



A review of NSW Coal Seam Gas Regulation and International Best Practice

LEGAL BRIEFING PAPER

prepared by

**EDO NSW
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Prepared for **Our Land Our Water Our Future**

Foreword

Coal seam gas mining represents a risk to water resources, food production and community health and well-being. It is an unsafe and invasive industry that expands rapidly across vast areas.

Currently, petroleum licences and applications encompass 48.5 million hectares of land in NSW - equivalent to approximately 60% of the entire state. Although current CSG production is very limited in NSW, it is an industry that scales up rapidly - more than 20,000 CSG wells have been approved in Qld in just four years.

Communities across NSW have expressed their opposition to CSG mining. From the Gloucester Valley to the Northern Rivers, from the Riverina to Narrabri, from Newcastle to greater Western Sydney, communities have made it clear that they do not accept the risks that come with CSG.

Experience from CSG mining in Qld shows that the economic benefits from CSG accrue largely to overseas shareholders, and that the costs fall disproportionately on local communities.

It is local communities who are now paying exorbitant prices for domestic gas supplies, caused by the CSG export industry linking Australia to the Asian market and triggering world-parity pricing.

Recently, the NSW Chief Scientist released a report into CSG mining in NSW. That report recognised substantial risks associated with CSG mining and recommended that it should only be allowed to proceed in NSW if a 'world class' regulatory regime was put in place to manage those risks.

In its response, the NSW Government also committed to a 'world class' regime, although the 'NSW Gas Plan' that it released appeared to fall well short of even the Chief Scientist recommendations.

So, what would a 'world class' regulatory regime look like? This briefing paper provides a glance at exactly what is happening with regulation of unconventional gas mining in other jurisdictions around the globe.

It is not designed to be comprehensive, but aims to identify some of the best standards in use anywhere in the world. It is clear from this paper that the NSW Gas Plan, and the proposed new regulatory regime proposed by the NSW Government, is nothing like 'world class' in its current form. Major improvements will be needed to deliver a genuine 'world class' outcome.

Some examples of specific world class practices elsewhere in the world include:

- *A ban on hydraulic fracturing in France and partial ban in Germany (banned at depths <3,000m).*
- *The designation of 'no-go' zones for gas drilling in Alberta and Germany.*
- *A ban on flaring from hydraulically fractured gas wells in the US (commences January 2015).*
- *The increasing adoption of Health Impact Assessments in a number of countries.*
- *Placing the onus of proof on the gas driller to show they did not cause harm in Germany.*
- *Full disclosure of the chemical composition of both fracking fluids and flow-back fluids in the UK.*

Delivering the 'world class' regime the Chief Scientist has demanded, and the people of New South Wales deserve, will require the Government to implement leading practices from the around the globe, as outlined in this paper, prior to coal seam gas mining being undertaken in NSW.

It will also require the NSW Government to firmly entrench the principles of Ecologically Sustainable Development within petroleum law.

Our Land Our Water Our Future, November 2014

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On 30 September 2014, the NSW Chief Scientist & Engineer released her *Final Report of the Independent Review of Coal Seam Gas Activities in NSW (Chief Scientist's Report)*.¹ The Report urges the NSW Government to commit to a world-class regulatory framework for coal seam gas (CSG) and other extractive industries. It found that CSG regulation is in need of comprehensive reform to improve clarity and consistency; to protect water resources, public health and the environment; and ensure the highest standards of compliance. The NSW Government has long suggested that CSG activities in NSW should conform to world's best practice and, as a demonstration of progress towards this, the Chief Scientist's 16 high-level recommendations have been positively received by a range of stakeholders. The NSW Gas Plan indicates the NSW Government's intention to establish a 'world class' regime for management and the leading practices identified in this paper should be considered as part of that process.

Based on our comparative legal analysis and a preliminary review of the Chief Scientist's findings, we have identified eight areas where NSW laws need to be improved if NSW is to truly have leading practice in CSG development and implementation:

1. **Ecologically sustainable development**
2. **Community engagement and landholder rights**
3. **Protecting sensitive environments**
4. **Monitoring data and access to information**
5. **Hydraulic fracturing (fracking)**
6. **Well integrity and decommissioning**
7. **Air quality and health**
8. **Environmental bonds and levies**

To identify examples of leading practice, EDO NSW completed a desktop analysis of CSG law in different jurisdictions (including areas where CSG is known as coal bed methane (CBM)), and of shale gas law (another unconventional gas) where appropriate. We then undertook a gap analysis of NSW CSG laws as they relate to implementation of leading practice. Better practices do exist and are currently being implemented in other jurisdictions. Adapting a number of these practices and incorporating them into NSW laws, subject to local needs and conditions, is an essential first step for comprehensive reform. We note there remain some important areas for reform outside the scope of this review, including inter-agency governance, clear compliance and enforcement responsibilities, and robust regulatory oversight.

The NSW Government should implement leading practice measures in these eight key areas now, and put in place a plan to comprehensively reform extractive industries legislation so that it does actually enshrine and implement 'world class' leading practice standards, consistent with ecologically sustainable development.

1. Ecologically sustainable development

The Chief Scientist's compliance report noted six high-level principles for regulatory best practice. In brief: *Certainty, Openness, Transparency, Flexibility* (risk and outcome-based), *Practicality* and *Efficiency*.²

EDO NSW broadly supports these principles. In addition, as environmental, health and safety impacts are at the heart of community concern around CSG, these principles must be overlaid with a commitment to ecologically sustainable development (ESD) and its underlying principles.³ ESD aims to integrate environmental, social and economic factors in decision-making, and to protect natural resources and ecosystems so that both present and future generations can benefit from them.

ESD principles are already enshrined in NSW pollution, planning, environment protection and water laws. However, the absence of guiding objects or references to ESD in the *Petroleum (Onshore) Act 1991* (NSW) (**PO Act**) means that decision makers considering CSG licensing are not required to make decisions on the basis of ESD principles or triple bottom line outcomes.⁴

Including ESD as a legal objective would be a first step. To be considered world class, NSW legislation should include more objective or criteria-based tests for environmental outcomes when making decisions (such as whether to allocate CSG licences, and on what conditions);⁵ cumulative impacts must be considered in licence allocation, strategic planning and project assessment;⁶ and strategic decisions must be made on a whole-of-catchment or aquifer scale. Governments must reverse the tendency to interpret ESD in a way that prioritises short-term economic outcomes and benefits. To be sustainable, decision-making processes must integrate longer-term economic, environmental and social benefits, costs and risks. CSG laws must also integrate with (not override) environmental laws.

