish in or around the waters or unsuitable for use in irrigation, or obstructs or interferes with, or is likely to obstruct or interfere with persons in the exercise or enjoyment of any right in relation to the waters, or*
>
> *(c) placing in or on, or otherwise introducing into or onto, the waters (whether through an act or omission) any matter, whether solid, liquid or gaseous, that is of a prescribed nature, description or class or that does not comply with any standard prescribed in respect of that matter,*
>
> *and, without affecting the generality of the foregoing, includes:*
> *(d) placing any matter (whether solid, liquid or gaseous) in a position where:*
> *(i) it falls, descends, is washed, is blown or percolates, or*
> *(ii) it is likely to fall, descend, be washed, be blown or percolate,*
>
> *into any waters, onto the dry bed of any waters, or into any drain, channel or gutter used or designed to receive or pass rainwater, floodwater or any water that is not polluted, or*

(e) placing any such matter on the dry bed of any waters, or in any drain, channel or gutter used or designed to receive or pass rainwater, floodwater or any water that is not polluted, if the matter would, had it been placed in any waters, have polluted or have been likely to pollute those waters.
"waters" means the whole or any part of:

(a) any river, stream, lake, lagoon, swamp, wetlands, unconfined surface water, natural or artificial watercourse, dam or tidal waters (including the sea), or
(b) any water stored in artificial works, any water in water mains, water pipes or water channels, or any underground or artesian water".

The discharge of treated coal seam gas water into the Bohena Creek system clearly constitutes pollution under the POEO Act 1997. As detailed in the pollution section earlier in the document, the samples collected from the discharge clearly show that the introduction of the water into the Bohena Creek system was likely to change the condition of that creek. The elevated levels of ammonia and cyanide were recorded at levels that would be detrimental to the health of aquatic fauna according to ANZECC guidelines.

The Review of Environmental Factors for the discharge asserts:

"The proposal carries no potential for direct or indirect impact on aquatic species, ecological communities or habitat. The creek is naturally ephemeral in its style, and has not contained any visible or measurable base flows since December 2004. There are no permanent or temporary pools within the impacted reach with any potential to contain aquatic species".

The Australian Museum has recently confirmed records of the Spangled Perch within pools in Bohena Creek, and important native flora has also recently been identified in the creek system including the carnivorous plant *Drosera indica*. A number of different frog species are also known to occur along Bohena Creek. Therefore, the discharge into Bohena Creek by Santos is highly likely to have caused environmental harm within the meaning of the POEO Act 1997.

Waste Disposal

s115of the POEO Act 1997 states that:

1) Offence If a person wilfully or negligently disposes of waste in a manner that harms or is likely to harm the environment; (a) the person, and (b) if the person is not the owner of the waste, the owner, are each guilty of an offence.

The POEO Act 1997 defines waste as:

***waste** includes: (a) any substance (whether solid, liquid or gaseous) that is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment*

It is apparent from the detailed information provided earlier in this document on the recorded spills of coal seam gas water near the Bibblewindi Treatment works that waste within the meaning of the POEO Act 1997 has been deposited into the environment in a manner that is likely to harm it. The revelations from Santos that all of the spills both pre- and post Eastern Star Gas at the treatment works 'were preventable' and the evidence that Eastern Star Gas did not report the spills to authorities, indicates that the disposal was either wilful or negligent. Sam Crafter, of Santos, has stated in relation to the Eastern Star Gas spills that *'These problems were entirely preventable and were the result of poor practice'*[43]. In relation to three of the spills that occurred after Santos took over 100% ownership, Santos have acknowledged that all three *'were preventable'*[44] and in relation to at least one of the Santos spills, Sam Crafter also stated on 14th February that "*We need to be clear, this incident was entirely preventable* ***and it shouldn't have happened***"[45].

Therefore, there is a very strong case to be made that coal seam gas spills in the Pilliga are in breach of s115 of the POEO Act 1997. However, the EPA does not appear to be investigating the matter, merely stating that it is supporting the DRE in their investigations. As far as we are aware, there has been no sampling conducted by the EPA of the spills. It is a cause of major concern if the primary regulatory authority of under the POEO Act 1997 is not empowered or required to investigate the environmental incidents that have occurred in the Pilliga.

Contaminated Lands Management Act 1997

Section 5 (1) of the Contaminated Lands Management Act 1997 specifies that:

"Contamination" of land, for the purposes of this Act, means the presence in, on or under the land of a substance at a concentration above the concentration at which the substance is normally present in, on or under (respectively) land in the same locality, being a presence that presents a risk of harm to human health or any other aspect of the environment".

Section 8 of the CLM Act 1997 sets out the general functions of EPA in relation to contaminated lands as follows:

(1) It is the duty of the EPA to do the following in a manner and to an extent reasonable in the circumstances:

(a) examine, and respond to, information that it receives of actual or possible contamination of land,

(b) address any contamination that the EPA considers to be significant enough to require regulation under Division 2of Part 3,

(c) record what it has done under paragraphs (a) and (b)and the reasons for it.

(2) It is the duty of the EPA to respond to a person (other than the EPA or an authorised officer) who has furnished information referred to in subsection (1). The response must:

(a) be made in a reasonable time, and

(b) state what the EPA has done in relation to the information and the reasons for doing it, and

[43] http://www.nvi.com.au/articles/F16santos.html
[44] http://blogs.abc.net.au/nsw/2012/02/0830-abc-new-england-north-west-news-10022012.html
[45] http://au.prime7.yahoo.com/n4/news/a/-/national/12899545/call-for-csg-ban-video/

(c) be in writing if the information was in writing.
(3) In addition to any functions the EPA has under this or any other Act, the EPA may take such reasonable steps as it considers necessary in relation to investigating or managing contamination of land (including significantly contaminated land) or the threat of harm from any such contamination".

Section 60 of the CLM Act 1997 includes a duty on the owner of a site to report contamination. This duty is regulated by a set of guidelines - 'Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997'[46]. One of the key indicators of contamination set out in the guidelines is ' *visible signs of toxic responses to contaminants in flora and fauna'*. The guidelines then go on to say that *'In some cases the indicators themselves will provide enough evidence to conclude that the contamination should be reported to DECC*'. However, if further investigation is required, the guidelines specify that such a site investigation should:

1. describe past and present activities that potentially contaminated the land and the adjacent areas, including groundwater, surface water and sediments;
2. identify potential contamination types;
3. assess the site condition;
4. assess the nature, degree and extent of the contamination;
5. assess any harm that has been, or is being, caused by the contamination; and
6. assess the possible exposure routes and exposed populations and the nature of any risk presented by the contamination.

It also states that "*A suitably qualified and experienced environmental consultant should be engaged to do the assessment. The consultant should use the publication Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites (NSW EPA 2000) as a basis for conducting the investigation and preparing a report."*

It is notable that the report commissioned by Santos from Golder Associates and included in their report on ESG operations, does not refer to the Contaminated Sites Guidelines for Reporting by the NSW EPA nor does it refer to the Contaminated Lands Management Act 1997. Since the report does not specifically address these matters, it cannot provide a conclusion as to whether or not the contamination should be reported in accordance with the Guidelines and the Act.

The Guidelines do specify that *'the duty to report is not intended to capture the notification of....sites without offsite contamination where....any onsite contamination has been adequately addressed by the planning process under the Environmental Planning and Assessment Act 1979'*. However, it is apparent in this case that the contamination has not been adequately addressed under the EP&A Act 1979, given the regulatory failures of DTIRIS and the failures in reporting by Santos/ESG. Furthermore, there are substantial offsite impacts in this case which have extended out beyond the area subject to approval by the Review of Environmental Factors under the EP&A Act 1979.

Once notification has occurred, the Act gives the EPA power to regulate sites that it defines as 'significantly contaminated'. Once a site has been declared to be 'significantly contaminated', the EPA has powers to require management orders or site audits by accredited site auditors.

[46] DECCW 2009

The coal seam gas spills in the Pilliga discussed earlier in this report clearly constitute 'contamination' within the meaning of the CLM Act 1997. At the very least, Santos should have, in accordance with s60, conducted an investigation in accordance with the Guidelines for Reporting Contamination to determine whether notification to the EPA was required. The EPA should have, in accordance with s8, examined and responded to the reports of contamination in the Pilliga.

Given that neither of these two assessments have occurred, EPA should now ensure that:

- An independent site investigation is conducted of the contaminated area in accordance with the *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA 2000).
- An accredited site auditor is engaged to review the investigation and report.

The EPA should examine, and respond to, reports of contamination in the Pilliga in accordance with s8 of the CLM Act 1997 and provide a response to complainants.

Role of the Environment Protection Authority

The events of the last 12 months in the Pilliga raise serious concerns about the role of the EPA in enforcing environmental laws in relation to coal seam gas companies and their operations. In a response to a complaint by environment groups in October 2011, EPA stated that *'The EPA does not have a formal statutory approval or regulatory role under the Protection of the Environment Operations Act 1997 until the production stage of gas development"*.

However, the EPA *does* have a formal regulatory role over coal seam gas operations during the exploration phase. Although coal seam gas exploration is not a scheduled activity and exploration does not require an environment protection licence, it certainly does not exempt the activity from the operation of the POEO Act 1997. On the contrary, **the POEO Act 1997 applies in full and the fact that coal seam gas explorers do not obtain a licence means that they have no defence against prosecution under the Act**.

Therefore, the EPA has full regulatory powers under the POEO Act and the CLM Act 1997. However, they have exercised their powers only in relation to the water pollution complaint and not in relation to any other alleged breaches. This leads us to question the extent to which the Environment Protection Authority is empowered by the NSW Government to enforce environmental laws against coal seam gas companies.

Certainly, there is an interesting comparison to be made with the role of the EPA in handling environmental incidents in the Pilliga with their role in handling environmental incidents at Stockton with the Orica plant. There are surprising similarities between the two - both have involved several environmental incidents in a short period of time, both have had incidents involving ammonia and arsenic releases, both have involved problems and time delays with self-regulation and self-reporting. However, that is where the similarities end. At Orica, the EPA were sent in by the NSW Premier Barry O'Farrell with all guns blazing and shut down the plant. In the Pilliga, the EPA has been relegated to a marginal role investigating only one incident and coal seam gas operations have continued unhampered by any regulatory action.

Full list of recommendations

We recommend:

1. The Minister for Resources should now immediately utilise his powers under the *Petroleum (Onshore) Act* 1991 to:
   - Cancel PEL238 and PAL2 in accordance with s22 of the Petroleum Act.
   - Forfeit all securities to the Crown (amounting to $878,000) in accordance with s16A of the Petroleum Act and utilise those funds to commission a thorough independent ecological risk assessment of the impacts of coal seam gas activities to date in PEL238 and PAL2.
   - Commence legal action against Santos for all major and minor breaches identified in this report.

2. The NSW Government should urgently commission the following independent scientific assessments of the impact of coal seam gas activities in the Pilliga, within an ecological risk assessment framework:
   - A site investigation of all contaminated areas in accordance with the contaminated site guidelines of the Environment Protection Authority, which is then subject to review by an accredited site auditor.
   - Thorough eco-toxicology assessments of the impacts of contamination to date and the development of regional ecologically-based investigation levels that are relevant to the region and to the sensitive environment of the Pilliga.
   - Independent testing of the integrity of all coal seam gas wells in PEL238 and PAL2 (including de-commissioned wells) to determine if damaging impacts have occurred in operations below-ground.
   - A forensic investigation into the water treatment plant and whether there was a large, unreported spill in the vicinity in December 2011.
   - A detailed assessment of the distribution and full extent of vegetation clearing and resultant impacts on wildlife habitat.

3. There should be a Special Commission of Inquiry (under the NSW Special Commissions of Inquiry Act 1983) established into all aspects of coal seam gas operations in PAL2 and PEL238 to provide one single and far-reaching investigation into the matter. This should include, but not be limited to, the following:
   - The entire operation of PEL238 and PAL2 to date including all incidents revealed in the Santos report into Eastern Star Gas, all complaints by the community and all incidents that have occurred since Santos took on 100% ownership.
   - The production of gas for commercial purposes within an exploration licence at the Tintsfield pilot production, including an analysis of the approvals process for the Review of Environmental Factors which allowed it to proceed.
   - All potential breaches of environmental laws for which the Environment Protection Authority is the appropriate regulatory authority, including those which the EPA has not investigated to date.

- Recommendations for prosecution which have arisen from the investigation across all relevant legislation.
- Recommendations for a thorough overhaul of the legal framework regulating coal seam gas operations in NSW.

4. The NSW Government should refer to the matter to the Australian Securities Investment Commission to investigate whether there have been any breaches of the Corporations Act 2001, in particular whether the actions of the directors or officers have been reckless, or intentionally dishonest and have not exercised their powers or discharged their duties in good faith in the best interests of the company or for a proper purpose, in accordance with s184.

5. The NSW Auditor-General should be requested to:
   - Investigate the failings of coal seam gas regulation in the Pilliga including self-regulation by gas companies, flaws in monitoring, compliance and enforcement by government agencies and the interaction between coal seam gas companies and government authorities.
   - Make recommendations for thoroughly restructuring compliance and enforcement of coal seam gas operations and community complaint procedures and for adequate resourcing of regulatory authorities.

Appendix 1 Mr Pickard Reports to DPI 2009-2011

DI&I REPORTS

2009

October—Saturday Diesel Spill 17km long from Boundary Rd in State Forest to Dewhurst 8 – big puddle at D8 – have DVD- ESG claimed 20ltr and 30ltr. Was on local 7 news. Council attended Monday, Mr Marshall, saw extent of spill- DPI sided with ESG version. Also notified state forests, they investigated Sunday and found no evidence of Diesel spill, (Vid)

May---- Dewhurst 6c pumping fluids into unlined sub-pond, No fencing or protection, on Ch 7 locally. DPI notified said that there was no fluid going onto unlined ground. (Vid)
Excessive clearing beside access roads. DPI said that it was necessary to obtain clear vision, only small trees removed, DPI informed large trees felled- practice stopped soon after. (Vid)
Grey trail of Drilling fluid from D8 to Bibblewindi Treatment works, Still there 14 days later. No action. (Vid)

August-- Drive through was recorded and question about bringing of Bibblewindi West and Bibblewindi Laterals plus clearing sent to Anna Timbrell of DoP, she sent on to DPI- no word yet from DPI (Vid)

June---- Long weekend, Clearing of bush for pipeline, DPI notified near sacred site, ESG changed creek crossing point. (Vid)

Bibblewindi West 22- unlined drill pond - DPI notified, said that ESG had told them that there was no chance of Salts or water being adsorbed into the ground. Also Dewhurst 7 and Bibblewindi 10. same report to DPI same answer back. (Vid and Ph)

Forest partially closed by ESG, DPI notified-ESG had no permission to close roads or areas off to , so can use – ESG did not take down signs at Bibblewindi, however Contractor used State Forest Timber Harvesting signs to keep areas closed.(Timber Harvesting was not being done most of the time,even used signs 500m on private property) (Vid)

Illegal Drillers camp – Council Resolved to notify DPI, because of road damage caused in building camp (see Narrabri Council Meeting Minutes of August meeting and resolution registers until December 2009)

Animal deaths - DPI notified. Nothing back (Vid and Ph)

December 25 2009 to January 1 2010 Rain event and ponds at Dewhurst 8 washed out, DPI notified- ESG claimed that it was too wet to see ponds. Owner and I went up there, roads, private and Council could take heavy vehicles, owner had machinery there. (Vid and Ph)

2010

6th January 2010 ; Faxed DII Maitland re report of overflowing ponds,over Christmas / New Year and when did ESG report these events to you,was it within the 48 hours as per Exploration Licence conditions. Also mentioned ESG and how little they had done to correct Noise Disturbance problem

from Drill Rig, of 2009--- reply by phone call only at which time I notified him tat there were NaCl and Kcl on site at Bibblewindi 22H. (Vid, Pho. and Fax)

8th January 2010 ; Faxed to DII Maitland re 6 inch Poly Pipe from Bohena Wells to Bibblewindi Treatment plant, laid on ground and not buried, quoted fire, asked for Inspector to be sent up--- No reply. (Fax)

21st January, sent email re clearing clearing photos on Dewhurst 8 to Glen.Turner@environment.nsw.gov.au

22nd January find out that DII Maitland is now handling matter, a Mr McFadyen
22nd January 2010 Faxed DII re pad construction breaches and man proof fencing breaches at Dewhurst 8 (see Dewhurst 8 REF sections 4.2.3 Drainage and 4.2.4 Initial Rehabilitation and Site Restoration) (Have Fax.)

27th January 2010 fax to G Summerhayes re pond over flows at Dewhurst 10 and mentioning Email of 22-1-10.(Summerhayes sends conformation of fax's sent 6,8,22nd January 2010 and also referred complaints from DECCW to DI&I these being :

18th January 2010 concerns over native clearing at Dewhurst 8

20th January 2010, 4 page fax concerning water management and discharge, *Dead Wildlife, DFO spill,Environmental Licence and Venting of Methane to Atmosphere* (this is the Christmas/ New Year 2009/2010 pond overflows at Dewhurst 8 Pilot Production Complex) ((Told ESG to better construct sites – no action taken) (DII has all photos and Video that was sent to DECCDW) Summerhayes tells me of approved method of Pond Decommissioning – Pump out, roll out trap leave material in pit and fill over.
ESG had not followed their REF and got away with it.(see Dewhust 8 REF section 4.2.4) (*Have Fax,Vid and Pho. Also DII Report Acceptance form)*

27th January 2010 aggressive phone call from Summerhayes, ESG had told him a few porkies re road conditions an rain amounts, he believes ESG and not locals,we got around, how else cold I have taken photos, ESG staff were on holidays and all shut down.I reported Dewhurst 5 dead and dieing trees as a result of Drill pond being spilt while being filled in (photos and video prove that, but Summerhayes got cranky and asked me If I actually saw it happen, NO, (no action taken)

26th February 2010 ; Mollee Creek spill, notified DII (news release only – no action taken as yet by either Council or DII)

Not reported to DII but information received 28-2-10 " All fluid transfer from Eastern Star sites was stopped on Saturday, until further notice,and the contractor at Dewhurst 8 has left the site. It was a sub-contractor to Lein Contracting that spilt the drill fluid at Mollee Creek, subbie came from Wee Waa."

Rang around May/June re the relocation of the Treatment ponds for Tintsfield Pilot located at Wiliga Park, as the Contractor told me, and the pipe work was going nowhere near the given location in the original (as it turns out) REF. The change of local was news to him because all the REF's he had seen indicated it was going in cleared ground, and not the tree area (no formal reply only what happened that day on phone)

June; first report re clearing at Dewhurst 8 photos provided to DII (fly-over and ground photos provided – reply was that it was all approved clearing as per REF.(Vid and Photo)

August ; Clearing of trees at Wilga Park, notify DII, news to them as to new local, but does admit that he has sent back an REF on water treatment because he was not happy with the TDS figure Also asked about ESG operations in the State Forest being shut down due to **Environmental Concerns.**

December ; Culgrooa 2 flooding and Chemicals in water, pad built in flood way, ESG got pinged for Pad construction only. Also pad on wrong side of road according to REF, (Vid and Ph, plus witnesses)

2011

January; DII about holes found in the liner of small water receivable pond (vid , poor quality ESG got in a knot over it - see letter)

DII and State Forest over use of road in very wet conditions and road damage (Vid)

EVENTS AWAITING REPORTING

but DII has slowed down reporting procedures to mail contact only (see email from Summerhayes and another person) , what is wrong with email?

Look into clearing at Dewhurst 8 pilot production (Vid and Ph) {reported in 2010 nothing back-again in 2011}

Open and unlined pond at Bibblewindi West 22 (Vid and Ph)

Dead trees at Bohena 2, 3, 4/4L, 5 & 7. Plus open pond, unlined and non- stock proof fencing at Bohena 7 (Vid and Ph)

Emergency overflow arrangement at Bohena collection ponds (Vid and Ph) runs into bush and has been used.

Exposed above ground, coal seam gas water from Bohena Wells to Bohena collection ponds (Vid and Ph).

Why big diam pipe from Bohena collection ponds to Bohena Creek, no treatment at Bohena collection ponds, and system has been used. (Vid and Ph). All piping above ground.