The alternative to legislating and implementing ESD is a continued and inexorable decline in environmental conditions for present and future generations; and a heightened risk of serious or irreversible environmental impacts, with lasting consequences for our society and economy.⁷

Leading practice measures

- NSW water laws, Queensland planning laws, and UK water laws variously require that authorities 'apply the principles of ESD'; that functions and powers be exercised 'consistently with ESD principles, or in the UK, 'to contribute to achievement of [ecologically] sustainable development'.⁸ These examples are more stringent than Queensland and Victorian laws that, whilst enshrining ESD, require regulation and management of CSG and other petroleum activities, and development of these industries, in a way that 'has regard' to the need for ecologically sustainable development and its principles.⁹

2. Community engagement and landholder rights

Significant community concerns exist regarding notification, clear information, and local engagement in CSG decision making processes. This includes initial licensing decisions, equity in negotiation of access arrangements, upfront consideration of environmental and social impacts, landholder and community appeal rights, and landholder access to compensation if CSG activities cause damage.

In NSW, all CSG activities, including exploration and production stages, require a petroleum title under the *Petroleum (Onshore) Act 1991* (**PO Act**). Notification obligations and rights vary with the type of petroleum title and proposed activity (CSG exploration or production). For example, timeframes for notice vary from 21-45 days *after* an application is made. Some notification and consultation requirements are set down in law. Others are found in departmental procedures and guidelines. There is no community or landholder 'merit appeal' right against the issue of a licence.¹⁰ Once a petroleum licence is granted, many CSG activities also require development consent under the *Environmental Planning and Assessment Act 1979* (**Planning Act**). The Planning Act requires development consent for some CSG projects, including 30 days' exhibition. However, some smaller

CSG proposals do not require public exhibition. Merit appeal rights may exist for some decisions on larger projects.

The Chief Scientist's compliance report notes problems with the way that petroleum licences are issued. The current approach generates an expectation that if resources are found during exploration, a production lease will be issued, 'it is very difficult to restrict the production phase'.¹¹ This approach is problematic given the limited local involvement, appeal rights and environmental impact considerations in licensing decisions. For example, comments on exploration licences are explicitly limited to exploration issues. Concerns about subsequent project implementation are directed to the development consent stage.¹²

If a CSG project needs 'development consent' under the Planning Act (some exploration and all production), community members who made an objection may be able to appeal on the 'merits' of the Government's decision. However, two restrictions limit these rights in practice. First, smaller-scale exploration activities don't need such consent, and receive little or no public scrutiny before approval. Second, merit appeal rights are removed if the Planning Minister directs the Planning Assessment Commission (**PAC**) to hold a formal public hearing before making the final decision.¹³ In relation to land access, landholders do not have the ability to refuse mining on their land. This is because the State owns mineral resources and has the power to confer rights to extract them. In NSW, the main landholder right is to exclude (object to) CSG activities under and around homes, gardens and 'significant improvements', or on cultivated land. The Resources Minister has final discretion to decide on or override the cultivated land exclusion.¹⁴ Exploration can't take place on privately owned land unless a binding access arrangement is in place. This may be negotiated or it may be required through an arbitration process.¹⁵ Landholders are entitled to compensation if the surface of their land is 'injuriously affected' by CSG activities, although it can be hard to demonstrate the cause of harm on the basis of limited data.

A further concern relates to limits on local council involvement and zoning protections. The decision to approve or reject CSG projects is usually made by state authorities, and councils cannot designate and enforce 'no-go' zones. Under the Planning Act, small-scale activities are approved by the Office of CSG without public exhibition. For larger exploration activities and all commercial production, the Planning Department or PAC generally makes the decision.¹⁶ Finally, even if councils and communities agree that local areas require protection, the *Mining SEPP 2007* explicitly overrides local zoning.¹⁷ This prevents councils and communities from having appropriate input into decision making and overrides local protections, for example for areas of high conservation value and local priority agricultural areas.

Giving affected members of the public access to effective and meaningful rights to notification, consultation and appeals recognises the often substantial impacts that mining can have on a community's wellbeing, and on the environment. Exploration and mining companies seek to make private profit from exploiting a public resource. It is appropriate that the public has a legal right to participate in decisions, and ensure decisions are accountable.

The Chief Scientist recommended that the NSW Government 'ensure clear and open communication on CSG matters is maintained at all times', including simplicity, clarity, openness, and measuring performance; and that the Government 'investigates, as a priority, a range of practical measures' to implement or extend stronger protections and benefits to affected communities. This should include 'fair and appropriate' land access arrangements, compensation and valuation; compensation for other local residents affected (above threshold levels); and funding for local councils (from CSG company fees and levies) to fund infrastructure and repairs.

Leading practice measures

Notification and consultation

- For notification of exploration activities, Colorado law requires companies to give a 'Notice of Intent to Conduct Oil and Gas Operations' to local councils, landholders and building owners in certain circumstances at least 30 days prior to submitting the application. The notice states that a permit to conduct oil and gas operations is being sought. It must include a general description of the proposed facilities, their location, and anticipated date of commencement.¹⁸
- Colorado established a taskforce in August 2014 to make recommendations to the legislature on minimising land-use conflicts in siting oil and gas developments.¹⁹ Taskforce members represent the oil and gas industry, agriculture, the home building industry, conservation community, local governments and community leaders.
- Alberta's recently introduced *Unconventional Regulatory Framework (URF)* will require companies to proactively involve local community and other stakeholders throughout the full lifecycle of the project. The Alberta Energy Regulator (**AER**) currently requires operators to provide a specified Landholder Information Package of information to landowners, occupants and land managers likely to be affected by CSG activities.²⁰ The industry in Alberta is also required to develop an effective participant involvement program that includes parties whose rights may be directly and adversely affected by the nature and extent of a proposed application.
- Also in Alberta, a Multi-Stakeholder Advisory Committee (**MAC**) process was established to assist consultation and allow community recommendations to be implemented and monitored. It was chaired by Alberta Energy and Alberta Environment departments. Committee members represented environmental organisations, landowners, agriculture, local government, the energy industry and provincial government departments.

Merit appeals, decision-making and compensation

- In Tasmania, any person with an 'estate or interest' in the affected property (landholders) can object to the granting of an exploration licence (such as for shale gas). The Mining Tribunal decides on the objection. The Minister must consider this determination in deciding whether to grant the licence. However, this is not a 'merit appeal' to a court to make the final decision.²¹
- In Colorado, certain appeals can be launched by the licence applicant, the surface owner, or a local government, depending on the appeal's purpose. However this has been criticised for excluding local citizens' groups.²²
- Colorado adopts a 'home rule' provision for municipalities of over 2,000 people. This gives local government exclusive authority to legislate for purely local issues. Several Colorado municipalities have used home rule provisions to place a moratorium, suspension, or ban on new oil and gas exploration and the use of hydraulic fracturing for a period of time.²³ Most of these exclude oil or gas operations within city limits.
- Germany is proposing to introduce a precautionary approach to CSG, and where environmental or property damage does occur, Germany is proposing to reverse the onus of proof to require the relevant company to demonstrate it was not the source of any damage.²⁴

3. Protecting sensitive environments

In NSW, key regulatory requirements to prevent impacts on sensitive environments include: legislated exclusions (including for national parks, historic sites, nature reserves, karst conservation areas and Aboriginal areas) and other, more discretionary exempted areas; local and regional exclusion zones (for residential zones and critical industry clusters); region-specific assessment processes ('Agricultural Impact Statements' for all agricultural land; 'Gateway Panel certificates' if CSG proposals affect mapped Strategic Agricultural Land); and the Aquifer Interference Policy (which guides decision-makers, but is not binding or enforceable).²⁵

A symptom of the incremental development of CSG law and policy is that there is no uniform application of the rules.²⁶ Many of these regulations (i.e. local and regional exclusion zones and assessments) only apply to 'new' CSG activities, excluding areas where approval has been granted, even if CSG production has not started or may expand in the future. While exclusion zones are a positive step to balancing land uses, no such protections apply to Strategic Agricultural Land (e.g. the Gateway Panel cannot refuse a certificate) or areas of 'High Conservation Value'.²⁷

The Resources Minister also has discretion to allow CSG activities in 'exempted areas' not completely excluded by legislation. This makes Crown lands vulnerable, and is how CSG exploration is occurring in the Pilliga State Forest, for example. Such wide ministerial discretion should be removed, in favour of objective science-based criteria, environmental data, and genuine community engagement.

Once projects have been approved, significant community concern exists about whether project implementation will protect surrounding environments. Lack of data on existing environmental conditions makes it difficult to demonstrate whether systems are responding to CSG extraction as predicted and whether waste products are being adequately managed. A significant concern in this regard remains the lack of regulatory guidance of the appropriate disposal of produced water and the potential environmental impacts that will arise from inappropriate disposal techniques. These concerns are heightened when the cumulative impacts of multiple projects or large numbers of wells are considered.

The Chief Scientist's Report found that 'risks can be managed' – but with a significant reservation – 'provided drilling is allowed only in areas where the geology and hydrogeology can be characterised adequately, and provided that appropriate engineering and scientific solutions are in place...'.²⁸ Current risk management needs improvement to reach best practice and 'there are no guarantees' of safe and beneficial CSG extraction. Relevant recommendations included that the Government should: use its planning powers and expertise to designate areas where CSG is and is not to be allowed (Recommendation 5); establish a 'formal five-step mechanism' to better collect, monitor, and analyse environmental data, and act on the results (Recommendation 13); and consider the need to align regulation of methane from coal mining, and buffer zones for non-CSG gas production, with CSG laws (Recommendation 16).

Leading practice measures

Identifying and protecting 'no-go zones'

- In Alberta, the affected public has the capacity to determine 'No-Go' zones. For example, the MAC identified and recommended environmentally sensitive and threatened areas where CSG development is not appropriate and would not be allowed.²⁹
- The *Colorado Habitat Stewardship Act 2007* aims to minimise adverse impacts to wildlife affected by oil and gas operations.³⁰ Operators must avoid restricted habitat areas when planning and constructing new oil and gas development operations,³¹ subject to certain exceptions and safeguards (including consultation with Colorado Parks and Wildlife).³²

- Germany intends to *'eliminate the risk to the public water supply by banning any kind of fracking in water protection areas, mineral spring protection areas, catchment areas of reservoirs and lakes that are a direct source of drinking water; the federal states may include areas of drinking water production in this ban. In nature conservation areas and Natura 2000 [European protected] areas, fracking facilities may not be built to ensure the protection of these particularly sensitive areas.'*³³ The ban will amend Germany's Water Resources Act.

Baseline studies and cumulative impact assessment

- Government Best Management Practices for CSG in Montana identify the need for adequate baseline studies to be conducted prior to the commencement of CSG activities. The BMP Guidelines see this information as *'a critical element in developing and choosing the types of practices to apply as well as the strategies for mitigation that will prove most effective'* and recommend it be applied to *'existing conditions such as groundwater hydrologic characteristics and quality, surface water quality and flow, vegetation type and distribution, soil type, use and sensitivity, and the presence of local habitat'*.³⁴
- The Alberta URF operates on the basis of resource 'play'³⁵ areas to achieve environmental, economic and social outcomes set by regulators. Companies operating in play areas will have to work collectively to draft 'play-based development plans' rather than focus management on individual wells. One aim of this regulation is to assist in the appropriate management of cumulative impacts.
- The Canadian Association of Petroleum Producers *Best Management Practices Natural Gas in Coal/ Coal Bed Methane* recognises the importance of managing cumulative impacts. It specifically requires CBM operations to *'minimise cumulative impacts wherever practical'*.³⁶
- The United States Western Governors Association recommends that CBM companies should co-ordinate with other industries, government agencies and private landholders to develop watershed (i.e. catchment) management planning processes to ensure the adequate protection of water resources and downstream water uses.³⁷ The State of Wyoming is currently piloting watershed planning programs.
- In Nova Scotia (Canada), the CSG industry is required to obtain specific approvals for the management of produced water and ensure that any releases of this water meets water quality guidelines designed to protect aquatic life and drinking water,³⁸ equivalent to the *Australian and New Zealand guidelines for fresh and marine water quality* (ANZECC Guidelines).
- The Chief Scientist's Report identified South Australia and Western Australia as exemplars for inter-agency cooperation and coordination, and for example, have publicly available MOUs and protocols to explain relative roles and responsibilities.³⁹

4. Monitoring data and access to information

In NSW, key regulatory requirements for data collection, monitoring and analysis include: pre-approval environmental assessments – via a Review of Environmental Factors (**REF**) or Environmental Impact Statement (**EIS**); conditions on petroleum titles (such as compliance with Codes of Practice for well integrity and hydraulic fracturing), on development consents, and on environment protection licences (**pollution licences**);⁴⁰ Aquifer Interference Policy procedures; a newly announced Water Monitoring Framework and Groundwater Baseline Project, and CSG companies and other pollution licence holders must provide public access to mandatory monitoring data in pollution licence conditions.⁴¹

Some CSG exploration activities (and all CSG production) require public exhibition and comment on an EIS before approval. However there are significant problems with the smaller-scale REF processes and assessment under Part 5 of the Planning Act. This includes limited arms-length oversight (by the Office of CSG, but not the Office of Environment & Heritage), no public scrutiny or consultation on the impacts assessed, and little transparency (an REF is only required to be published after the activity is approved).