Vent point on water line from Bibblewindi West to Treatment and gas gathering works, vents coal seam water to the ground, big black tarry stain and salt (have seen in operation, so has Wilderness film crew, Vid and Ph).

Why are large amount of Chemicals stored in the open at the Narrabri Dept. of ESG and yet must be under cover when on Drill site? June 2011 9Vid and Ph)

Unlined pond at Bibblewindi Lateral 16, contains salty coal seam water, contrary to DII regulations (Vid and Ph).27-6-11 and earlier

Imported top clay soil removal from Dewhurst 19, loaded truck was seen entering Boundary Road going where? This layer being replaced by imported top soil from where? (Vid and Ph of site only)

27-6-11.

Dewhurst 2, Many white Salt deposits(up to 1msq.) and salt lumps along with a patch of grey granular substance, salt can be easily seen in photo (Vid and Ph) 26-6-11.

Why is Garlands road graded below the natural ground level in the Water Treatment area, and most water run-offs going up hill, thus in times of rain road becomes the water course for the run-off, this is contrary the Occupation Permit Conditions . This road is a Public road.26-6-11

Why area roads and tracks only gated and not whole sites, e.g. Bibblewindi treatment and gas gathering works since January 2011.

Why is water outlet into Bohena Creek not in the location as approved, and despite requests to DII, no Modifications to the original have been located .(Vid and Ph)and why is this outlet not fully in the Creek? May 2011.

Where is the REF stating that trees can be removed for the Water Complex at Wilga Park (Vid and Ph) new clearing and burning has just taken place. 21-6-11.

Why is the Venting going on at Bibblewindi 26 H and how long has it been going on, REF to cover this venting, and what quantity of Methane (green house gas) released, and where recorded ? (Vid and Ph) 3-7-2011.

Why has the top covering from Dewhurst 19 which would be Contaminated by Drilling Chemicals, be used as road repair material on Boundary Rd. and outside Bibblewindi 22? (vid) 3-7-2011

Why is the vent pipe stand in the concrete pipe, in front of Bibblewindi West 23, cracked open and spitting coal seam water and Methane out?(Vid and Ph) 3-7-2011

For DoP

Leaking Gas line at Bohena 3. Why has not normal maintenance procedures not picked this up? Does ESG have any, and if so where are they publicly displayed?

Appendix 2.1-2.4 - Cate Faehrmann MLC Correspondence

CATE FAEHRMANN MLC
Member of the Legislative Council
THE GREENS NSW

Mr Sam Haddad
Director General
Department of Planning
GPO Box 39
Sydney NSW 2001

21 July 2011

Dear Mr Haddad

RE: Alleged infringements - Narrabri Coal Seam Gas Project

On a recent visit to Pilliga Forest near Narrabri, I was shown around various exploration and pilot production sites of Eastern Star Gas' Narrabri Coal Seam Gas Project by local residents and farmers.

A number of infringements of licensing and approval conditions are alleged to have occurred, having been witnessed by locals. Attached is a summary of those alleged infringements, some of which I was shown during my recent visit.

I would appreciate your advice as to how the Department of Planning has responded in each of these cases outlined in the attached. Please clarify what processes are in place for the submission of complaints, the reporting of breaches by members of the public and the department's subsequent responses.

Also, please provide information regarding the auditing of these processes.

During my visit I was most concerned at the sight of unlined sump ponds, vegetation kills, extensive weed invasion and what appeared to be a pipe leading to a local creek for wastewater overflow.

Clearly some of the sump ponds had overflowed during heavy rain. This is unacceptable, as it is allowing runoff to be fed into waterways. I have also been shown photographs of a dead kangaroo that had gone to an unfenced, but lined, sump pond to drink and had been unable to get out.

From everything I witnessed on my visit to parts of Eastern Star Gas' operation I believe they should be investigated for multiple breaches of approval and license conditions.

Yours sincerely

Cate Faehrmann

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CATE FAEHRMANN MLC
Member of the Legislative Council
THE GREENS NSW

Ms Lisa Corbyn
Chief Executive
Office of Environment and Heritage
PO Box A290
Sydney South NSW 1232

21 July 2011

Dear Ms Corbyn

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On a recent visit to Pilliga Forest near Narrabri, I was shown around various exploration and pilot production sites of Eastern Star Gas' Narrabri Coal Seam Gas Project by local residents and farmers.

A number of infringements of licensing and approval conditions are alleged to have occurred, having been witnessed by locals. Attached is a summary of those alleged infringements, some of which I was shown during my recent visit.

I would appreciate your advice as to how the Office of Environment and Heritage has responded in each of these cases outlined in the attached. Please clarify what processes are in place for the submission of complaints, the reporting of breaches by members of the public and the Office's subsequent responses.

Also, please provide information regarding the auditing of these processes.

During my visit I was most concerned at the sight of unlined sump ponds, vegetation kills, extensive weed invasion and what appeared to be a pipe leading to a local creek for wastewater overflow.

Clearly some of the sump ponds had overflowed during heavy rain. This is unacceptable, as it is allowing runoff to be fed into waterways. I have also been shown photographs of a dead kangaroo that had gone to an unfenced, but lined, sump pond to drink and had been unable to get out.

From everything I witnessed on my visit to parts of Eastern Star Gas' operation I believe they should be investigated for multiple breaches of approval and license conditions.

Yours sincerely

Cate Faehrmann

Parliament House, Macquarie Street, Sydney NSW 2000 | Phone: 02 9230 2320 | Fax: 02 9230 2420 | Email: cate.faehrmann@parliament.nsw.gov.au

CATE FAEHRMANN MLC
Member of the Legislative Council
THE GREENS NSW

COPY

Dr Richard Sheldrake
Director General
Department of Primary Industries
Locked Bag 21
Orange NSW 2800

21 July 2011

Dear Dr Sheldrake

RE: Alleged infringements - Narrabri Coal Seam Gas Project

On a recent visit to Pilliga Forest near Narrabri, I was shown around various exploration and pilot production sites of Eastern Star Gas' Narrabri Coal Seam Gas Project by local residents and farmers.

A number of infringements of licensing and approval conditions are alleged to have occurred, having been witnessed by locals. Attached is a summary of those alleged infringements, some of which I was shown during my recent visit.

I would appreciate your advice as to how the Department of Primary Industries has responded in each of these cases outlined in the attached. Please clarify what processes are in place for the submission of complaints, the reporting of breaches by members of the public and the department's subsequent responses.

Also, please provide information regarding the auditing of these processes.

During my visit I was most concerned at the sight of unlined sump ponds, vegetation kills, extensive weed invasion and what appeared to be a pipe leading to a local creek for wastewater overflow.

Clearly some of the sump ponds had overflowed during heavy rain. This is unacceptable, as it is allowing runoff to be fed into waterways. I have also been shown photographs of a dead kangaroo that had gone to an unfenced, but lined, sump pond to drink and had been unable to get out.

From everything I witnessed on my visit to parts of Eastern Star Gas' operation I believe they should be investigated for multiple breaches of approval and license conditions.

Yours sincerely

Cate Faehrmann

Parliament House, Macquarie Street, Sydney NSW 2000 | Phone: 02 9230 2320 | Fax: 02 9230 2420 | Email: cate.faehrmann@parliament.nsw.gov.au

CATE FAEHRMANN MLC
Member of the Legislative Council
THE GREENS NSW

The Hon. Robyn Parker MP
Minister for the Environment and Heritage
Level 32 Governor Macquarie Tower
1 Farrer Place
SYDNEY NSW 2000
office@parker.minister.nsw.gov.au

COPY

3 August 2011

Dear Minister Parker

RE: Coal seam gas drilling in the Pilliga East Conservation Area

I write to seek your urgent advice on the status of an application to drill two coreholes within the Pilliga East State Conservation Area of Petroleum Exploration Licence 238.

I am informed that this application from Eastern Star Gas is currently being assessed by you under Part 5 of the Environmental Planning and Assessment Act 1979 in relation to s47J (7) of the National Parks and Wildlife Act, 1974.

It is the firm belief of communities across New South Wales that coal seam gas mining is inadequately regulated and presents severe risks to the environment and water supply. As you will be aware, the Pilliga is an area of special ecological significance. I am extremely concerned about the potential for significant damage to threatened species habitat.

I am equally concerned about the precedent of allowing drilling within protected areas without any public consultation or exhibition. I am of the understanding that no exploration drilling has to this date been approved within a State Conservation Area in New South Wales.

Please provide my office with a copy of all documents relating to this application, including but not limited to the Review of Environmental Factors as prepared by proponent.

I urge you to apply very close scrutiny to this proposal and to reject outright any operation which compromises the integrity of any State Conservation Area.

I look forward to your urgent reply and advice on these matters.

Yours sincerely

Cate Faehrmann

CC: The Hon. Barry O'Farrell MP, Premier
The Hon. Brad Hazzard MP, Minister for Planning and Infrastructure

Parliament House, Macquarie Street, Sydney NSW 2000 | Phone: 02 9230 2320 | Fax: 02 9230 2420 | Email: cate.faehrmann@parliament.nsw.gov.au

Appendix 2.5 Summary of Alleged infringements

SUMMARY OF ALLEGED INFRINGEMENTS

Leakage of saline water leading:

- Tree deaths adjacent to Bohena 2D, 3, 4/4L, 5 & 7 and Dewhurst 5
- Salt scalds recorded at numerous wells, including Dewhurst 2 and Bibblewindi 16
- Water leakage around wells such as Bibblewindi 21H
- Water being piped into vegetation at Bohena evaporation ponds

Failure to line drill ponds:

- Current unlined drill ponds at Bohena 7, Bibblewindi 16, Bibblewindi 22, Bibblewindi 21H
- Previous records of unlined drill ponds at Dewhurst 3, 5, 7 and Bibblewindi 10

Run-off during flood events:

- Dewhurst 8 complex – overflow of drill ponds from December 25th 2009 to 1st January 2010
- Mollee Ck – waste water released directly into Mollee Ck, February 2010
- Culgoora 2 – flooding caused chemicals to be spilled from a poorly constructed well-pad that was not compliant with the Review of Environmental Factors, December 2010

Excessive clearing:

- Dewhurst 8 complex – The Review of Environmental Factors specifies a maximum clearing of 10 hectares however, aerial photos indicate that a greater area of vegetation may have been cleared
- Wilga Park water treatment – reported clearing of trees for water treatment ponds not specified in a Review of Environmental Factors
- Excessive clearing, including large trees, recorded for access roads in May 2009

Weed invasion and failure of rehabilitation

- There has been little or no successful rehabilitation of abandoned drill holes and there are numerous serious weed incursions at almost every corehole that has been drilled in the Pilliga forest
- Examples include Dewhurst 6c, Dewhurst 5, Bohena 2D, Bohena 7 and numerous other well-pads
- The failure with regard to rehabilitation is despite the fact that the relevant REFs require 'the removal of imported materials and the rehabilitation of the site'
- No rehabilitation of areas which have been subject to tree deaths at Bohena 2D, 3, 4/4L, 5 & 7 and Dewhurst 5

Other events

- Reports of a diesel spill from Boundary Rd to Dewhurst 8 complex, October 2009
- Reported animal deaths near a number of drill ponds
- Reported failure to provide appropriate fencing around drill ponds or well-pads at Bohena 7, Dewhurst 8, Dewhurst 6c and many other wells.
- Recorded gas leakage from A pipeline at Bohena 3

Failure to deliver biodiversity offsets

- Biodiversity offsets that were part of the statement of commitments for the Part 3A approval are still yet to be implemented

Appendix 3 – Spill Water Test Results January 2012

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1200852**	Page	: 1 of 6
Client	: **EAST WEST ENVIROAG P/L**	Laboratory	: Environmental Division Sydney
Contact	: MS ANNE MICHIE	Contact	: Client Services
Address	: 82 PLAIN STREET TAMWORTH NSW, AUSTRALIA 2340	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: anne.m@ewenviroag.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 6762 1733	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 6765 9109	Facsimile	: +61-2-8784 8500
Project	: EW120081	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: EW120081		
C-O-C number	: ----	Date Samples Received	: 16-JAN-2012
Sampler	: ----	Issue Date	: 25-JAN-2012
Site	: ----		
		No. of samples received	: 3
Quote number	: SY/282/10	No. of samples analysed	: 3

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Edwandy Fadjar	Organic Coordinator	Sydney Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.**
- **ED041G: LOR raised for SO4 analysis on sample ID: 120081-2 due to sample matrix.**
- **ED-093F:LCS recovery for some elements falls outside ALS Dynamic Control Limit. However, they are within the acceptance criteria based on ALS DQO. No further action is required.**
- **EG020: LCS recoveries for particular element(s) fall outside ALS Dynamic control limit, however, they are within the acceptance criteria based on ALS DQO. No further action is required.**
- **EG035T: Positive mercury results have been confirmed by re-analysis.**
- **EP080:Level of reporting raised for toluene due to ambient background levels in the laboratory.**

Analytical Results

Sub-Matrix: WATER				Client sample ID	120081-1	120081-2	120081-3	----	----
				Client sampling date / time	12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00	----	----
Compound	CAS Number	LOR	Unit		ES1200852-001	ES1200852-002	ES1200852-003	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		7.78	8.67	6.64	----	----
EA006: Sodium Adsorption Ratio (SAR)									
Sodium Absorption Ratio	----	0.01	-		12.6	19.9	----	----	----
Sodium Absorption Ratio	----	0.01	-		----	----	<0.01	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		942	2930	29	----	----
EA016: Non Marine - Estimated TDS Salinity									
Total Dissolved Solids (Calc.)	----	1	mg/L		612	1900	19	----	----
EA065: Total Hardness as CaCO3									
Total Hardness as CaCO3	----	1	mg/L		64	299	<1	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	73	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		387	1270	11	----	----
Total Alkalinity as CaCO3	----	1	mg/L		387	1340	11	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		23	<100	<1	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		93	383	2	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		9	67	<1	----	----
Magnesium	7439-95-4	1	mg/L		10	32	<1	----	----
Sodium	7440-23-5	1	mg/L		231	792	3	----	----
Potassium	7440-09-7	1	mg/L		11	30	3	----	----
EG020T: Total Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		0.017	0.021	<0.001	----	----
Cadmium	7440-43-9	0.0001	mg/L		0.0001	0.0004	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L		0.179	0.187	0.005	----	----
Copper	7440-50-8	0.001	mg/L		0.080	0.191	0.007	----	----
Lead	7439-92-1	0.001	mg/L		0.056	0.050	0.002	----	----
Nickel	7440-02-0	0.001	mg/L		0.075	0.171	0.001	----	----
Zinc	7440-66-6	0.005	mg/L		0.109	0.094	0.006	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		0.0001	0.0008	<0.0001	----	----
EK040P: Fluoride by PC Titrator									

Analytical Results

Sub-Matrix: WATER				Client sample ID	120081-1	120081-2	120081-3	----	----
				Client sampling date / time	12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00	----	----
Compound	CAS Number	LOR	Unit		ES1200852-001	ES1200852-002	ES1200852-003	----	----
EK040P: Fluoride by PC Titrator - Continued									
Fluoride	16984-48-8	0.1	mg/L		**0.4**	**1.9**	<0.1	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**10.8**	**37.6**	**0.28**	----	----
Total Cations	----	0.01	meq/L		**11.6**	**41.2**	**0.21**	----	----
Ionic Balance	----	0.01	%		**3.37**	**4.55**	----	----	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		**43.2**	**12.5**	<1.0	----	----
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2-Methylphenol	95-48-7	1.0	µg/L		**3.2**	**6.9**	<1.0	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		**13.8**	**8.9**	<2.0	----	----
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	<1.0	<1.0	----	----
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	<2.0	<2.0	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Acenaphthene	83-32-9	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Fluorene	86-73-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Phenanthrene	85-01-8	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Anthracene	120-12-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Fluoranthene	206-44-0	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Pyrene	129-00-0	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Chrysene	218-01-9	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L		<0.5	<0.5	<0.5	----	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: 120081-1	120081-2	120081-3	----	----
				Client sampling date / time: 12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00	----	----
				ES1200852-001	ES1200852-002	ES1200852-003	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L	**230**	**600**	**110**	----	----
C15 - C28 Fraction	----	100	µg/L	**1370**	**2610**	**220**	----	----
C29 - C36 Fraction	----	50	µg/L	**150**	**490**	<50	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	**1750**	**3700**	**330**	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	<20	<20	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	----	20	µg/L	<20	<20	<20	----	----
>C10 - C16 Fraction	----	100	µg/L	**250**	**700**	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	**1170**	**2670**	**190**	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	**400**	<100	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	**1420**	**3770**	**190**	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<5	<5	<5	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L	<2	<2	<2	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	<1	<1	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**33.4**	**43.0**	**17.9**	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	**32.0**	**43.6**	**36.2**	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%	**28.7**	**45.1**	**40.0**	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**31.7**	**46.2**	**47.0**	----	----
Anthracene-d10	1719-06-8	0.1	%	**29.5**	**50.6**	**55.1**	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	**30.8**	**50.0**	**64.3**	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**108**	**94.4**	**89.6**	----	----
Toluene-D8	2037-26-5	0.1	%	**99.8**	**97.2**	**94.3**	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	**121**	**114**	**109**	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	64.1
2-Chlorophenol-D4	93951-73-6	11.3	122.9
2.4.6-Tribromophenol	118-79-6	11.7	144.0
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	19.9	122.8
Anthracene-d10	1719-06-8	23.3	125.8
4-Terphenyl-d14	1718-51-0	20.3	134.5
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

Appendix 4 – Spill Soil Test Results January 2012

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1200798**	Page	: 1 of 6
Client	: **EAST WEST ENVIROAG P/L**	Laboratory	: Environmental Division Sydney
Contact	: MS ANNE MICHIE	Contact	: Client Services
Address	: 82 PLAIN STREET TAMWORTH NSW, AUSTRALIA 2340	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: anne.m@ewenviroag.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 6762 1733	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 6765 9109	Facsimile	: +61-2-8784 8500
Project	: EW120080	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: EW120080		
C-O-C number	: ----	Date Samples Received	: 16-JAN-2012
Sampler	: ----	Issue Date	: 23-JAN-2012
Site	: ----		
		No. of samples received	: 5
Quote number	: SY/282/10	No. of samples analysed	: 5

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

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- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

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Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Edwandy Fadjar	Organic Coordinator	Sydney Organics
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Sanjeshni Jyoti Mala	Senior Chemist Volatile	Sydney Organics

General Comments

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Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: 120080-1	120080-2	120080-3	120080-4	120080-5
				Client sampling date / time: 12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00
				ES1200798-001	ES1200798-002	ES1200798-003	ES1200798-004	ES1200798-005
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.2**	**9.4**	**9.9**	**5.2**	**5.3**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**377**	**588**	**1690**	**13**	**11**
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**14.6**	**23.8**	**20.5**	**10.4**	**6.0**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**130**	**420**	**110**	**10**	<10
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	**280**	**250**	**850**	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	**80**	**80**	<10	<10
Magnesium	7439-95-4	10	mg/kg	**20**	**150**	**60**	<10	<10
Sodium	7440-23-5	10	mg/kg	**530**	**960**	**3510**	**80**	<10
Potassium	7440-09-7	10	mg/kg	**30**	**170**	**50**	<10	<10
EG005T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**10**	**15**	**10**	**10**	**10**
Copper	7440-50-8	5	mg/kg	<5	<5	<5	<5	<5
Lead	7439-92-1	5	mg/kg	**5**	**6**	<5	<5	**6**
Nickel	7440-02-0	2	mg/kg	**3**	**5**	**4**	**2**	**2**
Zinc	7440-66-6	5	mg/kg	<5	**9**	**5**	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
3- & 4-Methylphenol	1319-77-3	1.0	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloro-3-Methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: 120080-1	120080-2	120080-3	120080-4	120080-5
				Client sampling date / time: 12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00
				ES1200798-001	ES1200798-002	ES1200798-003	ES1200798-004	ES1200798-005
EP075(SIM)A: Phenolic Compounds - Continued								
Pentachlorophenol	87-86-5	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)fluoranthene	205-99-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
^ **C6 - C10 Fraction minus BTEX (F1)**	----	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEX								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: 120080-1	120080-2	120080-3	120080-4	120080-5
				Client sampling date / time: 12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00	12-JAN-2012 15:00
				ES1200798-001	ES1200798-002	ES1200798-003	ES1200798-004	ES1200798-005
EP080: BTEX - Continued								
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080: BTEXN								
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ **Total Xylenes**	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**116**	**104**	**112**	**109**	**116**
2-Chlorophenol-D4	93951-73-6	0.1	%	**114**	**102**	**110**	**108**	**116**
2.4.6-Tribromophenol	118-79-6	0.1	%	**99.7**	**91.5**	**86.8**	**102**	**101**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**114**	**103**	**112**	**113**	**116**
Anthracene-d10	1719-06-8	0.1	%	**122**	**112**	**119**	**120**	**121**
4-Terphenyl-d14	1718-51-0	0.1	%	**111**	**100**	**106**	**106**	**108**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**79.1**	**88.3**	**82.4**	**91.3**	**93.2**
Toluene-D8	2037-26-5	0.1	%	**79.0**	**83.3**	**80.0**	**90.0**	**94.8**
4-Bromofluorobenzene	460-00-4	0.1	%	**86.8**	**75.9**	**82.0**	**91.7**	**95.2**

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	56.3	133.3
2-Chlorophenol-D4	93951-73-6	53.8	133.8
2.4.6-Tribromophenol	118-79-6	23.1	134.9
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	58.9	132.7
Anthracene-d10	1719-06-8	55.0	137.6
4-Terphenyl-d14	1718-51-0	54.0	147.8
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	72.8	133.2
Toluene-D8	2037-26-5	73.9	132.1
4-Bromofluorobenzene	460-00-4	71.6	130.0

Appendix 5 – Prof. Bidwell Spill Water and Soil Test Summary

The following is a summary of the results of chemical analyses on soil and water samples collected from a suspected spill zone adjacent to a coal seam gas water treatment facility in the Pilliga State Forest and from a reference location. This analysis and the associated summary are based on the chemical data and photographs of the site provided by the Wilderness Society.