Post-approval regulation and compliance responsibilities are complex, divided between the Office of CSG (petroleum title compliance), the Environment Protection Authority (EPA) (pollution licence compliance) and the Department of Planning (development consent compliance). The NSW Office of Water also plays a role in relation to water licences. This causes some confusion within communities, industry and agencies themselves as to which regulator is responsible for monitoring and compliance.⁴² There is no central repository for the provision of information and access to information remains difficult if it is not required by the licence conditions.

The Chief Scientist recommended that NSW move to a target and outcome-focused regulatory system with three key elements: environmental impact and safety targets that are iterative and adaptive, appropriate penalties for breaches, automatic monitoring to detect and respond to direct and cumulative impacts, and assist land use planning, environmental targets and outcomes (Recommendation 8); develop a centralised Risk Management and Prediction Tool for CSG and other extractive industries (Recommendation 11); and implement a formal five-step mechanism to better collect, monitor, and analyse environmental data, and act on the results (Recommendation 13). The Chief Scientist highlights the need for environmental data of an order of magnitude more comprehensive, accurate and up-to-date.

Leading practice measures

- The Chief Scientist's Report identifies South Australia, Western Australia, Alberta and Colorado as examples of jurisdictions that have updated centralised data collection online systems.⁴³
- *FracFocus.org* is designed to improve public transparency of information on fracking activity. This US website allows the public to search data by gas company, state, well location, and chemical. FracFocus is used by Colorado and many other states 'as a means of official state chemical disclosure'.⁴⁴ This includes the identities and concentrations of all chemical ingredients, identification of nearby wells and various other information. Colorado is also one of only two US states (with West Virginia) that ensures that landholders are notified of hydraulic fracturing.
- In Alberta, Directive 59 requires well licensees to file records and reports of daily operations on wells that are in the process of being drilled, completed, reconditioned or abandoned. Data relating to drilling, well completion or abandonment, fracture fluid and fracture water source, and completion intervals, among other operational aspects, are covered.⁴⁵ This data is used to maintain an accurate record of each well drilled for use by the government and industry. Directive 44 details requirements for the surveillance, sampling and analysis of water production in oil and gas wells completed above the base of groundwater protection. Only wells that produce a total water volume equal to or greater than 30 cubic meters per month are subject to its requirements. Operators are also encouraged to participate in regional air shed monitoring organizations that are set up through the Clean Air Strategic Alliance.

5. Hydraulic fracturing (fracking)

In NSW, key regulatory requirements for hydraulic fracturing are articulated in: the NSW Code of Practice for Coal Seam Gas Fracture Stimulation (**Fracking Code**), the *Petroleum (Onshore) Act 1991* and its Regulation; the *Environmental Planning and Assessment Act 1979* (EP&A Act); the *Protection of the Environment Operations Act 1997*; and certain health guidelines. The Fracking Code sets out requirements that aim to ensure that fracking is conducted in a safe manner and that communities, the environment and water resources are protected. Compliance with the Fracking Code is a standard condition on title.⁴⁶ Before fracking begins, the titleholder must prepare a Fracture Stimulation Management Plan (**FSM Plan**) to be approved by the NSW Government. The *Water Management Act 2000* regulates CSG activities that occur where there is a water sharing plan and includes regulation of the extraction and disposal of water. NSW has banned the use of additives containing BTEX compounds.⁴⁷ Additionally, all additives used in CSG drilling and fracture stimulation processes must be tested by the National Association of Testing Authorities-certified laboratory in order to meet the Australian Drinking Water Health Guidelines.⁴⁸

However, concerns remain about the fact that most of the 'leading practice' identified in the Fracking Code is not mandatory and as a result notification requirements for landholders or neighbours are limited and there does not appear to be an enforceable requirement that CSG workers have the required qualifications and skills.⁴⁹ The BTEX ban also appears in policy, not law.

The Chief Scientist recommended that: impacts to water resources, baseline conditions, and risk trigger thresholds be identified in FSM Plans prior to the undertaking of any mining or extraction activities (including CSG and irrigation); and the expert advisory body frequently examine relevant data to check for factors signalling problems and recommend to the Government that appropriate action be taken (Recommendation 13).

Leading practice measures

- Germany is implementing a ban on fracking for CSG and shale drilling less than 3000 metres below ground. The key principle is that 'protection of health and drinking water has absolute priority.' The Government will review the ban in 2021 following a scientific review of environment impacts, as 'it is not currently possible to assess the impact of fracking shale rock and coal beds due to a lack of empirical evidence in Germany'.⁵⁰
- Germany further proposes to include nine specific conditions on any permitted fracking projects.⁵¹ These include placing the burden of proof on companies regarding any subsidence damage from fracking measures or deep wells; comprehensive environmental impact assessment for all deep drilling; harm to groundwater in a catchment area of public water points or for direct use in food and beverages must be completely ruled out; the identity of all substances and expected quantities used must be disclosed (with provision for a public register); ground and surface water monitoring; supervision of well integrity; and reporting requirements.⁵²
- Similarly, France has prohibited utilising hydraulic fracturing for the exploration and mining of oil and gas, in enacting Law n 2011-835 in July 2011.⁵³
- The *UK Onshore Shale Gas Well Guidelines Exploration and appraisal phase Issue 1 February 2013*⁵⁴ require both the public disclosure of fracture fluid composition on an industry managed website (www.ukoog.org.uk) and the disclosure of flow-back fluids including the estimated and actual amounts recovered and the chemical composition of those fluids.
- Best practice guidelines prepared for the Petroleum Technology Alliance Canada and the Science and Community Environmental Knowledge Fund⁵⁵ encourages reduction in chemical usage during hydraulic fracturing including the use of ultraviolet light rather than biocide chemicals.