Soil Samples
Analyses were conducted on three soil samples collected adjacent to the facility and two samples collected from a reference location. Soil samples from the suspected spill zone had higher average pH, electrical conductivity (70 times higher), and levels of sodium (39 times higher), chloride (90 times higher), sulfate, calcium, magnesium, and potassium than reference samples. There were no clear differences in levels of total metals, phenolic compounds, PAHs, total petroleum hydrocarbons or BTEX compounds in soil samples from the two locations.

Water samples
Two samples of standing water were collected from the site near the treatment facility and one sample of standing water was collected from a reference location. pH of the water from near the treatment facility was slightly elevated as compared to the reference sample. As seen for the soil samples, water collected from the suspected spill zone had higher electrical conductivity and levels of major cations and anions as compared to the reference sample. In contrast to the soil, the water sample from near the treatment facility also had higher levels of total metals (arsenic, chromium, copper, lead, nickel, and zinc), phenol and methylphenols, and total and recoverable petroleum hydrocarbons than the reference water.

Interpretation
The range of ions, metals and hydrocarbons detected in the standing water near the treatment facility is consistent with constituents commonly found in untreated produced water. The elevated levels of ions and conductivity in soils and water within the suspected spill zone could pose a risk to vegetation and soil organisms, although a follow-up monitoring study with increased sample numbers and additional reference locations would be needed to effectively determine this. Additional stratified sampling near the treatment facility could also help determine the spatial extent and persistence of the suspected spill zone.

Joseph R. Bidwell
Professor of Environmental Science and Management
The University of Newcastle

Appendix 6 – Prof. Bidwell Test Recommendations

FACULTY OF SCIENCE AND INFORMATION TECHNOLOGY

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

12 March 2012

Prue Bodsworth and Naomi Hogan
The Wilderness Society Newcastle Inc
Hunter Heritage Centre,
90 Hunter Street,
Newcastle, NSW, 2300

Dear Prue and Naomi,

As a follow up to our conversation regarding the value of ecotoxicity testing to further evaluate the potential impacts of the coal seam gas effluent spill near the Santos treatment facility in the Pillaga, I offer the following:

While chemical testing alone is effective at indicating what contaminants may be present at a site, they tell very little about true bioavailability or ecological risk. While the "guideline" values used by the consultants that did the chemical testing on the soil are better than nothing, they were not derived as ecological action levels. I would also argue that the delays in analysing the samples may have lead to a reduction in the concentration of chemical residues that were measured, making comparison to guideline values even more problematic. Another key issue is that single chemical guideline values do not account for the interactions of chemicals that could occur in a mixture. These interactions could actually reduce the toxicity of some components or make it worse. Biological testing could integrate the combined effects of the chemicals and, when coupled with properly conducted chemical analyses, provides the most effective assessment of risk.

I would suggest a two-tiered biological assessment of soils from the site. First, a survey of the existing soil invertebrates from the spill zone as compared to reference sites could be done. This can easily be accomplished by collecting a sample of surficial litter from the site and using a Berlese funnel to extract the resident invertebrates. The numbers and types of invertebrates from each site could then be compared to determine if there were differences in community composition. Samples of the soils from the spill zone and reference sites could also be used for plant germination bioassays in the laboratory to see if germination is comparable between the two. If Santos is planning a clean-up of the site, these data could be used in a "before and after" design to determine the success of remediation. It may also be that the communities between the different sites are comparable now, which could influence just how much must be done for "remediation".

I would be happy to discuss these methods with you in greater detail if you wish.

Best regards,
Joseph R Bidwell

Joseph R. Bidwell
Professor and Chair
Discipline of Environmental Science and Management
joseph.bidwell@newcastle.edu.au

Appendix 7 – Bohena Creek Water Test Results August 2011

CERTIFICATE OF ANALYSIS

Work Order	: **ES1118565**	Page	: 1 of 8
Client	: **EAST WEST ENVIROAG P/L**	Laboratory	: Environmental Division Sydney
Contact	: MS STEPHANIE CAMERON	Contact	: Client Services
Address	: 82 PLAIN STREET TAMWORTH NSW, AUSTRALIA 2340	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: stephanie.c@ewenviroag.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 6762 1733	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 6765 9109	Facsimile	: +61-2-8784 8500
Project	: EW110647	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: EW110647		
C-O-C number	: ----	Date Samples Received	: 26-AUG-2011
Sampler	: ----	Issue Date	: 02-SEP-2011
Site	: ----		
		No. of samples received	: 2
Quote number	: SY/299/08	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Hoa Nguyen	Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **EG020: Bromine & Iodine quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**
- **EG020: It has been confirmed by re-digestion and re-analysis that dissolved concentration of some elements is higher than total concentration for sample ES1118565 # 002**
- **EG020: LCS recoveries for some elements fall outside ALS Dynamic control limit, however, they are within the acceptance criteria based on ALS DQO. No further action is required.**
- **EK026: LCS recovery for TCN fall outside ALS dynamic control limits. However, they are within the acceptance criteria based on ALS DQO. No further action is required.**
- **EP080:Level of reporting raised for toluene due to ambient background levels in the laboratory.**
- **ES111856-001: Ca and Mg results are below LOR therefore SAR cannot be calculated.**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: 110647-1	110647-2	----	----	----
				Client sampling date / time: 25-AUG-2011 15:00	25-AUG-2011 15:00	----	----	----
				ES1118565-001	ES1118565-002	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.53**	**7.29**	----	----	----
EA006: Sodium Adsorption Ratio (SAR)								
^ Sodium Absorption Ratio	----	0.01	-	----	**1.24**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**218**	**184**	----	----	----
EA015: Total Dissolved Solids								
^ Total Dissolved Solids @180°C	GIS-210-010	5	mg/L	**139**	**216**	----	----	----
EA041: Colour (True)								
Colour (True)	----	1	PCU	**5**	**20**	----	----	----
pH Colour	----	0.01	pH Unit	**7.38**	**7.22**	----	----	----
EA045: Turbidity								
Turbidity	----	0.1	NTU	**0.4**	**4290**	----	----	----
EA065: Total Hardness as CaCO3								
^ Total Hardness as CaCO3	----	1	mg/L	<1	**36**	----	----	----
EA075: Redox Potential								
Redox Potential	----	0.1	mV	**263**	**244**	----	----	----
pH Redox	----	0.01	pH Unit	**7.4**	**7.2**	----	----	----
EA165: CO2 - Free and Total								
^ Free Carbon Dioxide as CO2	85540-96-1	1	mg/L	**2**	**3**	----	----	----
^ Total Carbon Dioxide as CO2	85540-96-1	1	mg/L	**89**	**21**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**94**	**22**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**94**	**22**	----	----	----
ED040F: Dissolved Major Anions								
^ Sulfur as S	63705-05-5	1	mg/L	<1	<1	----	----	----
Silicon	7440-21-3	0.05	mg/L	**0.08**	**3.86**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	**2**	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**21**	**32**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	**6**	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	**5**	----	----	----
Sodium	7440-23-5	1	mg/L	**52**	**17**	----	----	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: 110647-1	110647-2	----	----	----
				Client sampling date / time: 25-AUG-2011 15:00	25-AUG-2011 15:00	----	----	----
				ES1118565-001	ES1118565-002	----	----	----
ED093F: Dissolved Major Cations - Continued								
Potassium	7440-09-7	1	mg/L	**1**	**3**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	**0.16**	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.053**	**0.056**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	**0.078**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Lithium	7439-93-2	0.001	mg/L	**0.023**	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.001**	**0.031**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	**0.002**	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.002**	----	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.002**	**0.002**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.007**	**0.064**	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	----	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.016**	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.26**	<0.05	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	**0.10**	----	----	----
Bromine	7726-95-6	0.1	mg/L	**0.6**	<0.1	----	----	----
Iodine	7553-56-2	0.1	mg/L	<0.1	<0.1	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	**0.05**	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.056**	**0.049**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: 110647-1	110647-2	----	----	----
				Client sampling date / time: 25-AUG-2011 15:00	25-AUG-2011 15:00	----	----	----
				ES1118565-001	ES1118565-002	----	----	----
EG020T: Total Metals by ICP-MS - Continued								
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	**0.061**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Lithium	7439-93-2	0.001	mg/L	**0.027**	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.001**	**0.021**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	**0.001**	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	**0.002**	----	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.002**	**0.002**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.008**	**0.069**	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	----	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.012**	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.27**	<0.05	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG050F: Dissolved Hexavalent Chromium								
Hexavalent Chromium	18540-29-9	0.010	mg/L	<0.010	<0.010	----	----	----
EG052F: Dissolved Silica by ICPAES								
^ Silica	7631-86-9	0.1	mg/L	**0.2**	**8.3**	----	----	----
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	<0.10	**8.02**	----	----	----
EK026G: Total Cyanide By Discrete Analyser								
Total Cyanide	57-12-5	0.004	mg/L	**0.014**	<0.004	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**1.56**	**0.03**	----	----	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: 110647-1	110647-2	----	----	----
				Client sampling date / time: 25-AUG-2011 15:00	25-AUG-2011 15:00	----	----	----
				ES1118565-001	ES1118565-002	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.02**	**2.15**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.02**	**2.15**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**2.2**	**3.0**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**2.2**	**5.2**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.01	**1.38**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	**0.01**	----	----	----
EK084: Un-ionized Hydrogen Sulfide								
Unionized Hydrogen Sulfide	----	0.01	mg/L	<0.1	<0.1	----	----	----
EK085M: Sulfide as S2-								
Sulfide as S2-	18496-25-8	0.1	mg/L	<0.1	<0.1	----	----	----
EN055: Ionic Balance								
^ Total Anions	----	0.01	meq/L	**2.47**	**1.38**	----	----	----
^ Total Cations	----	0.01	meq/L	**2.29**	**1.53**	----	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	<1	**8**	----	----	----
EP025: Oxygen - Dissolved (DO)								
Dissolved Oxygen	----	0.1	mg/L	**9.8**	**7.9**	----	----	----
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	10	µg/L	**68**	<10	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	<20	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L	<20	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	----	----	----

Analytical Results

Sub-Matrix: WATER				Client sample ID	110647-1	110647-2	----	----	----
				Client sampling date / time	25-AUG-2011 15:00	25-AUG-2011 15:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1118565-001	ES1118565-002	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft - Continued									
>C16 - C34 Fraction	----	100	µg/L		<100	<100	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	----	----	----
Toluene	108-88-3	2	µg/L		<5	<5	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	----	----	----
^ Total Xylenes	1330-20-7	2	µg/L		<2	<2	----	----	----
^ Sum of BTEX	----	1	µg/L		<1	<1	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	<5	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		**91.9**	**91.5**	----	----	----
Toluene-D8	2037-26-5	0.1	%		**91.2**	**90.5**	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		**82.0**	**79.7**	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	76.4	133.1
Toluene-D8	2037-26-5	79.6	126.8
4-Bromofluorobenzene	460-00-4	79.1	125.0

Appendix 8 – Dr Lloyd-Smith Bohena Creek Test Results Summary

NTN NATIONAL TOXICS NETWORK

PO Box 173 Bangalow
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www.ntn.org.au

Working globally for a toxic free future

Ms Carmel Flint
Northern Inland Council for the Environment
16 Roslyn Ave Armidale
NSW 2350

15th November 2011

Dear Ms Flint,

Thank you for the opportunity to review the water sampling results supplied by East West Enviroag as Project No. EW 110647.

NTN notes the sampling results are of limited scope and do not include analysis for any drilling additives or hydraulic fracturing chemicals. On reviewing the Company's documentation, a list of chemicals used or the identity of the chemical components of the company's wastewater are not provided.

We acknowledge that the sampling results are from Bohena Creek in the Pilliga Forest; one sample being taken from the Eastern Star Gas discharge point, which contains produced coal seam gas (CSG) water treated with reverse osmosis.

The other sample was taken approximately 1 kilometre upstream from the discharge point, and represents the natural water quality of the Bohena Creek for comparison purposes.

We also note that the Bohena Creek is an ephemeral creek with a shallow alluvial aquifer that discharges into the Namoi River and that the upstream sample (Sample 2) was obtained by digging approximately 1m down to the aquifer, hence the turbidity.

The sample taken from the Eastern Star Gas discharge point demonstrates higher results for ammonia, cyanide, methane, bromine, lithium and boron.

Results:

	Sample 1	*Sample 2*
Lithium Diss.	0.023 mg/l	<0.001 mg/l
Bromine Diss.	0.6 mg/l	<0.1 mg/l
Ammonia as N	1.56 mg/l	0.03 mg/l
Methane C1-C4	68 ug/l	<10 ug/l
Total Cyanide	0.014 mg/l	<0.004 mg/l
Boron Diss.	0.26 mg/l	<0.05 mg/l

1

The two elevated results of concern are ammonia and methane.

Methane

Methane was detected in water at the discharge site at 68 micrograms per litre (ug/l), whereas it was not detected in the upstream sample. Methane evaporates out of water, providing a further source of methane fugitive emissions to the atmosphere. Methane is a powerful greenhouse gas.

Since it evaporates, methane is not usually considered to present a health problem in drinking water. However, little is known of its long term impacts on human health, but when present at high concentrations, methane acts as an asphyxiate, which can cause breathing difficulties.[1]

Ammonia

Ammonia was detected at the discharge site at 1.56 milligrams per litre (mg/l), which is three times the Australian Drinking Water Guideline value of (0.5mg/l). Whereas it was detected at 0.03 mg/l in the upstream sample, well below the acceptable range for aquatic ecosystem.

Environmental Effects of Ammonia

Ammonia can be toxic to aquatic fauna. Fish exposed to low levels of ammonia over time are more susceptible to bacterial infections and have poor growth.

The toxicity of ammonia is affected by water pH, the measure of whether water is acidic, basic (alkaline) or neutral. Ammonia-nitrogen (NH_3-N) has a more toxic form at high pH and a less toxic form at low pH, un-ionized ammonia (NH_3) and ionized ammonia (NH_4^+), respectively.

Exposure to un-ionized ammonia concentrations as low as 0.002 mg/l for six weeks causes hyperplasia of gill lining in salmon fingerlings and may lead to bacterial gill disease. [2]

Ammonia toxicity increases as temperature rises.

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[1] Methane Fact Sheet, WISCONSIN DEPARTMENT OF HEALTH SERVICES. http://www.dhs.wisconsin.gov/eh/chemfs/fs/Methane.htm

[2] NRC (National Research Council). 1979. Ammonia. Committee on Medical and Biological Effects of Environmental Pollutants, Division of Medical Sciences, Assembly of Life Sciences. University Park Press, Baltimore, Maryland

Concentrations of ammonia that are acutely toxic for fish, can cause loss of equilibrium, hyper-excitability, increased breathing, cardiac output, and oxygen uptake, and, in extreme cases, convulsions, coma, and death. At lower concentrations, ammonia produces many effects in fish including a reduction in egg hatching success, a reduction in growth rate and morphological development, and pathological changes in the tissue of the gills, liver, and kidney.[3]

The 1.56 mg/l detected at the outlet site is above the USEPA recommended maximum contaminant level (MCL) of <0.6 mg/l and exceeds the 0.02 mg/l MCL recommended by USEPA for fish health and aquatic life in general.[4]

Carbon Dioxide

Total Carbon Dioxide was detected in water at the discharge site at 89mg/l, whereas Sample 2 measured 21mg/l.

Carbon dioxide (CO2) is present in water in the form of a dissolved gas. Typically, surface waters contain less than 10 parts per million free carbondioxide while ground waters may have much higher concentrations. Dissolved in water, CO2 forms carbonic acid, which lowers pH. Aquatic plant life from phytoplankton to large rooted plants, depend on carbon dioxide and bicarbonates in water for growth, however, an increase in carbon dioxide makes it more difficult for fish to use oxygen. To take in oxygen, fish must first discharge the CO2 in their blood stream, a process which is slowed down considerably when there are high concentrations of CO2 in the water itself. The acceptable range of carbon dioxide for most finfish is <2.0 mg/L (ppm).[5]

Recommendation[6]

We recommend further sampling be undertaken to confirm the results and that analysis be expanded to the range of compounds used by the unconventional gas industry that are not removed by reverse osmosis filtration.[7] The mechanisms by which a molecule may be rejected by the reverse osmosis membrane are size exclusions (or sieving), electrostatic repulsion and hydrophobic adsorption.

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[3] INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY ENVIRONMENTAL HEALTH CRITERIA 54 AMMONIA, World Health Organization, Geneva, 1986

[4] A.O. Fadiran and S.P. Dube, 2009. A Study of the Relative Levels and Factors in the Analysis of Total Ammonia Nitrogen in Some Surface and Groundwater Bodies of Swaziland. *Asian Journal of Applied Sciences, 2: 363-371.*

[5] http://www.alken-murray.com/TESTS01.htm

[6] Please note this information is provided as general information and should not be seen as professional advice.

[7] www.industry.qld.gov.au/documents/LNG/csg-water-beneficial-use-approval.pdf

Chemicals unable to be successfully removed include bromoform, chloroform, naphthalene, nonylphenol, octylphenol, dichloroacetic acid, trichloroethylene, tris(2-chloroethyl)-phosphate.[8] Low molecular weight, non polar, water soluble solutes such as the methanol and ethylene glycol are also poorly rejected.[9]

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[8] Stuart J. Khan Quantitative chemical exposure assessment for water recycling schemes, Waterlines Report Series No 27, March 2010 Commissioned by the National Water Commission.
[9] http://www.aquatechnology.net/reverse_osmosis.html

SUBMISSION TO THE NSW LEGISLATIVE COUNCIL

INQUIRY INTO COAL SEAM GAS

7TH SEPTEMBER 2011

Submission from: Group Against Gas (GAG) Kyogle

Contact: Boudicca Cerese bcerese@activ8.net.au

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Key Points:

- The threats to vital ground and surface water systems and food producing land posed by coal seam gas (CSG) developments are unacceptable. It is crucial that water and food security be prioritised over gas production, particularly when these resources are so scarce in Australia, and when they are under increasing threat from human population growth and climate change.
- The Northern Rivers region is renowned for its natural values, visual beauty and vibrant, innovative communities- industrial CSG development is not compatible with these qualities and would destroy the very essence of our region. This clash of values is epitomised by the proposal to put a gas transmission pipeline right through the middle of one of the region's precious World Heritage Areas.
- The rush to coal seam gas is not about energy security for NSW, it is all about making money from export of gas to overseas markets. The company Metgasco has plans for a 90PJ export facility supplied by Northern Rivers coal seam gas production which would require in excess of 1500 gas wells, whilst it's planned local power station requires 40-55 wells.
- The recent regulatory changes to the rules governing coal seam gas activities in NSW do not adequately address any of the significant risks posed by this industry. Significant overhaul of relevant legislation and regulation is needed to effectively manage the impacts of the CSG industry.
- The health and well being of individuals and communities are being drastically affected by industrial gas production in Queensland and the USA. Northern Rivers residents do not want this industry expanding out of control across our region or state, as evidenced by the many anti-CSG groups that have formed, the thousands of people who have attended anti-CSG events and the opposition from six out of the seven local councils in the region.
- The ecosystem services, biodiversity conservation, tourism and public enjoyment values of public lands are threatened by coal seam gas developments on or

adjacent to these lands. There are significant areas of public lands that are likely to be damaged and degraded by any expansion of the coal seam gas industry in the Northern Rivers and across the state.

Recommendations:

- All CSG activity in NSW should be stopped to allow for comprehensive, rigorous, independent studies into the environmental, social and health impacts of the industry.
- There should be a complete prohibition on any CSG activity on or adjacent to high conservation value lands, wetlands, beneficial use aquifers, residential areas and homes, important food producing areas and public lands.
- Legislative and regulatory changes should be introduced to properly address the threats to the natural environment, local communities, water supplies, food production and human health. The rights of landholders to refuse CSG exploration and production should be enshrined in the *Petroleum Onshore Act 1991.*
- There should be full, independent assessment of the hydrogeological character of any areas that are proposed for coal seam gas exploration, before any exploration or production takes place.
- Any CSG activity should have to comply with all relevant environmental legislation, including chemical use, water management and native vegetation laws. Communities should have the legal right to enforce and challenge environmental laws under which the industry operates.
- The state government should invest in renewable energy alternatives rather than supporting the expansion of the CSG industry, thereby entrenching the state's dependence on fossil fuels and greenhouse gas emitting technologies.

- The NSW government regional land use strategy initiative should be extended to parts of NSW such as the Northern Rivers where there are proposals for significant expansion of CSG production.

Introduction

Group Against Gas (GAG) Kyogle is a community group based in the Kyogle area of Northern NSW and is made up of residents from across the Northern Rivers region. This group was formed by local residents in response to plans for the construction of the proposed Casino to Ipswich gas transmission pipeline and the expansion of coal seam gas exploration and production activities in the region. The group represents a broad cross section of the local community from cattle farmers and local business owners to organic growers and environmentalists. A diverse range of ages are represented from retirees and high school students, to parents with young families who are concerned for their children's futures.

We welcome the opportunity to make a submission to this Inquiry and voice our strong objection to the rapid, unchecked expansion of the coal seam gas industry in our region and across the state. We would like to present to the Committee when it visits our region and we invite the committee members to visit the Kyogle district and see first hand the areas that would be affected by any further expansion of the coal seam gas industry in the region.

Existing coal seam gas activities in the Northern Rivers

At present almost the entire Northern Rivers region is covered by existing petroleum titles or applications (Figure One). Exploration activities are taking place across the region and a 30-45 well gas field and 30MWgas fired power station have been approved in the Casino area. The gas company Metgasco is currently seeking

approval for construction of a pipeline to transport gas out of the region and is looking into the feasibility of supplying some 90PJ of gas to an export processing plant at an as yet undetermined location[1]. There are also preliminary plans to develop another gas-fired power plant in the south of the region, between Casino and Grafton[2].

Community opposition to coal seam gas activities

In the last nine months there has been a massive groundswell of community opposition to this industry in the Northern Rivers region. There are now at least five dedicated community groups active in different locations who are working to raise public awareness about the threats posed by the industry, engage with governments to express community concerns, and seek community input into decision-making processes. These local community groups are forming alliances with environmental organsiations and industry bodies who also have serious concerns about the impacts of coal seam gas activities on the environment, local communities, water supplies, food production and human health. Well-attended rallies and events have been held in major towns across the region, with some 3,000 people attending a rally held in Murwillumbah in May[3].

Groups in the region have taken their concerns to both state and federal governments, with local Grafton beef farmers meeting with their local representative Steve Cansdell, and members of the Keerrong Gas Squad travelling to Canberra to meet with federal environment minister Tony Burke's advisors. Our own group has approached the Member for Lismore Thomas George to speak at our meetings and listen to community concerns, though he has not attended to date. We have also presented a petition of over 1300 signatures to our local federal member Janelle Saffin, requesting that the federal assessment process for the proposed Casino to

[1] Metgasco Quarterly Reports, December 2010, March 2011, July 2011
[2] http://www.echonews.com.au/story/2011/08/04/time-to-get-educated-about-coal-seam-gas/
[3] http://www.echo.net.au/node/81972

Ipswich pipeline be broadened to include impacts on the World Heritage listed Border Ranges National Park.

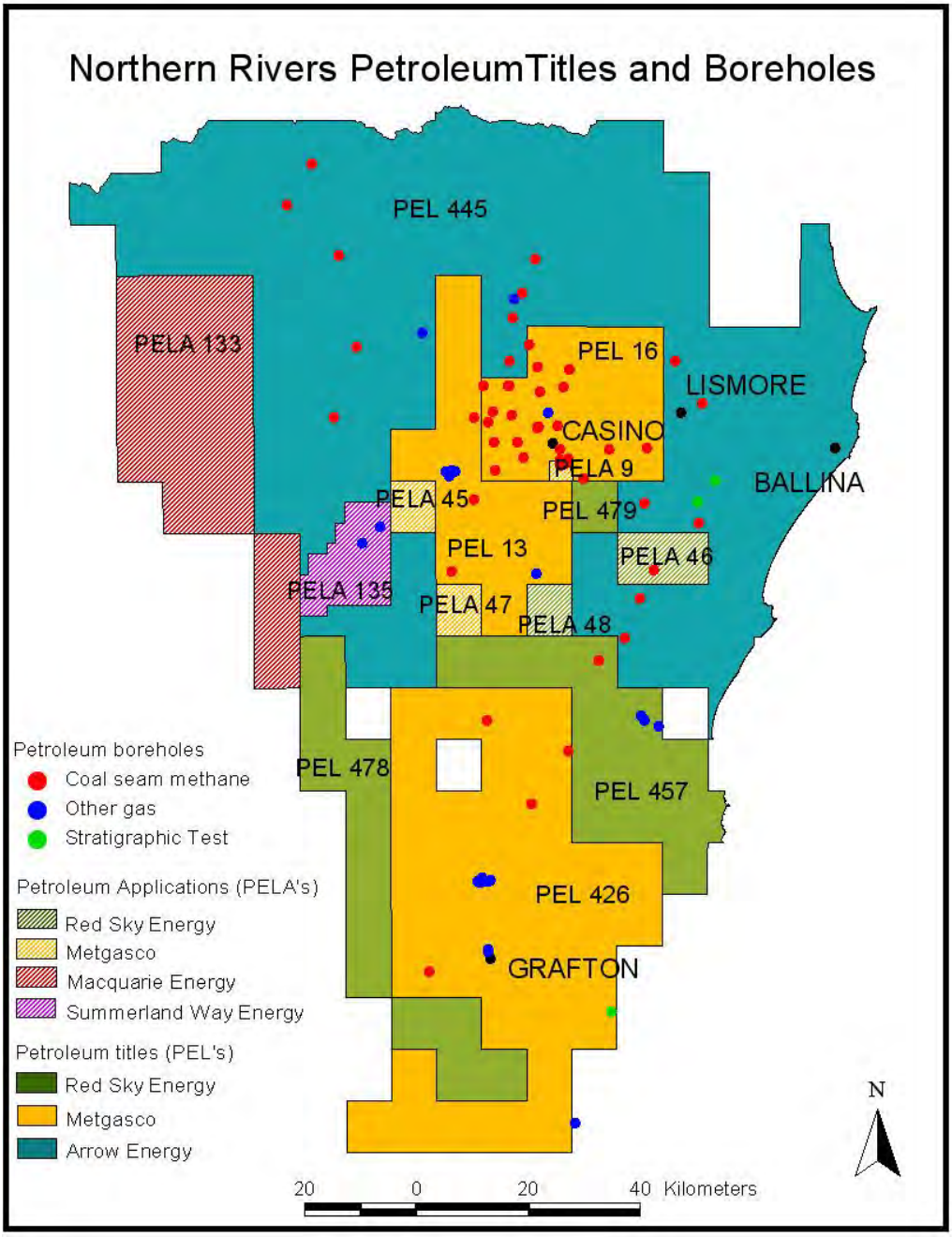

Figure One: Northern Rivers Petroleum Titles and Boreholes

Several group members have compiled this submission and we have attempted to cover the wide range of concerns that the members of our group have in relation to

the coal seam gas industry. Whilst most of the group do not have a background in relevant disciplines, we have been forced to inform ourselves about the science of this industry and its impacts so that we can engage with industry and government and have a worthwhile and informed input into decision-making processes when given the opportunity to do so. In the following submission we have attempted to directly address each of the terms of reference outlined by the Inquiry.

The environmental and health impact of CSG activities

Effect on ground and surface water systems

Groundwater risks

There now exists a large body of evidence that shows that coal seam gas (CSG) activities pose a range of significant threats to ground and surface water systems. The Australian Government's National Water Commission Policy Statement[4] clearly states that there will be a range of serious negative impacts on ground and surface water systems including: depletion of already over allocated connected ground and surface water systems; changes in water pressures and therefore availability; land subsidence over large areas; alteration of natural flow patterns and river and wetland health from release of waste water; cross-contamination of aquifers; and changes in beneficial uses characteristics of aquifers.

Australia is the driest inhabited continent on Earth and at the heart of the continent's water supply are our underground aquifers. The large volumes of water that must be extracted from the coal seam to facilitate gas flow can result in the lowering of

[4] Australian Government National Water Commission, 'The Coal Seam Gas and water challenge', August 2011.

adjoining aquifers or shallower, alluvial systems[5] [6]. Ross Dunn , a spokesperson for the petroleum industry group APPEA, has said: "drilling will, to varying degrees, impact on adjoining aquifers- the extent of impact and whether the impact can be managed is the question". Dunn goes on to say: "the intent of saying that is to make it clear that we have never shied away from the fact that there will be impacts on aquifers"[7]. Evidence from the Powder River Basin in the Wyoming/Montana region of the USA records drops of up to 200 feet in drinking water wells adjacent to coal bed methane production sites in the USA[8], whilst in Queensland drops of several metres[9] have already been recorded in farm bores. The removal of large volumes of water from the underground water system can also lead to a decrease in base-flow to creeks and rivers that are recharged from groundwater flows[10]. Australians know how precious water is, it is therefore our responsibility to protect and preserve all water resources for the very future that our descendants depend upon.

As a result of connectivity between coal seams and other aquifers containing higher quality water, there is also the risk of inter-aquifer transfer of poor quality water from the coal seam, which would pollute other aquifers and render them unusable for agriculture, town water supplies and stock watering[11]. If cross-contamination occurred, high quality aquifers could be contaminated, or their chemistry altered, through exposure to air, gas, toxic fracking chemicals and drilling fluids, or the release of natural compounds like BTEX, heavy metals and radionuclides that are

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[5] Groundwater (Deep Aquifer Modelling) for Santos GLNG Project - Environmental Impact Statement 31/3/2009 http://www.glng.com.au/library/EIS/Appendices/P2_Groundwater%20(Deep)%20FINAL%20PUBLIC.pdf appendix P2 section 3.4.2

[6] Hillier, J.R. Groundwater connections between the Walloon Coal Measures and the Alluvium of the Condamine River, August 2010

[7] See article on front page of The Sydney morning Herald on the 3rd August 2011 entitled "Coal Seam Damage to Water Inevitable".

[8] Western Organization of Resource Councils (WORC). 2003. Factsheet. *Coalbed methane development: Boon or bane for Rural Residents.*

[9] Four Corners Gas rush program: http://www.abc.net.au/4corners/content/2011/s3141787.htm

[10] Northern Geoscience: Draft report on Hydrogeological investigatiaons Dooralong & Yarramalong Valleys, Wyong NSW.

[11] Mavroudis, D. Downhole Environmental Risks Associated with Drilling and Well Completion Practices in the Cooper/Eromanga Basins, PIRSA 2001

present in the coal seam, many of which are known to have significant human health impacts[12]. There have now been at least four identified instances of toxic BTEX chemicals being found in wells or water monitoring bores at Queensland CSG operations[13]. The company Origin has been unable to explain where the BTEX found in one of its fracked exploration wells may have come from, and maintains that these chemicals are not present in drilling or fracking fluids[14].

The groundwater impacts of CSG activities are of particular concern given the thousands of wells that are planned across the eastern seaboard of Australia, the speed at which they are being constructed, the lack of independent monitoring of well construction and the risk of failure of bore casings and cement bore seals over time under saline groundwater conditions. According to a JP Morgan[15] report into the effects of the CSG industry on water systems in Queensland, there is a significant risk of gas migrating from coal seams to overlying aquifers where a pathway exists. This "process of gas migration usually occurs in areas at a distance from the CSG well where depressurisation is lower. As such, the gas does not flow at high pressure to the surface and instead migrates away from gas fields through natural geological pathways or via artificial conduits such as man-made water bore wells. The build up of gas in water bores can result in large uncontrolled releases of gas which may pose a risk to public health and safety".

Another concern in relation to possible groundwater impacts is drilling of substandard wells and that the longevity of well casings cannot be assured. A former long-term

[12]Loyd-Smith, M. & Senjen, R. (National Toxics Network) 2011, ***Hydraulic Fracturing in Coal Seam Gas Mining:***
The Risks to Our Health, Communities, Environment and Climate
[13] http://www.smh.com.au/environment/toxins-found-at-third-site-as-fracking-fears-build-20101118-17zfv.html, http://www.lngworldnews.com/australia-arrow-finds-traces-of-btex/,
[14] http://origintogether.com/your-questions/faqs/#fraccing
[15] JP Morgan **ESG and the Energy Sector** Water Concerns: QLD Coal Seam Gas Developments Report Summary

hydrologist with the Queensland government has stated[16] that there may be problems with up to five per cent of CSG wells being drilled in Queensland, which would lead to issues of contamination and depletion. Unlike the drilling of water bores in the GAB where an inspector attends every drilling event[17], there is no independent monitoring of the drilling procedures for thousands of gas wells being drilled in the GAB across Queensland. A study by Mavroukis (2001) maintains that the isolation of boreholes drilled for gas extraction from other beneficial use aquifers cannot be guaranteed in the long term due to failure of the cement drill casings. There are many mechanisms present in the underground environment that can contribute to deterioration of the cement that maintains zonal isolation between different underground formations penetrated during drilling. The most significant of these mechanisms is cement carbonation, whereby the cement casings deteriorate as a result of the saline water environment underground. The recent Senate Inquiry hearings into CSG held in Narrabri[18] explored the issue of casing failure and detailed instances where saline underground water has resulted in deterioration of water well casings which led to connection between previously unconnected aquifers and contamination of the GAB. In the long term, this raises serious questions about the possibility of depletion and contamination of beneficial use aquifers and who would be liable for the remediation of failed bores, when in many instances the company responsible for their drilling may be long gone. These types of well failures are now showing up in 50 to 100 year old wells in New York State (USA)[19].

At present, there is insufficient understanding of the interconnectivity between coal seams and other aquifers to know what the full implications of dewatering coal seams will be. The baseline data on existing groundwater levels is currently very limited, and

[16] http://news.ninemsn.com.au/national/8214369/gas-wells-could-leak-chemicals-into-water
[17] Four Corners Gas rush program: http://www.abc.net.au/4corners/content/2011/s3141787.htm
[18] RURAL AFFAIRS AND TRANSPORT REFERENCES COMMITTEE **Management of the Murray-Darling Basin system** (Public) TUESDAY, 2 AUGUST 2011 NARRABRI
[19] Ibid.

whilst some companies are monitoring groundwater draw down, this information is not publicly available and there is no independent monitoring. **We believe that there is an imperative on government to undertake full, independent assessment of the hydro geological character of any areas that are proposed for coal seam gas exploration, before any exploration or production takes place, to ensure that there will be no risk of contamination or depletion of beneficial use aquifers from CSG extraction.** It is vital that any such assessment be truly independent, not undertaken by scientists who have links with, or are resourced by, the minerals industry or mining companies, such as the proposed GISERA research initiative[20] where major research into CSG impacts is being funded by the proponents of the largest CSG project in Queensland.

The cumulative impacts of large-scale projects and large numbers of projects also need to be considered. For instance, the proposal for a large project by the company Eastern Star Gas in the Pilliga region in north west New South Wales covers an important area for recharge of the Great Artesian Basin (GAB), and the Basin is already likely to be seriously impacted by the thousands of wells drilled in regions of the GAB in Queensland. The Australian Government Water Group Advice[21] on EPBC Act referrals for major CSG projects in Queensland clearly states that "it can be concluded from the proponents' modelling that the legacy effects of the CSG developments are considerable, with at least 1,000 years passing before this part of the GAB will return to pre-CSG levels." We believe that governments cannot afford to ignore advice such as this and allow massive projects to go ahead without clearly modeling the impacts they will have on other users of groundwater supplies. Decisions on coal seam gas developments should take into account *all* of the

[20] 'First ever coal seam gas scientific research alliance established', CSIRO website, http://www.csiro.au/news/Coal-seam-gas-research-alliance.html

[21] Retrieved from: http://www.sixdegrees.org.au/sites/sixdegrees.org.au/files/Draft%20Water%20Group%20Response%20on%20EPBC%20Act%20Referrals.pdf

impacts on *all* the affected parties dependent on groundwater including natural areas, other industries and human populations.

Surface Waters

The disposal of the wastewater extracted from the coal seam also represents a major threat to surface water systems. This water is often highly saline- for instance a Queensland company estimates that each mega litre (one million litres) of waste water brings up 5 - 8 tonnes of salt[22], whilst the Queensland government estimates that 126,000 - 216,000 mega litres of produced water will be extracted per year in Queensland gas fields including 630,000 - 1,728,000 tonnes of salt. This water contains residues of the often toxic chemicals used in drilling and fracking processes as well as many other contaminants that are naturally present in coal seams such as heavy metals, BTEX compounds (benzene, toluene, ethyl benzene and xylene), and radioactive substances. There is no totally safe or adequate method of disposal of this toxic water or the massive quantities of salt that result from water treatment processes. Some of the currently used and proposed methods of disposal include irrigation of crops, storage in evaporation facilities, treatment and release of treated waters into waterways, and re-injection into aquifers. All of these disposal methods pose serious risks to either ground and/or surface waters and in some cases soils.

The use of produced water for irrigation of cropping land has been undertaken in other jurisdictions[23], however, there are critical barriers to the use of produced water for crop irrigation and stock watering which include the salinity, sodicity, electric conductivity, pH and toxicity of this water[24]. As the Energy Lab[25] (USA) reports:

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[22] Arrow Energy: Water and Salt Management, June 2010. http://www.arrowenergy.com.au/icms_docs/73090_Water_and_salt_management_brochure.pdf

[23] Produced Water Management Technology Descriptions http://www.netl.doe.gov/technologies/pwmis/techdesc/aguse/index.html

[24] Sessoms, H.N., Bauder, J.W., Keith, K. and Pearson, K.E. 2002. Chemical

"Perhaps the most significant barrier to using produced water for agricultural purposes involves the salt content of the water. Most crops do not tolerate much salt, and sustained irrigation with salty water can damage soil properties." As Sessons notes[26], there are a limited range of crops that can be grown on soils irrigated with produced water, thereby limiting the diversity of produce grown in areas where CSG production occurs if produced water is used in irrigation.