6. Well integrity and decommissioning

Key regulatory requirements for well integrity and decommissioning (abandonment) are currently articulated as conditions of the petroleum title; in the Schedule of Onshore Petroleum Exploration and Production Safety Requirements; through pollution licences; and in the NSW Code of Practice for Coal Seam Gas Well Integrity (**Well Integrity Code**). The Well Integrity Code seeks to ensure that well operations and abandonment are carried out safely and without risk to human health or detriment to the environment. It does this through specifying requirements and recommendations for well design, casing, cementing, drilling fluids and abandonment.

However, Well Integrity Code requirements are not in legislation. This means their status in the regulatory system is uncertain and reliant on government policy. It is unclear how well integrity is assured for well types that are exempt from the Well Integrity Code. Furthermore, it is unclear what happens if these measures fail and how the ongoing liability to maintain the wells is enforced.

The Chief Scientist described the current system as expressing 'guiding principles', which therefore do not have strong legal grounding.⁵⁶ The Chief Scientist recommended that all CSG industry personnel (including subcontractors) require ongoing mandatory training and certification. This recommendation extends to public sector employees specifically in compliance, inspecting and auditing CSG activities (Recommendation 14). The Chief Scientist also recommended that NSW develop a plan to manage CSG-related legacy matters including abandoned wells, incomplete compliance checks, and data collection gaps (Recommendation 15).⁵⁷

Leading practice measures

- In Colorado, all wells, 'as long as [they] are used for the injection of fluids', must be pressure tested at least once every five years⁵⁸ ensuring a regulatory commitment to ongoing management of well integrity.
- In Alberta, a well bore integrity plan must include assessments of 3D hydraulic fracture propagation extent.
- In the UK, a recent report recommended that best practice should include post management monitoring to detect any well failure after abandonment.⁵⁹

7. Air quality and health

In NSW, key regulatory requirements relating to flaring and air pollution include: pre-approval environmental assessments (such as ambient air quality assessment) during the REF or EIS process; conditions on development consents and pollution licences ; the *Protection of the Environment Operations Act 1997 (POEO Act)* and Regulations, including the *Clean Air Regulation 2010*,⁶⁰ and the National Environment Protection Measure (**NEPM**) Ambient Air Quality Guidelines as enacted by NSW legislation and policy. Despite these measures, community concern about the potential for harmful emissions remains. One example demonstrating these concerns is the National Pollution Index report for the year 2012/13 which showed the Narrabri Gas Project released 25,000kg of Volatile Organic Compounds (**VOCs**),⁶¹ a substance that must be recorded but has no limitations under the Narrabri Gas Project pollution licence (although limits for VOCs and other substances are imposed on other CSG projects, including the Camden Gas Project).

There remain a number of gaps in the regulatory system for ensuring appropriate air quality is maintained. NSW mining and planning laws do not provide for adequate assessment and

conditioning of the greenhouse gas emissions and climate change impacts of CSG and other major projects. Fugitive emissions from coal mining, oil and gas production account for about 8% of Australia's greenhouse emissions.⁶² Methane (including CSG) is a much more potent greenhouse gas than carbon dioxide. While various estimates have been made of greenhouse contributions and fugitive emissions from unconventional gas overseas, independent analysis and research on life-cycle CSG emissions has been scarce to date, particularly in Australia.

As noted, cumulative impact assessment is a key inadequacy of environmental assessments, in particular consideration of the impact of emissions within an air shed,⁶³ and the cumulative impact on the environment and human health. These problems are exacerbated by the lack of mandatory Health Impact Assessments (HIAs) as part of the broader environmental assessment process. Once projects are approved, air quality impacts are managed by the requirement of the *Clean Air Regulation 2010* to minimise smoke from flares, and by pollution licences issued by the EPA. Current pollution licences list a number of emissions that must be monitored for load based licencing, for example VOCs, nitrogen oxides and benzene, but have no specific requirements to limit emissions of these substances while projects are operating under exploration licences.

The Chief Scientist considers that risk of gas escape can be managed through adaptive management. The Chief Scientist's Report notes that suitable modelling is needed to help understand the risks associated with seam depressurisation. The report suggests that fugitive air emissions can be reduced or minimised by monitoring infrastructure such as wells and pipes for leaks and keeping fluids in enclosed containers. In managing health risks, the report notes there are limited peer-reviewed studies on potential impacts from CSG activities on human health, which makes it difficult to determine whether there are any causal effects.⁶⁴ The Report notes that the best way of preventing exposure to contaminants is to stop their release, but acknowledges that some release is inevitable. The Chief Scientist suggests it is imperative that cumulative impacts are modelled prior to any new activity taking place where CSG activity has already occurred.

Leading practice measures

- In Alberta, a CSG operator must obtain a permit for temporary flaring or incineration of natural gas if the gas well test volume exceeds a certain threshold. Such a permit requires the operator to list information about the reasons for planned flaring, flow rates, emission contents, total volumes, types of combustion devices, effects on ambient air quality and, in situations with the potential to exceed air quality limits, information on a management plan to prevent excess.⁶⁵
- Alberta also requires royalties on flared and vented gas.⁶⁶ Alberta charges royalties on all produced gas, a move that has helped reduce flaring by 72 per cent. Alberta has set up incentive programs to encourage alternatives to flaring; for example the programs encourage productive use of gas produced at well sites.⁶⁷
- US EPA Air Rules for the Oil and Natural Gas Industry⁶⁸ focus on reducing VOC emissions from natural gas operations which, from 1 Jan 2015, will require gas from hydraulically fractured wells to be captured rather than flared.
- Use of health impact assessment (HIA) has been recommended as a key component of strategic environmental assessment by the World Health Organisation.⁶⁹
- New Zealand published the Whānau Ora Health Impact Assessment Tool in April 2007.⁷⁰ The Tool is designed to be applied to any policy that may affect Maori people.
- In the United States, HIA is increasingly being recognised as an important component of environmental assessment required by the *National Environmental Policy Act of 1969*⁷¹ while Canada developed a guide for health impact assessment in 2004.

8. Environmental bonds and levies

The PO Act provides that a 'security deposit' may be imposed on petroleum titles (in such form, and on or before such date, as the Minister may determine) for the fulfilment of the holder's obligations under the PO Act in respect of the title (including obligations that may arise in the future) and to maintain that security deposit until those obligations are fulfilled.⁷²

Two of the Chief Scientist's review recommendations are relevant to this issue. First, that the Government apply full cost recovery to the industry for the cost of regulating CSG, via fees, levies, royalties and taxes and deliver an annual regulatory statement to Parliament (Recommendation 4). Second, that the Government consider a comprehensive policy of insurance and environmental risk coverage for the CSG industry. This should include security deposits, enhanced insurance coverage and establishing an environmental rehabilitation fund.