Whilst CSG wastewater can be treated to remove salts by reverse osmosis, this is a costly and energy intensive process and there remains the problem of how to dispose of the concentrated brine or salt residue from the process. It has been estimated that reverse osmosis treatment of brackish water (5000mg/l TDS)[27] costs between AU$330-630 per ML of water[28], with the energy consumption estimated to be some 1 kWhr per .001ML of fresh water produced. In a project such as the proposed Narrabri Gas Field in northwest NSW, based on a rate of water production of .16ML per CSG well, per day (given by the proponent in project documents[29]), the 1100 wells in the proposed gas field would produce up to 176 ML per day[30]. To treat the 176ML produced each day, given the lowest of the above estimates and a treated water (permeate) recovery rate of seventy per cent[31], would cost some $58,080- and use 123,200kWhr of power *per day*. In this project the estimated amount of salt/brine that would be produced each day is in the region of 52 ML, which means over one year some 18,980 ML of concentrate would need to be stored and/or disposed of, for

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Changes in Coal Bed Methane Product Water Over Time**.** Department of Land Resources and Environmental Sciences, Montana State University. Montana: Montana State University.

[25] same as 11 above

[26] Sessons, as 13 above

[27] Aqeeous solutions-experts in water treatment solutions http://www.aqueoussolutions.com.au/desal_faq.htm

[28] Clarke, D. 2008. South Australia's Proposed Desalination Plant. http://www.geocities.com/daveclarkecb/Australia/SaWater.html#Cost%20of%20desalination

[29] The Bohena Coal Seam Gas Project Review of Environmental Factors: Water Treatment and Disposal Project

[30] The Bohena Coal Seam Gas Project Review of Environmental Factors: Water Treatment and Disposal Project

[31] as for 18 above, p.16

each and every year of operation. There is at present *no solution* for the long-term disposal of these salts.

A further problem with reverse osmosis treatment is that it does not remove the smaller organic compounds found in CSG water. At present, water that is treated by reverse osmosis is being released into Queensland waterways[32], waterways that are part of the Murray Darling Basin and that are used downstream in NSW for a range of agricultural uses as well as town water supplies. This water is likely to contain organic compounds such as the BTEX group of chemicals that can be toxic in very small amounts and which bioaccumulate in the food chain. This wastewater has been approved for release without any analysis of the cumulative load of organic compounds that are being released into river system and therefore mobilized into natural aquatic systems and subsequently utilized by downstream users[33]. It is worth noting that many of these organic compounds are toxic in minute amounts and bioaccumulate in the food chain[34].

Another option currently in use and proposed for wastewater management is the use of storage and/or evaporation ponds. Some of the risks involved with these options include: spillage onto soil and runoff into waterways from dam leaks and during transport to these facilities via pipeline or tanker; overflow from storages during extreme rainfall events; spray drift onto adjacent lands and waterways; seepage into shallow aquifers; water transport impacts including heavy vehicle traffic with associated noise and road degradation; pipeline impacts such as vegetation clearing, erosion and landscape fragmentation; and animal deaths from exposure to pond water. Even in the early stages of this industry in NSW there have been wildlife deaths in the Pilliga Forest at pond sites, as well as extensive tree death from

[32] Australia Pacific LNG Pty Limited Environmental Authority {petroleum activities} No. PEN100067807
[33] Loyd-Smith, M. & Senjen, R. (National Toxics Network) 2011, Hydraulic Fracturing in Coal Seam Gas Mining:The Risks to Our Health, Communities, Environment and Climate
[34] Ibid

overflows and seepage of wastewater into adjacent vegetated areas. Whilst evaporation ponds are now banned in NSW, it is not clear whether storage facilities, which have the same risks associated with them, will still be allowed. In addition, evaporation ponds in projects that have already been approved will go ahead, such as the large 12-hectare evaporation facility planned for the environmentally sensitive Casino floodplain in northeast NSW[35]. There are also problems associated with the disposal of the drilling muds produced during drilling activities. In many cases these are being stored in temporary holding ponds, such as the new facility Metgasco has recently lodged a Development Application for in the Casino area[36]. Again, there is no satisfactory solution to long-term disposal of these substances.

A wastewater disposal method that is currently being trialled in Queensland CSG projects[37] and carried out in the coal bed methane industry in the US[38] is re-injection of the produced water back into the depleted coal seam aquifer or injection into other aquifers. This process is costly and energy intensive[39] and risks contamination of beneficial use aquifers with toxic or saline wastewater[40]. The US Geological Survey has recently published findings that suggest that re-injection processes canbe linked to earthquake activity[41]. ‘*"Earthquakes induced by human activity have been documented in a few locations in the United States, Japan and Canada,"* writes the USGS. *“The cause was injection of fluids into deep wells for waste disposal and secondary recovery of oil and the use of reservoirs for water supplies."*‘

[35] Metgasco: RVPS and CGP environmental assessment
[36] Temporary holding facility DA 2012/0021
[37] Australia Pacific LNG Project Talinga/Orana Environmental Management Plan http://www.aplng.com.au/pdf/talinga/Talinga_Att_5_Talinga_aquifer_injection_trial_management_plan.pdf
[38] Farag et al 2010, “Potential effects of coal bed natural gas development on fish and aquatic resources” p.7 from http://www.uwyo.edu/wycoopunitsupport/docs/Potential%20Effects%20of%20Calbed%20Natural%20Gas.pdf
[39] Warrence and Bauder, 2008
[40] Australian Government National Water Commission, ‘The Coal Seam Gas and water challenge’, August 2011
[41] http://rt.com/usa/news/fracking-earthquake-virginia-dc-817-061/

A significant concern with all of the proposed methods of wastewater disposal is the possibility that produced water will make its way into natural systems from "overland flow, infiltration or groundwater connections"[42]. This migration has the potential to seriously impact soils, wetlands, fish populations and aquatic ecosystems. These impacts have been detailed in semi-arid environments in the USA[43] similar to the western NSW environment where water is currently released into the ephemeral Bohena creek as part of the Eastern Star Gas pilot production projects[44].

It is vital that safe and environmentally sound processes are developed to deal with the large volumes of wastewater produced in CSG activities <u>before</u> large-scale CSG production goes ahead. It is not adequate that this industry goes into full-scale production before there is sufficient information available to assess the efficacies and impacts of wastewater management procedures. **If wastewater disposal methods that safeguard human health, ground and surface water systems, soils and vegetation cannot be developed, then this industry should not be allowed to expand in NSW.** The threats to water supply from CSG operations are particularly relevant given the increasing pressure that is being placed on our ground and surface water systems from population growth and climate change.

Effects related to the use of chemicals

A range of chemicals are used in the drilling and fracking fluids that are used in CSG extraction processes. A US House of Representatives inquiry into the chemicals used in the industry found that some 2,500 hydraulic fracturing products containing 750 chemicals and other components were used by just 14 companies in CSG

[42] Same as no. 22 above, p.7
[43] Ibid
[44] The Bohena Coal Seam Gas Project Review of Environmental Factors Water Treatment and Disposal Project

operations in the US, and up to 780 million gallons of the products were used in fracking processes[45]. Many of these chemicals are known to be harmful to human health if they become mobile in water or air, whilst for many the health effects are unknown as the chemicals used are not publicly disclosed or the data on their effects is insufficient to adequately assess their health and environmental impacts[46]. Many of the chemicals that are being used in fracking processes in the USA have been identified as having serious harmful health effects, including on the skin, eyes and kidneys; respiratory and gastrointestinal systems; brain and nervous systems; immune and cardiovascular systems; endocrine system or could cause cancer, mutations or birth defects[47].

In the Australian context there is a similar lack of information and disclosure relating to the chemicals used in fracking in this country[48], despite the fact that some 10-40 per cent of wells in Queensland are likely to use the fracking process[49]. The National Toxics Network[50] reveals that of the twenty-three most common chemicals present in fracking fluids in Australia, the National Industrial Chemical Notification and Assessment Scheme (NICNAS) have assessed only two, and these have not been assessed for use in fracking processes. Given that some forty per cent of the fluids used in fracking processes remain within the ground after the process is completed[51], **it is imperative that there is full disclosure of all chemicals used by CSG companies and that these chemicals be subject to comprehensive environmental and health hazard assessment by the industrial chemicals**

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[45] http://democrats.energycommerce.house.gov/sites/default/files/documents/Hydraulic%20Fracturing%20Report%204.18.11.pdf

[46] Doctors for the Environment Submission to the Senate Inquiry into Impacts of CSG on the Murray-Darling Basin

[47] http://www.endocrinedisruption.com/files/Oct2011HERA10-48forweb3-3-11.pdf

[48] [48]Loyd-Smith, M. & Senjen, R. (National Toxics Network) 2011, ***Hydraulic Fracturing in Coal Seam Gas Mining:***
The Risks to Our Health, Communities, Environment and Climate

[49] http://www.abc.net.au/environment/articles/2011/03/22/3169602.htm

[50] as for 35 above

[51] Coal Seam Hydraulic Fracturing Fluid Risk Assessment. Response to the Coordinator-General Requirements for Coal Seam Gas Operations in the Surat and Bowen Basins, Queensland. Golder Associates 21 October 2010

regulator, NICNAS. **In addition, there should be a thorough investigation of the ecotoxicology of these chemicals and their long term environmental fate** as well as the cost of remediation and clean up and disposal of any hazardous substances associated with the fracking process.

Effects related to hydraulic fracturing

According to Dr Jim Underschultz of the CSIRO[52], there are two major concerns related to hydraulic fracturing (fracking)- the chemicals used in the process and the inducement of fractures in formations outside the coal seam. If the fracture is not contained within the coal seam but extends into the aquifer above, there is a consequent likelihood of connectivity between previously unconnected aquifer formations and contamination of beneficial use water supplies from migration of fracking fluids and toxic substances and gases present within the coal seam. The risks posed by the chemicals used in fracking have been detailed above, and as a substantial amount of fracking fluid remains in the ground, there is a serious risk of harm to aquatic ecosystems, wildlife, human health and domestic stock should these chemicals contaminate ground and surface waters.

The US EPA[53] has detailed a range of impacts following the use of fracking processes in coal bed methane extraction in the USA. These impacts include:

- Explosive levels of hydrogen sulfide and methane under buildings and inside homes
- Death of vegetation (possibly due to seepage of methane and decreased air in root zones)

[52] http://www.abc.net.au/environment/articles/2011/03/22/3169602.htm
[53] U.S. Environmental Protection Agency. August, 2002. *DRAFT Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs.* EPA 816-D-02-006. Chapter 6. Water Quality Incidents. (http://www.epa.gov/safewater/uic/cbmstudy/docs.html)

- Increased concentrations of methane and hydrogen sulfide in domestic water wells
- Cloudy well water with increased sediment concentrations following hydraulic fracturing
- Strong odours and black coal fines in water wells
- Brown, slimy well water that smelled like petroleum
- Decrease in well water levels and surface water flows following hydraulic fracturing
- The discharge of produced water creating new ponds and swamps that were not naturally occurring in particular regions

I note that these impacts are from coal bed methane extraction processes, not shale gas extraction processes, and are therefore relevant to the Australian context. I make this distinction because some industry proponents[54] have been quick to disassociate themselves from the harmful impacts of the US gas industry by saying that all the impacts are related to shale gas production, not coal seam gas production which is not what they are involved in here in Australia. The above quote makes it clear that this claim is untrue.

There is now widespread concern that fracking processes have resulted in higher incidences of earthquakes in the regions where it is undertaken, including a higher prevalence of earthquake swarms[55]. The risks posed by hydraulic fracturing have been sufficient to cause France, South Africa and the United Kingdom to ban this process, and it is now banned in some states of the USA.[56]. Whilst the current regulation banning fracking in NSW is welcomed it is insufficient. This process should be banned indefinitely as it just poses too great a threat to precious groundwater supplies. In a continent as dry as Australia that relies so heavily on ground water

[54] pers. comm.. Henderson, P. CEO of gas company Metgasco, during public forum in Casino
[55] http://rt.com/usa/news/fracking-earthquake-virginia-dc-817-061/
[56] http://www.rodale.com/fracking-ban

resources for food and fibre production as well as town water supplies, we cannot afford to jeopardise our groundwater resources.

Effect on Crown Lands including traveling stock routes and State forests

Under the present minerals exploration regime in NSW even those public lands set aside for conservation such as State Conservation Areas, National Parks and water catchment Special Areas are not exempt from mining activities and infrastructure. In the Pilliga forests gas wells and associated infrastructure are proposed for a State Conservation Area (SCA), in the Northern Rivers a proposed major gas pipeline route passes right through the World Heritage listed Border Ranges NP, exploration drilling has recently commenced at Putty adjacent to World Heritage listed Wollemi NP, and exploration activity is planned for Special Areas in the Sydney, Illawarra and Hunter water catchments. Mining is also allowed in State Forests which effectively privatizes these areas which are supposed to be multi purpose areas for public enjoyment as well as providing a state owned timber resource. There are extensive areas of public lands in the Northern Rivers that would be under threat if CSG production were expanded in the region.

Projects such as the massive gas field planned for the State Forests and the SCA in the Pilliga region pose a range of threats including loss and fragmentation of vital habitat in an already heavily cleared region; increased spread of noxious weeds and feral pests and predators; and increased threat from bushfires. Gas field developments in natural areas threaten wetland ecosystems and important fauna habitats and effectively turn our remaining bushland remnants into industrial zones, with threats to wildlife from loss of habitat and food resources, high numbers of truck movements, industrial noise and pollution of land and waterways. Traveling stock routes (TSR's), which are already being targeted for pipeline developments and CSG exploration in NSW are particularly vulnerable. They should be protected from CSG

developments as they represent important wildlife corridors and refuges for plant and animals in otherwise cleared agricultural landscapes.

The type of industrial development involved in CSG extraction is completely inappropriate for these areas of public lands and totally compromises and threatens the natural values, ecosystem services and biodiversity reservoirs they preserve and maintain for current and future generations. **It is critical that high conservation value areas, drinking water catchments and water supplies, important vegetation remnants and corridors (including TSR's), wetlands and public lands, be properly protected from all CSG activities- we call on the government to ban all CSG activity on or adjacent to such areas.**

Nature and effectiveness of remediation required under the Act

The infant CSG industry in NSW has already been the subject of significant public scrutiny in relation to remediation of mining activities. Indeed, in an environment of inadequate regulation and lack of any significant independent monitoring, it has been largely up to the public to oversee the activities of this industry. Members of the public have exposed a number of instances where gas companies have failed to comply with the conditions detailed in environmental review documents (Reviews of Environmental Factor's). In the Pilliga Forests there have been examples of drill ponds being unlined, which has lead to seepage of toxic substances into surrounding bushland, and unfenced, which has resulted in deaths of native animals. Warrick Jordan, Campaigns Manager for the Wilderness Society, says[57] "In the Piliga Scrub, where exploration has started, we've found water dumped directly into creeks, produced water left in unlined ponds so it gets soaked straight back into the ground." In the Casino area there have been instances of abandoned drill sites being left un-remediated, with torn liners allowing seepage into surrounding areas and no removal

[57] http://www.mamamia.com.au/news/coal-seam-gas-gasland-and-fracking-making-farmers-uneasy/

of drilling fluids as required by REF's[58]. There have also been discovery of a number of leaking gas wells in the Northern Rivers region by members of the public[59].

These examples highlight the fact that both the nature and effectiveness of remediation under the Act is grossly inadequate; as are the assessment, approval and compliance protocols that currently exist. **Government should develop a strict legislative and regulatory framework for this industry to ensure proper preventative measures, environmental assessments, strong regulations and enforcement mechanisms are in place to ensure there are no adverse effects on the environment and communities and an independent authority should monitor these regulations.** It should not be up to the public to monitor CSG operations and it is not sufficient that the industry be allowed to regulate itself as is happening in Queensland- there should be independent compliance monitoring of all regulations. In addition, there should be much greater involvement of both local communities and the environment department at all stages of the assessment and approvals process for CSG exploration and production.

Given the risks outlined throughout this submission, we believe that all CSG activities should be stopped until full, independent studies can be conducted into the impacts of the industry on the natural environment, surface and groundwater systems, food production, human health and local communities. It will only be possible to design adequate properly legislation and regulation for this industry if the full impacts are properly detailed in a systematic way.

[58] http://www.northernstar.com.au/story/2011/06/13/gas-chief-admits-company-at-fault-over-storage-pon/
[59] http://www.northernstar.com.au/story/2011/03/01/leaking-coal-seam-gas-concerns/

Effect on greenhouse gas and other emissions

Whilst industry proponents promote the CSG industry as a clean and green alternative to coal, there is considerable doubt as to the accuracy of this statement[60]. The use of conventional natural gas for electricity production has been shown to generate about half[61] [62]of the greenhouse gas emissions of coal at the point of combustion. However, outside of the power plant emissions are much higher for gas than for coal[63] as a result of fugitive emissions and production and transport processes[64]. There has been no comprehensive, independent analysis of the full life cycle emissions of coal seam gas, with any figures that are currently used coming from CSG[65] industry proponents. **To properly ascertain the greenhouse emissions of CSG it is necessary for a fully independent study into the life cycle emissions from the industry to be undertaken that takes into account extraction, compression, leaks, pipeline transport, liquefaction, shipping, regasification, transportation and generation.** Fugitive emissions are an important consideration because "methane is 25-times worse than CO2 over a 100-year period. [ ] When its impact is considered over a 20-year period — which is a reasonable timeframe given our proximity to climate change tipping points – the climate change force [of methane] is 72-times greater than carbon dioxide.[66]"

Crucial to the argument around emissions is that we should not be comparing the emissions of CSG to coal- we should be comparing them to renewable energy

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60 Readfearn, G. Cloud over CSG emissions from: **http://www.brisbanetimes.com.au/environment/cloud-over-csg-emissions-20110818-1izx1.html; :** Fugitive emissions: what is the real footprint of coal seam gas? http://theconversation.edu.au/fugitive-emissions-what-is-the-real-footprint-of-coal-seam-gas-2940

[61] Readfearn etc

62Fugitive emissions: what is the real footprint of coal seam gas? http://theconversation.edu.au/fugitive-emissions-what-is-the-real-footprint-of-coal-seam-gas-2940

[63]Parkinson, G., 2011, *Is CSG cleaner than coal?*

[64] Senator Milne, 2011, Question and Speech - is coal seam gas as polluting as coal?

[65] As for 47 above

[66] Fugitive emissions: what is the real footprint of coal seam gas? http://theconversation.edu.au/fugitive-emissions-what-is-the-real-footprint-of-coal-seam-gas-2940

sources. Coal seam gas is still a fossil fuel, and even if it emits less than coal it still adds a significant amount of greenhouse gases to the atmosphere- some forty times the amount generated by solar and wind technologies. **By rushing into full scale gas production we are locking ourselves into a continued dependence on fossil fuels when we should be investing most of our resources in making the switch to renewables now, as we will have to do so anyway when the gas runs out in a few decades time.**

Relative air quality and environmental impacts compared to alternative fossil fuels

The major air quality concerns in relation to coal are the emission of toxic gases during combustion and the particulate pollution from airborne coal dust. Whilst CSG does not have these particular air pollution issues associated with it, there are issues with the toxic gases that are emitted at drill sites, compressor stations, and evaporation ponds, and when leaks occur during transport. In addition, "during various stages of gas exploration, production and maintenance, gases are vented directly into the air rather than contained or flared. Venting can release large volumes of toxic gases"[67].

When gas wells and compressor stations are located close to places of human habitation there can be serious risks to human health from methane, hydrogen sulfide and volatile organic compounds (VOC's)[68]. Exposure to VOC's (which are released from drilling and fracking fluids, during gas separation processes and from wastewater evaporation[69]) can lead to a range of serious health effects such as headache, loss of co-ordination, and damage to the liver and kidneys"[70]. VOC's can also result in formation of "ground-level ozone, a known respiratory irritant with

[67] GC Monitor, 'Gassed' : http://gcmonitor.org/downloads/gassedreport.pdf
[68] Dr's for the Environment submission to the senate inquiry into the Impacts of coal seam gas on the Murray-Darling Basin
[69] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1817691/pdf/ehp0115-a00076.pdf
[70] Ibid

detrimental effects on lung function"[71]. There have been reports from residents in the Tara area in Queensland of serious health impacts associated with commencement of CSG drilling in close proximity to their homes. These effects have included ear and nosebleeds, headaches, nausea, vomiting and skin rashes[72].

Other air pollution impacts include an instance in Queensland where there were reports from local residents of serious health impacts following the use of CSG wastewater for dust suppression along roads in the area[73]. Residents living in the vicinity of gas wells also report that the high levels of noise pollution from drill sites and compressor stations operating all night are resulting in sleep derivation and stress related illnesses[74]. There is also a risk from airborne pollutants when gas wells blow out and there is an uncontrolled discharge of gas, coal seam water and drilling/fracking fluids into the air and across the landscape. Blowouts such as this have occurred this year in the Dalby region of Queensland[75] and at Camden [76]in NSW.

Additional environmental risks- increased threat of fire

Coal Seam Gas extraction also poses significant threats of bushfires, both from increased ignition sources and fuels at the surface level, as well as underground fires in dewatered coal beds. Reports from the US highlight the high incidence of well fires and explosions, which can cause significant damage to the environment, and risk

[71] As for 51 above
[72] Orr, D, (Tara resident) July 2011, pers. comm.
[73] http://www.couriermail.com.au/business/claims-of-illnesses-and-cover-up-as-d-day-looms-for-coal-seam-gas-projects/story-e6freqmx-1225941426413
[74] Ibid
[75] **Arrow Energy caps coal seam gas well blowout near Dalby that was spewing gas and water** http://www.couriermail.com.au/business/coal-seam-gas-well-blowout-near-dalby/story-e6freqmx-1226060860912
[76] FORMAL WARNING GIVEN TO AGL OVER COAL SEAM GAS BLOW OUT http://nsw.greens.org.au/content/formal-warning-given-agl-over-coal-seam-gas-blow-out

human lives and property[77]. If coal seam gas developments go ahead in areas such as the Pilliga forests in north west NSW, a region that is prone to rapidly moving, high intensity burns, there is a serious threat of catastrophic fire as a result of the massive increase in ignition points and fuel load that a gas field comprises. The US Energy[78] Justice Network informs us that the EPA has reported "the spontaneous combustion and continued burning of completely dewatered coal beds [ ]. When water is pumped out of coal seams, coal becomes exposed to oxygen, and coal fires are possible. This can occur spontaneously, or from lightning strikes or ignition by grass fires or wildfires. The areas most likely to be the site of a coal fire are along the edges of basins where coal is close to the surface and oxygen can most easily enter the coal when water is removed."

The economic and social implications of CSG activities

Legal rights of property owners and property values

At present the legislation under which CSG extraction takes place in NSW and Queensland does not provide the landholder with the right to refuse access to their land or to prohibit extraction activities from occurring on their land. There has been widespread outcry from landholders in these states at the injustice of this situation. The whole process imposed on landholders has many drawbacks including:

- the superior negotiating skills of the mining company;
- agreements made with a landholder bind all future owners;
- many agreements have been signed without independent legal advice;
- landholders are often under an unreasonable time pressure to reach agreement;
- finalisation of disputed agreements proposals may take considerable time

[77]Riverkeepers: Fractured communities: Case Studies of the Environmental Impacts of industrial gas drilling
[78]From http://www.energyjustice.net/naturalgas/cbm#173

whilst in the meantime coal seam gas mining activities may commence;

- in Queensland, mediators are often Mining Registrars who are involved in the mining industry, not necessarily having an understanding of farming activities;
- a landholder's legal costs associated with a protracted dispute are payable by the landholder who in many cases may not be able financially to mount an adequate defence;
- it is doubtful if the ongoing financial loss of an organic producer certification would be realistically compensable;
- consultation with local landholders by coal seam gas companies is in many cases a sham with little time allotted for evaluating proposals;
- loss of privacy and security are realistically not quantifiable, nor are the deleterious effects of continual noise, dust and road traffic;
- the reduction in land values and environmental impacts affect other neighbouring landholders who are not parties to any compensation provisions that may appear in an access agreement;
- if long term damage is done to land and water resources, the company may no longer be operating and it will be impossible to make any claim on them for remediation or compensation.

In May 2010, Queensland Minister for Mining Stephen Robinson was forced to propose new laws in an attempt to "better protect landholders' rights when their land is accessed for coal seam gas exploration"[79]. Across NSW there has been widespread demands from landholders and farming industry groups asking for increased rights for landholders. The Greens Senator Larissa Waters recently tabled a bill in Federal Parliament[80] that would make legislative provisions for landholders to "refuse the undertaking of coal seam gas mining activities on their land without prior

[79] See the Sydney Morning Herald, May 17th 2010, http://news.smh.com.au/breaking-news-national/qld-plans-new-land-laws-20100517-v75x.html

[80] Landholders' Right to Refuse (Coal Seam Gas) Bill 2011

written authorization". It is clear that the current arrangements for access of CSG companies to private land heavily favour the companies and provide very few substantive rights to landholders. Given this imbalance, and the range of likely negative impacts of CSG activities on land and water resources and quality and amenity of rural life, we feel that it is imperative that landholders' rights be augmented. **We call on the NSW government to give landholders the right to refuse companies from accessing their land for CSG exploration and production by amendment of the *Petroleum (Onshore) Act 1991.***

Local farmers, residents and landholders have heard personal testimony from South East Queensland residents living in the vicinity of gas fields that their respective properties have become "unsaleable"[81] as a result of CSG mining, even though the CSG mining was not even taking place on *their* land. Despite indications that the *prospects* of CSG mining can temporarily increase land values in an economically struggling region[82], the *actual* outcome of CSG mining inevitably results in a fall in real estate values. CSG mining results in proliferation of wells and associated infrastructure across rural landscapes, and the evidence consistently shows that people do not want to live in or near a gas field.

Food security and agricultural activity

At a public meeting (attended by 300+ people) in Casino, NSW on Thursday 11th August 2011, concerns were raised by local farmers about the risks of CSG contaminating their produce. Food and water security concerns such as this are the foundation of much of the opposition to the coal seam gas industry in rural regions across the state. Leading Australian researchers, such as the CSIRO, urge us to remember: "groundwater resources in Australia underpin a range of agricultural and

[81] As cited at public meeting on 15th August 2011 at Lynchs Creek Community Hall.
[82] As described in personal conversation to the author by real estate agents in Casino NSW, during June, 2011.

mining industries"[83]. Agricultural production, particularly in inland NSW, relies heavily on the already over allocated water systems of the Murray Darling Basin and the Great Artesian Basin and other aquifers, and any depletion or contamination of these water systems will have a huge impact on food production. The Australian Government's department of Geoscience Australia says that coastal aquifers are an increasingly important resource and that: "Continuing population expansion along Australia's coastal fringe, combined with significant reduction in rainfall in many coastal catchments, has led to an increasing dependency on coastal groundwater resources"[84].

The loss of valuable arable land as a result of the spread of CSG wells, wastewater storage ponds, treatment facilities, pipelines and access tracks is also having a severe impact on the food producing capabilities of regional Australia. Some of NSW's most valuable and productive agricultural regions are currently under threat from CSG developments, including the Moree Plains, the Liverpool Plains, and the Northern Rivers. In addition to the loss of land taken up with gas infrastructure, CSG developments can add to erosion issues on farms, result in silting of streams and rivers, cause stock fatalities and disrupt water flows[85] [86]. There is already a massive proliferation of CSG developments destroying the best food producing areas of Queensland such as the Darling Downs, we have the opportunity in NSW to stop the industry from taking over our vital agricultural lands. Members of Kyogle GAG who are beef and dairy farmers are very concerned about the impacts coal seam gas could have on their best pastureland and waterways. Over many years they have improved their farming practices to take better care of the land and water and make their farm production more environmentally sustainable, yet their land is

[83] As viewed by author on August 30th 2011, http://www.csiro.au/science/Groundwater-hydrology.html
[84] As viewed by author on August 30th 2011, http://www.ga.gov.au/ausgeonews/ausgeonews201009/inbrief.jsp
[85] http://theconversation.edu.au/coal-seam-gas-a-risk-to-food-security-485
[86] http://www.aph.gov.au/Senate/committee/rrat_ctte/murray_darling/submissions/sub07.pdf

at risk from gas companies who are able to come onto their properties without landholders having a right to refuse access, and they don't even have to comply with all the legislation that farmers must adhere to, such as the Native Vegetation Act, the Water Management Act. Where there is a nexus between agriculture and mining, in areas where CSG is located, we are forced to choose between - **we strongly urge the State Government to prioritise our food and water security of NSW over CSG production by properly protecting all valuable food production areas and beneficial use water systems from CSG activities.**

Regional development, investment and employment, and State competitiveness

A recent report into the impacts of mining developments on regional Australia by Professor Kerry Carrington from QUT[87] highlights the fact that there is at present no mechanism whereby the economic benefits from royalties paid by mining companies can go back into the communities and regions that disproportionately bear the burden of mining development. Carrington's report details many of the detrimental effects that rapid, poorly planned mining expansion has had in Queensland and Western Australia, including the lack of local job creation with routinisation of fly in, fly out workforces; degradation of transport corridors and other local infrastructure; increased demand on social and health services and massively inflated rent prices.

The vast majority (often considered to be greater than 90%) of workers employed by CSG mining are employed specifically for the construction phase of CSG mining[88]. This means that despite claims that CSG mining is a good employer, the reality is that real, ongoing, and reliable employment is reserved for very few people. The actual skills needed for constructing CSG infrastructure are generally specialised,

[87] Fly IN Fly Out Inquiry from: http://www.abc.net.au/rn/lifematters/stories/2011/3301265.htm
[88] "Employment is typically largest during construction phase" reports the Chamber of Minerals and Energy of Western Australia in January 2005, for further details see: http://www.peopleforthefuture.com.au/files/files/20_FIFO_Report.pdf

meaning that CSG workers are predominantly fly-in/fly-out contractors, with little if any interest in the living environment of the communities where they are working[89]. Some of the problems in areas where the workforce is predominantly transient include: 2-3 times higher violent crime rates; 2.5 times higher mortality from accidents/ fatigue related incidents; and bad behaviour of workers under the influence of alcohol[90].

In addition, the presence of transient workers (in what are typically close-knit regional communities) destabilises pre-existing networks of reliable, inter-dependent economic relationships and can have other indirect and often unrecognised consequences on existing community life. For example the jealousy generated by outsiders seemingly (and actually) making large amounts of money from one's local and often child-hood landscapes and territories; intimidation caused by highly trained people belittling (by inference if not overtly) the skills and expertise of local people; and a general disregard for local standards of practice, economic regulation, trans-generational realities, and expressions of normality. These feelings of jealousy, intimidation and general disregard, then translate into behavioural and psychological expressions of dysfunction within the families affected by CSG mining[91]. In real terms, this means increased rates of domestic violence, self-harm, and child abuse- as disempowering behaviours of disempowered peoples.

Doctors for the Environment[92] have detailed the increasing incidence of solastalgia and other mental health problems in communities affected by mining activities.

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[89] See for example The Central Telegraph, 25th March 2011, http://www.centraltelegraph.com.au/story/2011/03/25/farmer-sick-csg-workers-camp/

[90] Carrington, K., Fly IN Fly Out Inquiry from: http://www.abc.net.au/rn/lifematters/stories/2011/3301265.htm

[91] See for example The Sun Herald, June 24th 2011, http://www.heraldsun.com.au/business/business-smarts/moneys-good-but-fly-in-fly-out-mine-workers-sex-lives-suffering-experts-warn/story-fn7j1dox-1226081548539

[92] **Submission to the Rural Affairs and Transport References Committee Inquiry** into management of the Murray Darling Basin – impact of mining coal seam gas **27 JUNE 2011** Submission from Doctors for the Environment Australia Inc. http://www.dea.org.au

Solastalgia is described as "*the distress that is produced by environmental change impacting on people while they are directly connected to their home environment*". The stresses from uncertainty and lack of control over land; water and air pollution and water shortages; permanent degradation and loss of productive agricultural land; loss of livelihood and landscape amenity; community disruption from transient workers and the pressures of negotiating with powerful mining companies, are leading to increased levels of stress related illnesses, depression and feelings of powerless amongst landholders who are often already under intense pressure from the impacts of extreme weather events such as droughts or floods[93].

The introduction of a mono-economy into regional townships dramatically impacts the diversity of pre-existing economic involvement in that town and region. Over many years economic networks develop and grow into what is often a fragile though functional web of interdependent economic citizens. In regional settings these economic networks are critically interdependent and especially vulnerable to outside influences, such as CSG mining. Given that the overwhelming majority of CSG employment is required for the construction of mining infrastructure, one can easily see that an influx of employees and employment opportunities will necessarily be limited to those skilled in CSG infrastructure construction which leads to a drain of skilled workers from other industries. Time and time again, local businesses collapse because they are simply unable to compete for the staff[94]. Employees are too often, though understandably, drawn to the immediate benefits of working in a temporary CSG mining industry, while in the long-term, local businesses consequently shut down. In the end a community is likely to be left with closed businesses and the abandoned aftermath of CSG extraction.

[93] Ibid
[94] Ibid

Some mining companies acknowledge the social impacts of mining as evidenced by the following statement from a Santos executive: "Positive and negative social impacts will typically be experienced by a community if the nature, magnitude, timing and duration of a social change are more than they are able and willing to manage"[95]. However, this statement really misses the mark in terms of who is responsible, placing the responsibility for "negative social impacts" squarely on communities rather than companies and government, and exemplifies the arrogance and belligerence with which such companies view the impact of their industry on Australian communities. It is increasingly clear that governments are not managing the social change impacts of mining on regional communities and companies are not being required to take responsibility for reducing these impacts.

There is an urgent need to direct serious resources to address infrastructure, services, social and community issues being experienced by mining regions and to make any use of non-resident workforces more sustainable. NSW has the opportunity to properly plan for these impacts before there is any further expansion in the CSG industry in this state. The federal government is currently undertaking an inquiry into the impact of fly-in, fly-out workers[96] on regional communities, chaired by Toney Windsor, the member for New England, whose electorate is affected by CSG exploration. It would be valuable for the state government to take note of the outcomes of this Inquiry so that NSW does not end up with the problems being faced in Queensland and Western Australia's mining regions.

[95] Page 23 *Santos GLNG Final Report: Social Impact Assessment*, 15th February 2009, http://www.glng.com.au/library/EIS/Appendices/Z_Social%20Impact%20Assessment%20FINAL%20PUBLIC.pdf

[96] See ABC New England North West News, 26th August, 2011, http://www.abc.net.au/news/2011-08-26/csg-inquiry-prompts-plea-for-aquifer-protection/2857200/?site=newengland&section=news

Expansion of CSG activities in an area such as the Northern Rivers is likely to reduce the diversity and variety of the regional economy and negatively impact a range of industries that are integral to the region, including beef and cattle farming, sugar cane production, as well as orchardists, nut producers, organic farmers, artisan farmers, and nature based tourist activities and accommodation. The whole appeal of this region is the productive land, scenic landscapes, clean waterways and large areas of remaining natural areas- these values are likely to be massively degraded by expansion of CSG activities in the region. There is widespread opposition to the CSG industry from people across the region and there is an urgent need for communities to have a say in how the region is developed. **We call on this Inquiry to extend the present regional land use strategy initiatives to our region so that we, as a community, get to have an input into the planning of the future regional development of the Northern Rivers.**

Royalties payable to the State

As detailed above, the current mining royalties regime does not direct money received by state governments back into regional communities to address the cumulative social and infrastructure impacts of mining developments. Moreover, there remains the question of whether the government is inherently compromised regarding CSG[97] in relation to royalties. That is, given the government's ownership of CSG resources (on behalf of The Crown) and the royalties they receive upon its extraction, in combination with its representation of the interests and wellbeing of the citizens of NSW- what is the government's priority? If government is receiving significant income from CSG developments there is a serious risk that their interest in protecting the interests of the environment and communities of the state may be compromised. The royalties currently received are inadequate to properly address

[97] See for example The Sydney Morning Herald, 30th August 2011, http://www.smh.com.au/environment/buyers-not-told-of-proposal-to-drill-for-coal-seam-gas-20110829-1jii5.html#ixzz1WT95ZHpT

the impacts of this industry, they should be increased and a portion of the income mandated to directly address any negative impacts of the industry. In addition the existing five year royalty free period should be abolished.

Local Government including provision of local/regional infrastructure and local planning control mechanisms

A significant impact of the CSG industry that is often ignored is the impact on local public infrastructure – especially roads. Our NSW inquiry should be aware that each CSG well requires literally hundreds of trucks, each in excess of 20 tones, for standard construction and operations[98]. Notwithstanding the particulate and chemical pollutants that trucks bring[99] to an area, is the economic impact of physically accommodating such vehicles on our roads. The roads we refer to are the smaller regional roads, of communities throughout regional and remote NSW. Local councils usually maintain these minor roads, without support from state or federal government. In simple terms, it is the ratepayers of a region who are the primary funders for the roads that are supposed to carry these CSG mining trucks. There should be adequate provisions for CSG companies to recompense local council for maintenance of all public roads, major or minor, which are used by those companies for the construction and maintenance of their wells, pipelines and other infrastructure.

It is unacceptable that local Government and local communities are currently largely excluded from planning and approval processes for CSG activities. In the Northern Rivers region, six out of the seven local councils have asked for a general moratorium on CSG extraction, with Murwillumbah council going further and imposing a moratorium on any CSG activity on council land. We believe that local

[98] As shown for example in the documentary *Gasland*, by Josh Fox, 2010.
[99] As discussed in interviews with human health experts in the documentary *Split Estate*, by Bullfrog Films, 2011.

councils and communities should have more input into planning and assessment approvals processes for CSG activities.

The role of CSG in meeting the future energy needs of NSW

Nature and extent of CSG demand and supply

According to APPEA[100], 'the CSIRO has [] estimated eastern Australia's CSG resources to be more than 250 trillion cubic feet, enough to power a city of 1 million people for 5000 years." The resource in Queensland has been rapidly developed over the last decade, with around 4,000 wells at present and an expansion up to some 40,000 wells planned for the future. Whilst some of this gas is being used for domestic supply to generate electricity and power gas appliances, the majority of it will be converted to LNG for export overseas. The industry is less developed in NSW where three small CSG production projects (AGL's Camden and Gloucester Gas Projects, Metgasco's Casino Gas project) and a pilot production project (Eastern Star Gas's Narrabri Project) for local power generation have been approved and are in various stages of construction, whilst there is widespread exploration activity taking place across the 25 per cent of the state covered by licenses.

Whilst the rhetoric and spin from governments and industry relating to the expansion in gas production is based on the need for Australia to reduce its carbon emissions

[100] http://www.appea.com.au/industry/csg.html

by moving away from coal to gas for electricity generation[101][102], a look at where the demand is coming from for the headlong rush into gas production tells a different story. Coal seam gas from all of the major gas fields that have been approved in Queensland in the last year (APLNG, GLNG, QCLNG Projects- totalling 18,650 wells) will be piped to Gladstone for processing into LNG and shipment to Asian markets[103][104]. These figures make it clear that the main driver for CSG expansion is the profits that are available from export of CSG from Australia to large overseas markets.

Relative whole-of-lifecycle emission intensity of CSG versus other energy sources

As detailed in an earlier section of this submission, the figures usually given for the greenhouse gas emissions of CSG are emissions at the point of combustion, which are about half that of coal. When comparing emissions of different types of gas, CSG is likely to have significantly greater fugitive emissions than conventional gas because it 'generally uses far more wells than "conventional" gas, and it is the drilling and development to production of those wells where the most fugitive emission take place'[105].

There have been no independent studies yet done on the full life cycle emissions of CSG, but investigations in the USA on non-conventional gas production suggest that the emissions from this type of gas may in fact be worse than those of coal[106]. Whilst

[101] 'State premiers turn up heat on Greens over their reservations about coal seam gas' http://www.theaustralian.com.au/national-affairs/greens-gas-campaign-off-target-says-origin-energy/story-fn59niix-1226117999751

[102] Santos website, http://www.glng.com.au/Content.aspx?p=55
[103] Ibid
[104] APLNG website: http://www.aplng.com.au/
[105] Fugitive emissions: what is the real footprint of coal seam gas? http://theconversation.edu.au/fugitive-emissions-what-is-the-real-footprint-of-coal-seam-gas-2940

[106] Howarth, RJ 2010 Preliminary Assessment of the Greenhouse Gas Emissions from Natural Gas obtained by Hydraulic Fracturing

the particularities of emissions from shale gas production detailed in these studies are different to those of coal seam gas production, it indicates that the combustion emissions figures alone are not an accurate indicator, and highlights the imperative that an independent investigation into Australian CSG industry emissions should be undertaken as a matter of urgency.