Leading practice measures

- Alaska and California have been identified as having strong bond requirements. In Alaska, oil and gas operators are required to post a bond of between \$100,000 and \$200,000 per well site. In California, a blanket bond of \$1 million for all onshore and offshore wells is required. These costs of bonding for individual wells and for blanket bonds are reflective of the high cost of plugging and reclaiming wells.⁷³
- Colorado gas law establishes an environmental response fund within the Treasury. This fund is supported by mandatory petroleum producer contributions (additional to other fees, reviewed every 2 years), as well as fines and charges recouped under petroleum law.⁷⁴
- In recognition of the finite nature of fossil fuel revenues, Alberta has established a sovereign wealth fund for its citizens. It has accumulated more than \$12 billion dollars of oil and gas revenues for future use.
- The AER in Alberta is entirely funded by industry through an administrative fee levied on oil and gas wells and facilities, oil sands projects and coal mines. This funding is separate to the substantial royalty income received by the province.⁷⁵
- The primary source of revenue for the South Australian EPA is fees and charges.⁷⁶

Conclusion

Coal seam gas laws in NSW are complex. Different laws, regulations and policies apply to different aspects of CSG activities; administered by different departments and agencies. Environmental, social and economic outcomes are uncertain. To ensure adequate implementation of the Chief Scientist's recommendations, significant reform requiring world's leading practice to be implemented is needed. As this regulatory snapshot shows, there are a number of leading practices that would improve CSG management and environmental performance that can be implemented immediately. Other regulatory change may take time but a strong, effective, regulatory system enshrining world's leading practice should be in place before further expansion of the industry is allowed.

REFERENCES

- ¹ *Final Report of the Independent review of Coal Seam Gas Activities in NSW*, September 2014, NSW Government, Chief Scientist & Engineer. See: <http://www.chiefscientist.nsw.gov.au/coal-seam-gas-review>.
- ² NSW Chief Scientist & Engineer, *Study of regulatory compliance systems and processes for coal seam gas* (Sept. 2014) (**compliance report**), Appendix 1, at A-5. These are derived from the SA Government's *Roadmap for Unconventional Gas Projects in South Australia* (2012). The SA Roadmap also emphasised appropriate financial return to the public.
- ³ These include the precautionary principle, equity within and between generations, ecological integrity and biodiversity protection as a fundamental consideration, and the 'polluter pays' principle. ESD is already referred in over 50 environmental, planning and mining laws in NSW, but not for CSG laws (see e.g. *Protection of the Environment Administration Act 1991* (NSW), s 6.) COAG's National Harmonised Framework policy for CSG also recommends the use of the precautionary principle to manage risk. The *National Strategy for Ecologically Sustainable Development* (1992) explicitly adopts ESD and its principles, including for mining and exploration activities.
- ⁴ Requirements to 'take into account' natural resource protection etc (*Petroleum (Onshore) Act 1991*, s 74) are inadequate because they are so vague, as is the limited requirement to 'have regard to' ESD under the *NSW Mining Act 1992*, s 3A.
- ⁵ For example, tests to 'maintain or improve environmental outcomes' have been adopted in the native vegetation and biodiversity offsetting contexts. These must be backed by baseline data, defined targets and robust scientific methodologies.
- ⁶ A catchment-based approach was also proposed in a review of CSG in Australia by the former NSW Natural Resources Commissioner (John Williams Scientific Services Pty Ltd "An analysis of coal seam gas production and natural resource management in Australia - Issues and ways forward", October 2012, recommendations 1 and 2) and is reinforced in the Chief Scientist's Report which calls for identifying areas where CSG should and should not occur (Recommendation 5).
- ⁷ See e.g. *State of the Environment 2011*, Report to Australian Government, 'In brief – Headlines'; see also National Sustainability Council, *Sustainable Australia Report 2013*, pp 81 and 92.
- ⁸ One object of the *Water Management Act 2000* (NSW) is 'to apply the principles of [ESD]', and water management committees must exercise their functions 'consistently with the principles of [ESD]' (ss. 3 and 14(3)). The *Sustainable Planning Act 2009* (Qld) requires decision makers to use ESD principles (ss. 4-5). In the UK, the relevant minister, Water Services Regulation Authority, and Consumer Council for Water 'shall exercise and perform [their] powers and duties ... to contribute to the achievement of sustainable development' (*Water Industry Act 1991* (UK), ss. 2(3)(e), 27A(12)).
- ⁹ See *Petroleum and Gas (Production and Safety) Act 2004* (QLD), s. 3(1)(a); *Minerals Resources (Sustainable Development Act) 1990* (Vic), ss. 1 and 2A; *Offshore Petroleum and Greenhouse Gas Storage Act 2010* (Vic), s. 61.
- ¹⁰ Under the *Petroleum (Onshore) Act 1991*, there is no arms-length assessment by a court or tribunal of whether the Department of Trade & Investment (Office of CSG) should have granted the licence.
- ¹¹ NSW Chief Scientist & Engineer's Review of CSG, Regulatory compliance report (2014), Appendix p A-32: *the discretion to grant a PEL [petroleum exploration licence] or PAL [petroleum assessment lease] needs to be exercised with care, as once it is awarded, it is very difficult to restrict the production phase;* See also *Petroleum Onshore Act 1991*, s 42(2).
- ¹² See e.g. <http://www.resourcesandenergy.nsw.gov.au/landholders-and-community/public-comment>.
- ¹³ 'Objector' merit appeals can only be launched by someone who objected to the development application, within 28 days of being notified of the decision (*Environmental Planning and Assessment Act 1979*, s. 98).
- ¹⁴ *Petroleum (Onshore) Act 1991*, ss 71-72; compensation may apply regarding production on cultivated land.
- ¹⁵ The 2014 Walker Review (*Examination of the Land Access Arbitration Framework*) made 32 recommendations to improve the arbitration process, which the Government has endorsed, with the intention to amend legislation in 2015.
- ¹⁶ That is, the project is classed as State Significant Development (SSD) and the Planning Minister's delegate makes the decision. A local council may object to a production lease being issued, or suggest conditions, which the Minister must consider (*Petroleum Onshore Act 1991* (NSW), ss. 57-58).
- ¹⁷ *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* cl 8, 7(2).
- ¹⁸ Colorado Oil & Gas Conservation Commission (COGCC), Rule 305(a)(1)-(2) pursuant to the *Oil and Gas Conservation Act*.
- ¹⁹ Colorado, Governor John Hickenlooper, 'Gov. Hickenlooper announces task force to address local control and land use issues' (Monday August 4, 2014), <http://www.colorado.gov/cs/Satellite/GovHickenlooper/CBON/1251655966910>.
- ²⁰ See Directive 56. The Alberta scheme shares many features with the Canadian Association of Petroleum Producers recommended best management practice. Their community engagement practices were previously embodied by the former EUB IL 2004-08 and the EUB's EnerFAQs 13 publication.
- ²¹ *Mineral Resources Development Act 1995* (Tas), s. 15. For example, the Mining Tribunal (a division of the Magistrate's Court) could propose conditions on the licence, or recommend refusal, before the Minister makes the decision. There is no explicit restriction on the issues that can be addressed in an objection.
- ²² COGCC Rule 503. In 2012, the Colorado Supreme Court refused to grant standing to a citizen's group who owned, resided on, and used land where a permit application was sought. *Colorado Oil and Gas Conservation Commission v Grand Valley Citizens' Alliance*, 279 P.3d 646, 650 (Colo, 2012). Justice Hobbs, (dissenting) said: 'When a local government declines to represent its citizens' concerns regarding harm to public health, safety, and welfare,... the Commission should grant the concerned citizens a hearing...' See also, case note: http://lawreview.colorado.edu/wp-content/uploads/2014/01/13.-85.3-Mecklenburg_Final_Web.pdf.
- ²³ For example 5 years in Boulder and Broomfield; indefinitely in Lafayette. Getches-Wilkinson Center for Natural resources, Energy, and the Environment (University of Colorado Law Faculty), 'Intermountain Oil and Gas BMP Project'
- ²⁴ See Natural Gas Europe, 'Germany: Government Provides Overview of New Fracking Regulation' 12/7/14, at www.naturalgaseurope.com/germany-new-fracking-regulations, accessed October 2014.
- ²⁵ Introduced in 2012, the Aquifer Interference Policy applies to the whole of NSW. It guides the NSW Office of Water in licensing water use for CSG activities, and it guides the Mining and CSG Gateway Panel, or Planning Assessment Commission, in assessing the impacts of 'aquifer interference activities' at the development assessment stage.
- ²⁶ See Chief Scientist's Report, for example, recommendations 1, 5 and 13.
- ²⁷ EDO NSW understands that the term 'High Conservation Value' has been used in mapping undertaken by the Office of Environment & Heritage and Department of Planning during the development of the Strategic Regional Land Use Policy in 2011-12. While further definition and risk assessment is needed, a potentially related term in the planning law context is 'sensitive environmental areas'.