Dependence of industry on CSG for non-energy needs (eg. chemical manufacture)

As the CSG industry is not yet developed in NSW there are not likely to be any other industries that are dependent on it for non-energy needs.

Installed and availability costs of CSG versus other stationary energy sources

Beyond Zero Emissions (BZE) has developed a comprehensive plan[107] that outlines how Australia can move to a zero emissions energy future over a ten year period with transition to one hundred per cent renewable energy sources that are "proven technologies that are already commercially available and that have already been demonstrated in large industries." The plan details how 24-hour base load energy supply can be provided from a "mix of wind turbines, concentrating solar thermal with storage, small-scale solar, and contingency capacity from biomass and existing hydroelectricity." We believe that governments should be moving rapidly to renewable energy technologies instead of locking in a dependence on fossil fuels for several more decades by encouraging the establishment of a whole new generation of gas infrastructure.

[107] Beyond Zero Emissions: Zero Carbon Australia Stationary Energy Plan http://beyondzeroemissions.org/

At a recent community sustainability forum held in Lismore, 250 Northern Rivers residents came together to look at ways communities and governments could move to a more sustainable way of living. The focus group discussing energy issues at this forum agreed that two of the main objectives for the region should be

1."To make the Lismore area self sufficient in renewable energy sources as quickly as possible;

2. To make the Lismore area carbon neutral [] by reducing green house gas contributions as quickly as possible, [] stopping coal seam gas development, and minimizing, and eventually ceasing our demand for fossil fuels."[108]

The Northern Rivers has one of the highest take up rates of roof top solar schemes and has been a leader in the development of renewable energy initiatives such as the Nimbin Community Solar Farm Project[109]. GAG Kyogle believes that the people of this region want to move straight to a renewable energy future, not go via a thirty year dependence on greenhouse gas emitting CSG production.

Proportion of NSW energy needs which should be base load or peaking supply and the extent to which CSG is needed for that purpose/ Contribution of CSG to energy security and as a transport fuel

Government and industry are fond of repeating the mantra that gas is the clean and green transition fuel that we must have to transition to a low carbon economy and reduce greenhouse gas emissions, and that we need CSG to ensure the energy security of New South Wales and Australia. However, as mentioned earlier, the reality is that the majority of the rapid expansion in CSG exploration and production across the eastern seaboard is geared towards export to overseas markets, not domestic supply.

[108] **Key Focus Area - ENERGY Notes**

[109] http://www.rpc.com.au/projects/solar_farm.html

For instance, in the Northern Rivers region, the company Metgasco has approval to construct a gas fired power station (Richmond Valley Power Station)[110], with the required 2.3PJ per year supplied by 40 CSG wells and/or 15 'conventional' gas wells (Casino Gas Project). Metgasco is also proposing to supply some 90PJ of gas from the Northern Rivers to an export facility at an as yet undisclosed location. Given the number of wells required to supply the domestic power station, in excess of 1500 wells would be required to supply 90PJ for export. So, that is 40-55 wells for domestic supply, and at least 1600 wells for export- and the company has the audacity to tell local residents that we need to develop this resource to secure the energy future of NSW!!

The interaction of the Act with other legislation and regulations, including the Land Acquisition (Just Terms Compensation) Act 1991

Coal seam gas exploration and mining companies would have us believe that they must comply with a wide range of legislation[111], however the Environmental Defender's Office NSW[112] has recently put out a discussion paper that highlights the deficiencies in current legislation and regulation governing CSG activities in NSW. The EDO paper states, "when it comes to mining and water use, the extraction of coal and gas has been prioritised, while the laws designed to regulate and protect the State's water quantity and quality have been overridden and are inadequate. Mining activities have long been privileged over other land uses and the protection of the environment." At the federal level, Greens Senator Larissa Waters[113] has commented, "The federal government has ticked off on three of the four major Queensland projects under its outdated national environmental laws, which don't

[110] Metgasco Ltd, RVPS and CGP environmental assessment
[111] http://www.agl.com.au/about/ASXandMedia/Pages/AGL-Hunter-Mike-Moraza-CSG-Industry-tightly-regulated-7March2011.pdf
[112] '*Discussion Paper on Mining Law in New South Wales'*
[113] http://larissa-waters.greensmps.org.au/content/media-release/greens-welcome-nsw-coal-seam-gas-inquiry

require the impacts on groundwater, food security or the climate to be considered."

One of the major failings in legislation governing CSG extraction is that it is based on 'make good' provisions and adaptive remediation instead of the 'precautionary principle' and ecologically sustainable development (ESD). The EDO report[114] suggests that the legislative regime should be changed in a number of ways to make the industry conform to ESD principles, including:

i) The purpose or objective of the legislation should clearly stipulate that social, cultural, economic matters etc. must be managed within sustainable boundaries

ii) Decision-makers under the legislation must exercise their powers and functions so as to achieve that purpose or objective.

iii) Legislation should bind discretion through specific criteria or benchmarks that the decision-maker must be satisfied have been met before granting approval.

It is clearly evident that the current legislative regime under which CSG extraction is carried out is not addressing the range of significant environmental and social issues posed by the industry. For instance, despite being a large user of water, CSG projects that have been approved under Part 3A of the *Environmental Planning and Assessment Act 1979* in NSW are exempt from State Water Acts- approvals under the *Water Act* or the *Water Management Act 2000* are not required. Under Section 75U of the *Environmental Planning and Assessment Act 1979*, water use approval under section 89, water management work approval under section 90 or activity approval under section 91 of the *Water Management Act 2000 (NSW)* ceased to apply. This has constrained the ability of the *Water Management Act 2000* to achieve its objectives in relation to mining.

[114] EDO NSW:' *Discussion Paper on Mining Law in New South Wales'*

The National Water Commission has issued a formal position statement on the Coal Seam Gas industry in Australia calling for industry, governments and planners to adopt a precautionary and more integrated approach to managing water-related impacts of coal seam gas developments. The Commission stated that if not adequately managed and regulated, the coal seam gas industry risks having significant, long-term and adverse impacts on adjacent surface and groundwater systems. The National Water Commissioner[115], Chloe Munro, has said that the Commission believed coal seam gas developers should operate under the same rules as other water users because "if not adequately managed and regulated, the industry risks significant, long-term and adverse impacts on surface and groundwater systems." **We call on the government to ensure that coal seam gas exploration and mining be made subject to all relevant environmental legislation, including the native vegetation and water management laws, and that the community should be given standing to ensure that it has full legal rights to challenge and enforce environmental laws under which coal seam gas companies are operating.**

It is clear that amendments also need to be made to both the *Mining Act 1992* and the *Petroleum (Onshore) Act 1991* to ensure better environmental standards, including:

i) Broader definition of environmental impact

ii) Recognition of the importance of previous environmental performance of the titleholder

iii) Improved mine rehabilitation practices

iv) Introduction of statutory requirements for environmental reporting

v) Clarification of definitional issues

In NSW where a decision under mining law is to be made on whether to approve an exploration application, there is merely a requirement to "take into account" the need

[115] see for instance in the Sydney Morning Herald 6th December 2010

to protect natural resources. Similarly, there is an open discretion as to whether environmental studies are done, conditions imposed or mining sites rehabilitated. For major mining projects, the planning legislation has also given Ministers wide discretion in recent years. Legislation should adopt a "maintain or improve" requirement so that projects do not go ahead unless they can scientifically demonstrate a neutral or positive environmental impact. This would be especially relevant in the case of coal seam gas extraction and waste disposal techniques. The polluter pays principle should be enshrined in any amended legislation.

In some instances where environmental approvals are required for projects to proceed, such as under the federal EPBC Act, it appears as though governments are beholden to industry, as highlighted by the following newspaper article[116]: "The Federal Government was forced to water down its environmental conditions on a $15 billion coal seam gas project for Queensland after the company threatened to walk away. Evidence of the threat came as the Government's own National Water Commission raised fears of long-term impacts from the multiple projects planned for the Surat Basin. A letter dated October 16th from Queensland Gas chief executive Catherine Tanna to Federal Environment Minister Tony Burke said the conditions placed on the company's plans were too severe."We have indicated to your officers that we have significant concerns with the proposed conditions relating to coal seam gas water management, offsets and the timing of various approvals," Ms Tanna said. "In their proposed form, these matters present sufficient difficulty to prevent my recommending the project to the BG Group board for a final investment decision." Two weeks after the letter, the BG board approved the project, on which the Federal Government had placed 300 environmental conditions.'

[116] The Courier Mail on 5th December 2010
http://www.gasland.com.au/2010/12/courier-mail-federal-cave-in-on-gas-restrictions/

Land Acquisition (Just Terms Compensation) Act 1991

Our understanding of access arrangements for CSG exploration and production is that they are governed by the Petroleum (Onshore) Act 1991 and the Pipelines Act 1967 (which confer the right to explore but not the automatic right of entry onto private property) and that the Land Acquisition (Just Terms Compensation) Act 1991 is not applicable as the land is not actually acquired for CSG activities. Under these Acts (Petroleum Onshore and Pipelines) an access agreement must be negotiated with the landholder. The process is commenced by the service of a notice of the company's intention to obtain an access agreement. A generic agreement may be offered by the company as a starting point and any reasonable initial legal advice needed by the landholder is payable by the company. Both the *Mining Act 1992* and the *Petroleum (Onshore) Act 1991* contain provisions that may be included in an agreement. If agreement cannot be reached in 28 days, a request may be made for an arbiter to be appointed. The "elephant in the room" is the fact that the landholder will ultimately be forced to enter into an agreement with the mining company by an arbiter- there is no right to opt out of the process and any fees paid to the farmer for gas wells are unlikely to adequately compensate for damage to land and water resources, disruption to on-farm activities, air and noise pollution and other impacts that are likely to accompany CSG developments

Regulations

As further encouragement, the coal seam gas industry has been allowed to become largely self-regulating and governments have generally become reliant on information supplied by the industry itself. Environmental regulation has been ineffective and the responsible agencies lack the resources to undertake many compliance and

enforcement responsibilities. The EDO[117] discussion paper raised a number of issues and provided a comprehensive set of responses relating to monitoring and enforcement of mining law. Licence approvals and licence conditions were seen to be inadequate, as too were levels of monitoring, and there was broad concern about a lack of enforcement action. There is a perceived lack of proportionality between the seriousness of the offence and the penalty. The improvements that were suggested included:

i) Monitoring, enforcement and compliance efforts must be properly resourced.

ii) There is also a need to ensure compliance well after mining operations have finished. Using environmental bonds as security is a good way of ensuring that the funds are available for environmental rehabilitation work.

iii) Initiate an independent performance audit of compliance and enforcement activities in relation to mining in NSW, including consideration of adequate resourcing. The audit should be conducted by the NSW Auditor-General and/or NSW Ombudsman, with the results made public.

iv) Increase ongoing monitoring and responsiveness to community reporting, to identify breaches of conditions of mining operations.

v) Establish a process to independently audit mining operators' performance against Environmental Assessment predictions, statements of commitment, Subsidence Management Plans and mine site rehabilitation.

vi) Adopt a tiered enforcement framework for mining and planning legislation, to ensure breaches of mining approvals and conditions result in punishment that deters misconduct. The framework should include categories of serious offences, mid-range (strict liability) offences and minor (absolute liability) offences.

vii) Planning laws should give prosecutors and courts a wider range of innovative enforcement tools as in other environment and pollution laws. These tools

[117] '*Discussion Paper on Mining Law in New South Wales'*

should include orders to pay investigation costs; undertake works for environmental benefit, including fund environmental organisations; complete audits, training and financial assurances; publicize offences or notify certain people; and remove any monetary benefit of the crime.

viii) Provide the Planning Minister with powers to suspend or revoke mining approvals for breaches of conditions. In addition, establish a process for landowners to apply to revoke their consent to land access if mining operations breach conditions.

ix) Increase resourcing for relevant compliance and enforcement divisions in order to improve rates of audits, investigations and prosecution.

x) Review the adequacy of noise impact guidelines.

xi) Introduce compulsory environmental bonds.

The impact similar industries have had in other jurisdictions

In jurisdictions where the industries are more advanced, mining for coal bed methane and other unconventional gas has had significant and adverse impacts on health, water quality, groundwater levels, air quality, geological stability, public safety, farmland, bushland, wildlife, livestock, rural community life and citizens' trust in their respective governments. Given that past performance is often the best predictor of future performance, the state of play in areas where the industries are more mature is an indication of where NSW is headed unless significant changes to legislative and regulatory regimes are introduced as a matter of urgency.

It is impossible for anyone to document the full extent of the impacts of CSG mining, or of unconventional gas mining in general. The main difficulties are twofold: first, the mining industry is not transparent about its activities; and second, eyewitness reports suggest that affected individuals are often too frightened of repercussions to come forward with their experiences. Having said that, it *is* possible to document *some* of

the adverse impacts using independent reports, video footage, independent laboratory test results, government and mining company documents, and eyewitness accounts from those brave enough to go public. It is important to note, however, that the following set of impacts is not exhaustive.

Impacts of CSG mining in Queensland, Australia

Water pollution

CSG mining in Queensland has already resulted in a number of incidences of water contamination. Some examples are:

- The National Toxics Network reported[118] in June this year that permits are provided for the release of wastewater produced in association with the fracking process. As an example, they cited a permit[119] for Australia Pacific LNG Pty Ltd, which allowed the release of 20 megalitres (ML) per day of treated water, for 18 months, into the Condamine River (which is part of the Murray-Darling Basin[120]). Toxins listed in the permit included radionuclides as well as persistent bioaccumulative toxic substances, for example nonylphenols, Bisphenol A (BPA), chlorobenzenes, bromides, heavy metals such as lead, cadmium, chromium and mercury, and BTEX. There was no requirement for an assessment of the cumulative load or the potential to contaminate sediment, plants, aquatic species and/or animals prior to release. Although release limits were included for the listed compounds, the majority of these were not based on the ANZECC water guidelines[121] as

[118] http://ntn.org.au/wp-content/uploads/2011/07/NTN-CSG-Report-July-2011.pdf
[119] Schedule C, Australian Pacific LNG Pty Ltd Environmental Authority (petroleum activities) No. PEN100067807
[120] http://en.wikipedia.org/wiki/Condamine_River
121 http://www.mincos.gov.au/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_ quality

many of the chemicals were not listed in the guidelines or were marked as having insufficient data to set a water quality guideline.

- Energy company AGL was forced to investigate after NSW Greens MP Jeremy Buckingham filmed a 'soapy residue' erupting from a gas well near Glen Alpine. [122]
- When QGC fracked their Myrtle 3 well, near Dalby, in 2009, it connected the Springbok aquifer to the coal seam below, the Walloon Coal Measures. QGC reportedly used 130 litres of THPS, a biocide, in the fracking process[123], allowing the possibility of contaminating the Springbok aquifer.
- The ABC reported last month[124] that BTEX chemicals were found in a monitoring bore at Arrow Energy's fields near Dalby in southern Queensland. Arrow Energy's press release[125] confirms that the company detected traces of benzene, toluene and xylene in five of 14 shallow bores at Arrow's Tipton West and Daandine gas fields, approx 25 kilometres from Dalby. The samples were taken over three days from 14 purpose installed monitoring bores constructed around CSG dams.
- Eyewitnesses report that during the Queensland floods of early 2011, ponds associated with gas mining in the Surat basin gas fields were covered by floodwater. While no testing of downstream water quality was possible, it is reasonable to assume that pond contents were released into the general floodwaters. The blog comment below[126] is an example of these reports:

"… in the Surat basin gas fields I have photos of evaporation ponds going under floodwater & of course concentrated salts flushed out….another photo of a drill rig & camp going under in a flood in these parts earlier in the month. The landowner asked

[122] http://macarthur-chronicle-campbelltown.whereilive.com.au/news/story/agl-study-shows-gas-well-leak-to-be-harmless/
[123] http://www.abc.net.au/news/2011-02-21/farmers-count-cost-of-coal-seam-gas-rush/1951670
[124] http://www.abc.net.au/news/2011-08-30/more-tests-at-csg-site-after-carcinogens-find/2861614
[125] http://www.arrowenergy.com.au/icms_docs/102322_Arrow_Energy_advises_of_monitoring_results.pdf
[126] http://larvatusprodeo.net/2011/01/01/queensland-floods/#comment-254722

them not to drill there- showed them the debri from previous floods against the trees. Of course these CSG companies know more than any local landowner."

Health issues

CSG mining in Queensland has been linked to a number of health issues. Members of Kyogle GAG attended a recent landholders' meeting in Lynch's Creek, NSW, where the speakers included a mother from the Queensland gas fields whose children had developed asthma, as well as a variety of other symptoms, since drilling began in their area. This is a quote from a Tara resident, distributed by GetUp:

> "When my son first started developing the headaches, we thought he had a tumour. We were just so scared. He had CT scans and everything and it was all clear. Then we started looking into impacts of coal seam gas development as they had just started drilling in our area and - the headaches, the nosebleeds, skin rashes that some people in the area have - it's all consistent with what other people are experiencing. We know a local lady who lives within 200 metres of a gas well. She and her son both became quite ill - they were even passing out. Her young son's the same age as my boy and he was bleeding from the nose as well as the ears. This got us thinking as well as researching the impacts, because it was at the same time as coal seam gas came to our town, Tara. It's just scary. A lot of people won't come forward because they're worried about repercussions from the people working in the industry, so they won't speak out." Debbi, Tara.

These illnesses have arisen since gas mining began in the area. While there is no proof that mining activities caused the illnesses, there is a clear mechanism by which CSG mining could cause these kinds of health problems, and the timing is consistent with a connection between them. The mechanism is this- residents of gas fields inhale air containing airborne toxins produced by nearby gas mining activities. They also drink local water, which may contain water-borne toxins, also produced by gas mining activities. It's not always possible to know what's in the water or the air, because laboratory tests are expensive and often no one knows what to test for. But where tests are done, gas mining activities have often been shown to release air and

water-borne toxins into the environment. Some of these toxins are detailed in the preceding sections. See also the section below on gas mining impacts overseas.

Gas leaks and Dalby blowout

A Qld government investigation[127] of 58 gas wells in the Tara area found 45% were leaking in some capacity. "Four (7%) of the gas wells were leaking at a rate at or above ten percent of the lower explosive limit (LEL) of methane... One (2%) of the gas wells tested was found to be leaking above the LEL (lower explosive limit) of methane."

On May 22, 2011, there was a gas blowout at Arrow Energy's Daandine field 25 kilometres west of Dalby. The incident occurred at about 9 a.m. but was not reported to Tom O'Conner, the landowner, until 2 p.m. The gas and water reached 100 metres into the air and the following day was still at 40 metres. It was the fourth incident on the O'Conner property.[128]

Erosion of natural values in construction areas

Gas mining activities in Qld have already resulted in widespread, extensive, clearing of vegetation to construct roads, well pads, storage ponds and other infrastructure. As a specific example, the construction of liquefication plants and port facilities has seriously affected the natural environment near Gladstone. The area is part of the

[127] Qld Dept of Employment, Economic Development and Innovation (2010) Investigation report: Leakage testing of coal seam gas wells in the Tara rural residential estates' vicinity.
[128] http://lockthegate.org.au/media/display/3430

Great Barrier Reef World Heritage Area and a significant amount of mangrove vegetation on the island is being cleared to make way for three LNG processing plants. Dredging in the harbour, and the noise of construction work, affects the local dugong sanctuary as well as a pod of threatened Indo-Pacific dolphins that used to be regular visitors[129].

Disruption of communities and the lives of individuals

Kyogle GAG has heard the personal stories of a multitude of affected residents of gas fields. The stories are too numerous to list, but themes include:

- increasing distrust in within communities
- fear of violence from fly-in, fly-out workers with no social connections to the community, and who don't even shop at the local businesses
- long-time landholders (and more recent) selling up and leaving the area
- disrupted sleep because of noise from compressor stations
- disrupted lives as normal activities are put on hold in order to deal with mining activities
- people who can no longer stay for long periods on their property because they get headaches or feel sick there

In his evidence to the Senate inquiry into the management of the Murray-Darling Basin[130], Stephen Doyle, the chairman of the St Vincent de Paul Queensland Social Justice Committee, commented on his organisation's experience of the impact of gas mining activities. "We are also concerned about the disruption of the social fabric of local communities caused by the influx of large numbers of transitory workers—and there has been publicity lately about fly-in fly-out workers, predominantly male, not families, coming into these communities. It certainly does affect the social fabric of

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[129] http://lockthegate.org.au/media/display/4449

[130] Commonwealth of Australia, Senate Rural Affairs and Transport References Committee (2011). Inquiry into the Management of the Murray-Darling Basin. Brisbane, 20th July. Transcript, p48

those communities, and people are right to be concerned about it. There is pressure on health and education services." He later adds, "There should be equitable compensation to landholders on a community-wide basis. It appears that a lot of the [access] agreements are being negotiated individually and this is causing a great deal of concern and suspicion among landholders as to 'what sort of deal the bloke down the road got as compared to what I am getting'. It leaves them pretty unsatisfied about the justice and transparency of the whole issue."

In the same session, a mining company representative claimed to "engage with the community", in order to minimise disruption from mining activities. The Chair, Senator Bill Heffernan, replied[131], "Then why did we visit a place the other day where a person has gone to the trouble of building a new house and has been informed that 200 yards down the paddock there is going to be a well? Why did I strike a bloke yesterday in Dalby who has pleaded with the gas company that he can feel his walls vibrating from a huge compressor station that is somewhere within his property—it must be, because the walls are vibrating—and he has been told, 'We have tested it and it is okay, mate. You should have built your house out of solid concrete or something,'-is that a fair thing?

Erosion of citizens' trust in government

Accounts from residents of the Queensland gas fields make it quite clear that the locals have lost faith in the ability, or willingness, of the government (of any political persuasion) to protect their interests in the face of the mining industry. Many describe spending precious (unpaid) days writing submissions, gathering signatures for petitions, writing and telephoning their local representatives, only to find that it was to no avail. Many residents have taken to non-violent direct action, for example at the

[131] Commonwealth of Australia, Senate Rural Affairs and Transport References Committee (2011). Inquiry into the Management of the Murray-Darling Basin. Brisbane, 20th July. Transcript, p41

Tara Blockade[132]. As Queensland residents communicate their experiences to those in proposed gas fields in NSW, this attitude is spreading south. Kyogle GAG is aware of a large number of normally apolitical people, including grandmothers, mums, local businesspeople and farmers who are attending non-violent direct action workshops, in preparation to defend their homes and farms from gas field development. Where previously they might have relied on the government for this protection, they now believe they have no choice but to do it for themselves.

Other impacts

Some other impacts already felt in Queensland include: lowering of bore water levels; reduction in the area of productive farmland available for food production; and loss of wildlife and biodiversity due to clearing of vegetation.

The impact of unconventional gas mining overseas

Because the unconventional gas mining industry overseas is more advanced than in Queensland, there is substantially more documentation of the impacts. Kyogle GAG is a volunteer organisation, and members have had to take time out from their usual full-time commitments to prepare this submission. Given these constraints, it is impossible to cover more than a fraction of the documented impacts of unconventional gas mining overseas. Instead, this submission provides an overview, by giving a selection of examples, with a focus on the US.

Much of the unconventional gas mined in the US is in shale formations (for example the Marcellus Shale), but it is also mined from coal beds and sandstone (as in Wyoming and Colorado)[133]. The impacts from different forms of non-conventional gas extraction are very similar. In September 2010, “Riverkeeper”, a New York-based

[132] http://www.kateausburn.com/2011/05/14/tara-the-frontline-of-a-coal-seam-gas-war/
[133] Michaels, C., Simpson, J., Wegner, W. (2010) Fractured Communities: Case Studies of the Environmental Impacts of Industrial Gas Drilling. Riverkeeper, NY.

clean water advocacy group, released a report[134] (attached) entitled "Fractured Communities: case studies of the environmental impacts of industrial gas drilling". In it, they document hundreds of case studies involving known and documented adverse impacts of gas mining, including well blowouts, explosions, drinking water contamination, illegal discharges, surface water spills, improper wastewater treatment, stray gas migration, illegal operations, permit violations and so on. There is not room here to mention them all. Below are a few summarised examples. With references supplied in the attached document.

Well blowouts, stray gas migration, and explosions

- An incidence of gas migration caused a house to explode in March 2004 in Jefferson County, resulting in three fatalities.
- On April 1, 2010 both a tank and open pit used to store hydraulic fracturing fluid caught fire at an Atlas well pad. Flames were at least 100 feet high and 50 feet wide, with the plume of black smoke visible for miles. Residents had been complaining of noxious odours at the site for days before the fire.
- In October 2007, pressurization of the surface casing in a newly drilled gas well caused an explosion inside a residence and impacted a private water well.
- On June 3, 2010 gas well blowout in Clearfield County, Pennsylvania, about 100 miles outside Pittsburgh, sent at least 35,000 gallons of wastewater and natural gas spewing into the air for 16 hours.
- In June 2010, an explosion at a gas well in West Virginia sent seven injured workers to the hospital.

[134] Ibid.

- On December 15, 2007, high-volume hydraulic fracturing operations conducted by Ohio Valley Energy Systems Corp. caused an explosion inside a home in Bainbridge, Ohio. The structure was damaged significantly.
- In July 2009, a resident was evacuated because of a gas leak from an East Resources well.
- In November and December 2007, residents of Walnut Creek in Millcreek, PA were evacuated from their homes for over two months because recently drilled gas wells in the area caused a gas migration. Natural gas levels in and around homes were found to be at explosive levels.

Water contamination

- In August 2010, Pennsylvania Dept of Environmental Protection (PA DEP) found that Talisman Energy was responsible for a November 2009 spill that sent over 4,200 gallons of hydraulic fracturing flow back fluid into a wetland and a tributary of Webier Creek, which drains into the Tioga River, a coldwater fishery.
- In August 2010, PA DEP found Atlas Resources responsible for allowing hydraulic fracturing fluids to overflow from a wastewater pit and to contaminate a high-quality watershed in Washington County.
- At a drilling pad with three gas wells in Troy, PA, Fortuna Energy illegally discharged flowback fluids into a drainage ditch and through a vegetated area, eventually reaching a tributary of Sugar Creek.
- In June 2010, the West Virginia DEP released a report concluding that in August 2009 Tapo Energy discharged an unknown quantity of a “petroleum-based material” associated with its drilling activities into a tributary of Buckeye Creek in Doddridge County. The spill contaminated a three-mile-long segment of the creek before it was contained.

- Following nearby hydraulic fracturing operations in 2009, the Railroad Commission of Texas and the Town of Dish tested a resident's tap water and detected elevated levels of arsenic, lead, chromium, butanone, acetone, carbon disulfide, and strontium up to 21 times above allowable concentrations.
- In early 2009, the PA DEP found 9 drinking water wells in the Dimock area contained methane, four at levels indicating a threat of explosion. Isotopic analysis showed the gas originated from a nearby geological formation which also happened to be a high-volume hydraulic fracturing site operated by Cabot Oil and Gas Corporation. The PA DEP ruled out the possibility that the gas was produced by bacteria or originated from a shallower gas-bearing formation. Later, The PA DEP also found elevated levels of methane gas in wells that provide drinking water to 13 area homes and identified combustible gas in the headspaces of seven of the wells.
- In September 2009, additional incidents in Dimock were linked to Cabot when three liquid gel spills occurred at the company's Heitsman natural gas well pad. The spills, totalling over 8400 gallons, polluted a wetland and caused a fish kill in Stevens Creek.
- In August 2010, Chesapeake Energy was found to have contaminated three drinking water wells in Bradford County with methane, with a lid exploding off of one of the wells.
- In April 2009, drilling activities conducted by Schreiner Oil & Gas impacted at least seven drinking water supplies along Hedgehog Lane in Foster, PA. Two of the affected water supplies contained methane and five had iron and manganese above established drinking water standards. After investigating, the PA DEP found that "the stray gas occurrence is a result of 26 recently drilled wells, four of which had excessive pressure at the surface casing seat and others that had no cement returns."

And so on. Each example, in isolation, constitutes a significant environmental impact. Cumulatively, the impacts are considerable. However, impacts aren't limited to explosion hazards and water pollution.

Air pollution

Air quality studies are expensive. It's not possible to test air quality wherever gas extraction takes place. However, the studies that do exist raise alarm bells.

- The town of Dish, Texas, where significant gas mining activities occur, was so concerned about their air quality that in 2009 they spent 15% of their annual budget to commission an independent report[135]. They found high concentrations of carcinogenic and neurotoxic compounds in ambient air near, and on, residential properties[136]. The compounds included benzene, xylene, carbon disulfide, naphthalene, dimethyl disulphide, methyl ethyl disulphide, and pyridine metabolites. Many of the compounds were found in levels that exceeded either short- or long- term Effects Screening Levels established by the Texas Commission on Environmental Quality (TCEQ).
- A Southern Methodist University report[137] found that the pollutant emissions from gas drilling activities in the Barnett Shale surpassed those produced by all of the vehicle traffic in the Dallas-Fort Worth region.
- A July 2011 report[138] (attached) found air samples collected from around natural gas operations in the San Juan Basin area of Colorado and New Mexico, as well as Garfield County in western Colorado, contained at least 22

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[135] State Tests Air Around Drilling And Pipeline Sites, KERA, Oct. 14, 2009, http://www.publicbroad-casting.net/kera/news.newsmain/article/0/1/1566121/North.Texas/State.Tests..Air.Around.Drilling.And . Pipeline.Sites.

[136] Wolf Eagle Environmental, DISH Air Study Results, Sept. 15, 2009 at 9, available at, http://www. townofdish.com/objects/DISH_Air_Study.pdf.

[137] Al Armendariz, Emissions from Natural Gas Production in Barnett Shale Area and Opportunities for Cost-Effective Improvements, Jan. 26, 2009, http://www.edf.org/documents/9235_Barnett_Shale_Report. pdf.

[138] Gassed! Citizen Investigation of Toxic Air Pollution from Natural Gas Development July 2011, Global Community Monitor, www.gcmonitor.org

contaminants. These include 4 carcinogens (benzene, acrylonitrile, methylene chloride and ethylbenzene) as well as neurotoxins and respiratory irritants. Levels between 3 and 3000 times higher than those considered safe were found near homes, playgrounds, schools and community centers[139].

Livestock and wildlife

In 2010, the Louisiana Department of Environmental Quality (LA DEQ) found that a "milky white substance", containing high levels of potassium chloride, flowed from a natural gas well operated by Chesapeake Energy and Schlumberger Technology, and into an area accessible by cows, 17 of which died[140]. People who witnessed the deaths reported that the cows appeared to be suffering a slow, painful death, with many bellowing loudly, bleeding and foaming at the mouth.

Earth tremors

The process of hydraulic fracturing for unconventional gas extraction has been implicated in the production of earthquakes and tremors. For example, industrial gas drilling activity in the Barnett Shale has been linked to a series of minor earthquakes in the Fort Worth region[141]. The Dallas- Fort Worth area has experienced at least 18 earthquakes since early 2008. In the town of Cleburne, less than thirty miles from Fort Worth, at least seven earthquakes were documented in Cleburne alone between June and July 2009. While no formal proof has been established, it is significant to note that the town of Cleburne had not registered an earthquake in its 142-year history prior to the June quakes[142].

In Blackpool, in the UK, two earthquakes shook the area surrounding where Cuadrilla Resources was fracking. Brian Baptie of the British Geological Survey (BGS), said

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[139] http://www.gcmonitor.org/article.php?id=1339

[140] KLSA, We may now know what killed cows in Caddo Parish (May 2009), available at: http://www.ksla.com/Global/story.asp?S=10325772.

[141] Is Drilling to Blame for Texas Quakes?, NPR, June 30, 2009, http://www.npr.org/templates/transcript/ transcript.php?storyId=106059425.

[142] Temblors Rattle Texas Town, Wall Street Journal, June 12, 2009, http://online.wsj.com/article/ SB124476331270108225.html.

"The timing of these two events in conjunction with the ongoing fracking at the site suggests that they may be related." He added: "It is well-established that drilling like this can trigger small earthquakes."[143]

A culture of deceit

These impacts, both in Australia and overseas, have been perpetuated and exacerbated by what appears to be a culture of "whatever we can get way with" within the mining industry, including misrepresenting the facts and ignoring applicable legislation.

Industry marketing

Politicians and decision-makers who are informed only by industry lobbyists receive a sanitised version of mining activities[144]. By the time they become aware of the problems that the industry has glossed over, it is too late to prevent significant impact, for example to people, water supplies, air quality and animal life.

It is important to learn from the misfortunes of others, and not to fall into the same trap. Mining industry claims must be treated with a degree of caution. For example, a frequent claim by industry representatives is that "there is no evidence of adverse impacts" and that "fracking is safe"[145]. This is simply not true, as the case studies above show.

Already in NSW, we have seen misleading advertising[146], misinformation[147], and the famous "We have no plans to..." (WHNPT) phrase.[148] (Eyewitness accounts by

[143] http://www.independent.co.uk/news/science/small-earthquake-in-blackpool-major-shock-for-uks-energy-policy-2291597.html

[144] http://newmatilda.com/2009/03/24/has-carbon-lobby-captured-kevin-rudd

[145] For example, Peter Henderson, CEO of Metgasco, in his address to the Casino community, August 2011, stated," Fracking is a safe practice" and in response to a question about environmental impacts, replied "I don't think it's been established that this environmental harm has been done".

[146] www.unitedearth.com.au/thecreekblog/coal-seam-gas-lies-2

[147] www.unitedearth.com.au/thecreekblog/coal-seam-gas-lies

[148] See for example, Dart Energy's Jason Needham's quote: "We've got no plans to frack…" http://www.greenleft.org.au/node/47914

farmers from the gasfields in Queensland report that mining industry representatives, when negotiating access agreements, often say "We have no plans to...drill/construct more roads/build more infrastructure/etc". While often that may be technically true - as in, they may actually have no plans at that time - it is often misleading, as many farmers come away with the impression that they plan *not* to. And it isn't always technically correct, either. Farmers have sighted maps dating from *before* they were told WHNPT, that show plans for more wells, another roads, more infrastructure.) The mining industry has placed advertisements on TV and in newspapers, claiming "clean, green" credentials. The mining industry is also financing movies that show mining in a favourable, non-threatening light (for example, Rio Tinto and Woodside invested in the recent movie, "Red Dog"[149]). It appears that more marketing may be coming our way soon[150].

It is important not to be swayed by glossy advertising, or misleading phrasing, and instead to look at the clear evidence of the impacts gas mining has had in other jurisdictions, because these are the likely impacts in NSW.

Disrespect for applicable legislation

Another aspect of the "whatever we can get away with" culture is a disrespect for applicable legislation. Again, it is important to learn from the mistakes made in other areas, so as to avoid them here in NSW. Experience from other jurisdictions is that legislation, on its own, is insufficient to regulate the activities of gas mining companies. Effective enforcement is also required. The examples below point to an industry with a culture of simply flouting the law, and if found out, simply paying the fine. Fines which are only a fraction of normal operating costs (such as those set out

[149] http://www.encoremagazine.com.au/mining-companies-support-red-dog-feature-1582
[150] http://www.smh.com.au/environment/conservation/ad-campaign-aims-to-put-industry-view-on-fracking-20110904-1jsdr.html

in the Water and Other Legislation Amendment Act 2010 (Qld)[151]) are not effective deterrents.

For example, on December 12, 2006, PA DEP found that Synd Enterprises, Inc. and Vertical Resources had "continued and numerous violations" of Pennsylvania law and had shown a lack of ability or intention to comply with the provisions of the commonwealth's environmental laws. Among the violations cited were: over-pressured wells that cause gas migration and contaminate groundwater; failure to implement erosion and sedimentation controls at well sites which has caused accelerated erosion; unpermitted discharges of brine onto the ground; and encroachments into flood ways and streams without permits[152]. Novus Operating LLC began drilling wells without Susquehanna River Basin Commission (SRBC) approval, despite SRBC's notification of the need for prior approval[153].

On July 10, 2009, PA DEP issued a cease and desist order against U.S. Energy Development Inc. "for persistent and repeated violations of environmental laws and regulations": 302 violations since August 2007, 197 of which remained unresolved as at September 2010. The violations included: failure to implement measures to prevent accelerated erosion, unpermitted discharges, failure to restore well sites, encroachments into streams and wetlands without obtaining required permits, and failure to plug abandoned wells[154].

In November 2009, the PA DEP took action against Cabot Oil and Gas Corporation for: excessive pressure/improper or insufficient cementing (casings) on certain wells;

[151] http://www.austlii.edu.au/au/legis/qld/num_act/waolaa2010n53379/
[152] PA DEP, DEP Seeks $657,040 Civil Penalty Against New York Company For Environmental Damage in Allegheny National Forest (January 11, 2007), available at: http://www.portal.state.pa.us/portal/server. pt/community/newsroom/14287?id=1114&typeid=1.
[153] SRBC, SRBC Orders Natural Gas Driller to Stop All Water-Related Work at Drilling Site in Tioga, County, PA (January 13, 2010), available at: http://www.srbc.net/pubinfo/press/docs/Project%20Re-viewNaturalGasNovusCeaseOrder11310.pdf
[154] PA DEP, DEP Orders U.S. Energy to Cease Drilling Operations Throughout Pennsylvania (July 10, 2009), available at: http://www.portal.state.pa.us/portal/server.pt/community/newsroom/14287?id=2273& typeid=1.

pollution of private water supplies within Dimock and Springville Townships in Susquehanna County; discharge of natural gas into ground water; discharge of industrial waste and/or residual waste onto the ground and/or into state waters, as well as failure to keep adequate records[155].

Colorado Oil and Gas Conservation Commission's (COGCC) states that during 2008 and 2009, it issued fines to 17 gas operators for violations impacting public health, safety, welfare and water resources. COGCC also reported that approximately 726 spills or releases of exploration and production (E&P) waste were reported to the agency during those years[156].

In Queensland, in November 2009, Carbon Energy Ltd failed to report a discharge of contaminated water from their plant to a nearby creek[157]. The ABC's Four Corners[158] revealed that materials safety data sheet (MSDS) submitted by QGC for the fracking chemical THPS (Tetrakis hydoxymethyl phosphonium sulfate) was American, incomplete and 10 years out of date. Importantly, it failed to correctly describe the toxic nature of the chemical. Arrow Energy was recently fined $40,000 after breaching Queensland's gas laws and drilling on a property near Dalby for two years without permission from the landowner[159].

In summarising their report, the authors of Fractured Communities[160] state:
"At a time when the oil & gas industry should be on its best behaviour, the industry continues to operate with impunity and lobby against federal regulatory oversight.

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[155] PA DEP Cabot Oil and Gas Consent Order and Agreement (November 4, 2009), available at: http:// s3.amazonaws.com/propublica/assets/natural_gas/final_cabot_co-a.pdf.
[156] Colorado Oil & Gas Conservation Commission, Department Of Natural Resources, Annual Report To The Water Quality Control Commission Of The Colorado Department Of Public Health And Environment, 3 (2008, 2009).
[157] http://www.derm.qld.gov.au/media-room/2010/07/kingaroy-plant-closed.html
[158] ABC TV Four Corners, program 'The gas rush', aired 21 February 2011. http://www.abc.net.au/4corners/content/2011/s3141787.htm
[159] http://www.miningaustralia.com.au/news/arrow-energy-fined-40-000
[160] Michaels, C., Simpson, J., Wegner, W. (2010) Fractured Communities: Case Studies of the Environmental Impacts of Industrial Gas Drilling. Riverkeeper, NY.

Even as the impact of the Gulf disaster continues to shine a light on the true costs of deregulation, the industry continues to cut corners at the expense of workers and communities across America."

Conclusion

This collection of examples from more mature mining industries clearly demonstrates the serious potential impacts of CSG mining in NSW. It is crucial for NSW to avoid the serious environmental and social consequences that have been experienced in the gas fields of Queensland and overseas.