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- ²⁸ NSW Chief Scientist and Engineer, *Final Report of the Independent Review of CSG Activities in NSW* (2014), pp 10-11.
- ²⁹ Alberta Energy Regulator, *CBM Multi-Stakeholder Advisory Committee (MAC) Recommendations: Progress Update – Year 3*, Recommendation 4.3.1E, http://www.energy.alberta.ca/NaturalGas/Gas_Pdfs/MAC2ProgressUpdateFinalNov09.pdf. See also The Dogwood Initiative (Canadian environmental conservation and public policy NGO), *Coalbed Methane: Best Practices for British Columbia* (n/d, circa 2009), at: <http://dogwoodinitiative.org/publications/reports/coalbed-methane-best-practices-for-british-columbia>.
- ³⁰ Colo Rev Stat § 34-60-128.
- ³¹ To 'the extent technically and economically feasible'. This applies to 'restricted surface occupancy areas', which include mapped habitat areas for certain protected species, such as Rocky mountain bighorn sheep production areas; desert bighorn sheep production areas; areas within certain distances of certain bird species and iconic bird nesting sites: Rules and Regulations, Definitions (100 series).
- ³² i.e. where authorised after consultation (COGCC Rule 306.c); when authorised by a Comprehensive Drilling Plan; upon demonstration that the identified habitat is not in fact present; when specifically exempted by the Colorado Parks and Wildlife; or in the event of situations posing a risk to public health, safety, welfare, or the environment (Rule 1205.a).
- ³³ 'Announcement of the key principles of the fracking regulation in Germany', Shale Gas Information Platform, GMZ Hemholtz Centre Potsdam, 11 July 2014, at <http://www.shale-gas-information-platform.org/areas/news/detail/article/announcement-of-the-key-principles-of-the-fracking-regulation-in-germany.html>. The EU Habitats Directive (Annex I) lists natural and near-natural habitats of Community interest (91 in Germany) whose conservation requires the designation of special conservation areas.
- ³⁴ ALL Consulting and Montana Board of Gas Conservation (2002) *Handbook on Best Management Practices and Mitigation Strategies on Coal Bed Methane in the Montana Portion of the Powder River Basin*. Prepared for prepared for US Department of Energy, National Petroleum Technology Office and National Energy Technology Laboratory
- ³⁵ A 'play' in this context is defined as 'a three-dimensional space that is the target of oil or gas development'. Characteristics include the geological formation, surface above the geologic formation (including the air, land, water and biota), types of fluids in the rock as well as other geological and reservoir characteristics. Therefore, plays are determined by the AER according to their unique geological and environmental characteristics as described.
- ³⁶ Canadian Association of Petroleum Producers (2006) *Best Management Practices Natural Gas in Coal (NGC)/ Coalbed Methane (CBM)*. Alberta, Canada.
- ³⁷ Western Governors Association (2006) *Coal Bed Methane Best Management Practices – A Handbook*. Available at: <http://www.oilandgasbmps.org/viewpub.php?id=47>.
- ³⁸ Nova Scotia Environment (2008) *Environmental Best Management Practices for Formation Water from Coal Bed Methane Exploration and Production Activities* Available at: <http://www.novascotia.ca/nse/dept/docs.policy/BMP.for.Formation.Water.from.Exploration.Production.pdf>
- ³⁹ NSW Chief Scientist & Engineer, 'Independent Review of Coal Seam Gas Activities in NSW – Final report (2014), Appendix 1: National and International Regulatory Practice: Some Observations, (2014), p14.
- ⁴⁰ Environment protection licences are issued under the *Protection of the Environment Operations Act 1997* (NSW).
- ⁴¹ *POEO Act 1997*, s 66(6). Access is to be in accordance with EPA Guidelines, *Requirements for publishing pollution monitoring data* (NSW EPA, 2012).
- ⁴² See for example, NSW Chief Scientist & Engineer, *Study of regulatory compliance systems and processes for CSG* (2014), pp 2 and 9.
- ⁴³ Appendix 1: National and International Regulatory Practice: Some Observations, (2014), p18.
- ⁴⁴ See FracFocus, About Us, <http://fracfocus.org/welcome>. FracFocus was funded by the Department of Energy and is maintained by the US Ground Water Protection Council and the Interstate Oil and Gas Compact Commission. While FracFocus is an innovative leading practice for public transparency, for a gap analysis of legal requirements and potential improvements see M. McFeely, *State Hydraulic Fracturing Disclosure Rules and Enforcement: A Comparison*, Natural Resources Defense Council, July 2012, www.nrdc.org/energy/files/Fracking-Disclosure-IB.pdf. Colorado law requires the disclosure of chemicals used in hydraulic fracturing via a Chemical Disclosure Registry, i.e. *FracFocus (Colo. Rev. Stat § 34-60, Rule 205A.b.(2))*.
- ⁴⁵ Directive 69, Chapter 2; <http://www.aer.ca/documents/directives/Directive059.pdf>
- ⁴⁶ *Petroleum Onshore Act 1991* (NSW) s 23.
- ⁴⁷ NSW Code of Practice for Coal Seam Gas Fracture Stimulation, cl 6.1. See also NSW Government, Trade & Investment, 'Ban on use of BTEX compounds in CSG activities', <http://www.trade.nsw.gov.au/policy/TI-O-120>.
- ⁴⁸ NSW Code of Practice for Coal Seam Gas Fracture Stimulation, cl 6.1.
- ⁴⁹ NSW Code of Practice for Coal Seam Gas Fracture Stimulation, iv. The NSW Well Integrity Code provides the same 'soft' statement.
- ⁵⁰ 'Announcement of the key principles of the fracking regulation in Germany', Shale Gas Information Platform, GMZ Hemholtz Centre Potsdam, 11 July 2014 (translation from the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety) at <http://www.shale-gas-information-platform.org/areas/news/detail/article/announcement-of-the-key-principles-of-the-fracking-regulation-in-germany.html>.
- ⁵¹ 'Fracking for tight gas', a long-standing practice since the 1960s, 'will continue to be allowed in principle'. Also, 'Science-backed tests to investigate impacts the environment and the substrate... may be performed if the fracking fluid does not endanger the groundwater.' Additional water quality regulations will be made. Ibid.
- ⁵² For more information see: <http://www.naturalgaseurope.com/germany-new-fracking-regulations>
- ⁵³ For more information see: <http://www.iclg.co.uk/practice-areas/oil-and-gas-regulation/oil-and-gas-regulation-2014/france>.
- ⁵⁴ United Kingdom Onshore Operators Group (2013) *UK Onshore Shale Gas Well Guidelines Exploration and Appraisal Phase Issue 1 February 2013*.
- ⁵⁵ ALL Consulting (2012) *The Modern Practices of Hydraulic Fracturing: A Focus on Canadian Resources prepared for the Petroleum Technology Alliance Canada and the Science and Community Environmental Knowledge Fund* Available at: www.capp.ca/getdoc.aspx?DocId=210903.
- ⁵⁶ NSW Chief Scientist & Engineer, 'Independent Review of Coal Seam Gas Activities in NSW Information Paper: Abandoned wells' (2014), 6.
- ⁵⁷ A further element of this is to create a formal mechanism to transition existing projects to new regulatory frameworks so that existing wells are no longer exempt from regulatory systems such as the Well Integrity Code.

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- ⁵⁸ Colorado COGCC Rule 326.a.(3) and (5).
- ⁵⁹ Report by the Royal Society and Royal Academy of Engineering, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/256359/Publication_RoyalSociety_2012-06-28-Shale-gas.pdf, 30.
- ⁶⁰ *Protection of the Environment Operations Act 1997, Protection of the Environment (General) Regulation 2009 and Protection of the Environment (Clean Air) Regulation 2010.*
- ⁶¹ NPI reporting information at: <http://www.npi.gov.au/npidata/action/load/emission-by-individual-facility-result/criteria/state/NSW/year/2013/jurisdiction-facility/1311>
- ⁶² Australian Government, *Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2013*, cited in D. Barret and S. Day, 'Coal seam gas emissions lower than US: first Australian study', 1 August 2014, <http://theconversation.com/coal-seam-gas-emissions-lower-than-us-first-australian-study-29699>. Barret and Day note: 'Fugitive emissions occur when methane escapes from production facilities, wells, pipes, compressors and other equipment' associated with coal or gas extraction.
- ⁶³ EDO NSW has previously discussed the need to consider air pollution in the context of air sheds. For further information on the existing regulatory tools available see our previous report *Clearing the Air: Opportunities for improved regulation of pollution in New South Wales*.
- ⁶⁴ NSW Chief Scientist & Engineer, *Managing environmental and human health risks* (2014), p 11, 23-24 and 28.
- ⁶⁵ Directive 60, 3.5.1.
- ⁶⁶ Directive 60, 2.12.
- ⁶⁷ Dogwood Initiative, above, 25-28. The Alberta Department of Energy developed criteria to 'waive royalty on otherwise flared solution gas and associated by-products when used in a manner that would normally require payment of royalty'
- ⁶⁸ <http://www.epa.gov/airquality/oilandgas/pdfs/20120417summarywellsites.pdf>
- ⁶⁹ <http://www.who.int/hia/en/>
- ⁷⁰ <http://www.health.govt.nz/our-work/health-impact-assessment/whanau-ora-health-impact-assessment>
- ⁷¹ R. Bhatia and A. Wernham, 'Integrating Human Health into Environmental Impact Assessment: An Unrealized Opportunity for Environmental Health and Justice' (August 2008) *Environmental Health Perspectives* Vol 116 No. 8.
- ⁷² See part 10A of the PO act for security deposit conditions.
- ⁷³ Dogwood Initiative 42.
- ⁷⁴ Colorado Statutes, Title 34. Mineral Resources – Oil and Natural Gas: Conservation and Regulation, Art. 60, § 34-60-122.
- ⁷⁵ NSW Chief Scientist & Engineer, 'Independent Review of Coal Seam Gas Activities in NSW – Final report (2014), Appendix 1: National and International Regulatory Practice: Some Observations, (2014), p10.
- ⁷⁶ *Ibid.*