Shale Gas Resources in Western Australia: An Assessment of the Legal Framework for the Extraction of Onshore Shale Gas

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This paper considers the regulatory framework of Western Australia for the extraction of onshore unconventional gas resources in Western Australia, particularly shale gas. It examines the impact of the primary method of extracting shale gas, hydraulic fracturing, also known as fraccing. After an examination of the fraccing process and the issues associated with the process, this paper examines the capacity of the Western Australian *Petroleum and Geothermal Energy Resources Act 1967* (Western Australia) (PGERA) to regulate the fraccing process associated with the extraction of shale gas. In examining the capacity of the PGERA to regulate the fraccing process, it has identified several regulatory gaps, and suggests amendments to the existing legal framework to ensure the comprehensive regulation of fraccing activities.

1. INTRODUCTION

The potential of shale and coal formations as sources of gas has been known for several decades, but have remained underdeveloped in many jurisdictions due to the difficulty in recovering gas from these geological formations. However, as security of energy supply emerges as a major economic and political threat, there is an increasing need to develop more difficult gas resources from formations that have not traditionally been considered as gas-yielding. The gas recovered from shale and coal formations is generally referred to as unconventional gas, whilst gas recovered from sandstone and carbonate formations is generally referred to as conventional gas. The gas recovered from both types of geological formations is the same: naturally occurring hydrocarbon gas, primarily comprising methane, but also containing ethane, propane and butane in smaller proportions.

The shale formations that contain gas are generally fine-grained sedimentary rocks that act as both the source and reservoir rock for the gas formations since it contains relatively large amounts of organic material compared to other rock types.[1] These reservoirs are known as low-permeability reservoirs, where the gas will not flow freely from a formation when a well is drilled. Rather the recovery of the gas requires well stimulation techniques. The common well stimulation treatment used is the process of hydraulic fracturing, commonly referred to as fraccing.

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[1] Schlumberger Oilfield Glossary, *Shale* (2011) <http://www.glossary.oilfield.slb.com/Display.cfm?Term=shale>.

The use of fraccing, especially in the USA, has raised considerable community concern. The fraccing process may potentially cause damage to aquifers, and the chemicals used in the process have been the subject of such controversy. This controversy was heightened with the release of the US movie *Gasland*, which highlights the fraccing process, and the Australian documentary *The Gas Rush*[2] on the extraction of coal seam gas (CSG) in Eastern Australia. The widespread publicity from these documentaries has raised concerns within the Western Australian community regarding the safety of the fraccing process for human health and the environment. Added to this concern are a number of incidences of contaminated CSG wells in NSW and Queensland. As a consequence, the Western Australian community has raised concerns over the capacity of the Western Australian government to adequately regulate shale gas resources (SGR) activities in Western Australia.

The purpose of this paper is threefold. Firstly it examines the need for the extraction of shale gas in Western Australia. Secondly it examines the issues that surround the extraction of shale gas resources, focussing on issues related to water and well design. Thirdly, it examines the legal framework regulating the extraction of onshore gas in Western Australia, focussing on the capacity of the *Petroleum and Geothermal Energy Resources Act 1967* (WA) to regulate shale gas exploration and production activities in Western Australia.

Although Western Australia contains a number of unconventional gas resources, including shale gas, coal seam gas and tight gas, the focus of this paper will be the vast shale gas resources of Western Australia since shale, and its concomitant gas resources, is the prevalent geological formation, spreading across the Perth, Carnarvon and Canning Basins.[3]

2. IMPORTANCE OF UNCONVENTIONAL GAS RESOURCES IN ENERGY SECURITY

The existence of shale formations as a source of gas has long been known. However, the shale formations typically have low porosity and permeability, which hinders the capacity of the gas to flow freely from the rock formation. As such, the capacity to recover the gas from these unconventional rock sources has previously been limited. However, given the increased global demand for petroleum,[4] as well as the looming spectre of a possible peak oil scenario, the need

[2] ABC TV, 'The Gas Rush', *Four Corners*, 21 February 2011 (Mathew Carney) <http://www.abc.net.au/4corners/content/2011/s3144806.htm>.

[3] US Energy Information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States* (April 2011), <http://www.eia.gov/analysis/studies/worldshalegas/>; <http://www.eia.gov/analysis/studies/worldshalegas/pdf/fullreport.pdf>.
Refer also to Department of Mines and Petroleum, Government of Western Australia, *Unconventional Gas in Western Australia, Frequently Asked Questions*, (2011) <http://www.dmp.wa.gov.au/12872.aspx#12883>.

[4] BP, *BP Statistical Review of World Energy: June 2009* (BP, 2009), 4-8.

for alternative sources of hydrocarbons is crucial. Hubbert[5] defines 'peak oil' as the maximum rate of production of petroleum in any area under consideration, recognising that it is a natural resource, subject to depletion.[6] Hubbert predicted that United States oil hegemony would cease in 1970, as petroleum demand surpassed production.[7] Although this concept received much ridicule, Hubbert's predictions proved accurate in 1973, with the US demand exceeding its declining production, thereby becoming and remaining a net petroleum importer.[8]

The importance of energy security in the US was reiterated by the *Carter Doctrine* of 1980,[9] which declared the US's intention to intervene militarily should US interests in the Persian Gulf be threatened. In the Stateof the Union Address of 1980, President Carter outlined the position of the United States regarding the Persian Gulf Region and the oil therein:

> An attempt by an outside force to gain control of the Persian Gulf region will be regarded as an assault on the vital interests of the United States of America, and such an assault will be repelled by any means necessary, including military force.[10]

This need for energy security was echoed in the new *National Energy Policy* in 2001 by Vice President Cheney, who announced that the Bush administration would make 'energy security a priority of trade and foreign policy'.[11] Energy security still remains an important focus of the United States.

As new technologies and materials are developed to extract the substantial shale gas resources, shale gas is becoming an increasingly important source of energy. This has been particularly evident in the USA, where in the last 10 years 20-26 trillion cubic feet (Tcf) of shale gas has been produced annually.[12] Furthermore, unconventional gas resources are the largest source of US natural gas supply, a trend that will increase in the next 20 years as SGR are developed in the US. In comparison, gas production from the Gulf of Mexico has declined, with only 2-3 Tcf

[5] The Coming Global Oil Crisis, *Experts: M King Hubbert* (2011) < http://www.hubbertpeak.com/Hubbert/>.
[6] Colin Campbell, *What is Peak Oil?* (Association for the Study of Peak Oil and Gas, 2006) (2006) <http://www.peakoil.net/>. See also M King Hubbert, 'Nuclear Energy and the Fossil Fuels' (Paper Presented before the Spring Meeting of the Southern District Division of Production, American Petroleum Institute, Plaza Hotel, San Antonio, Texas, 7-9 March 1956), 8-11. <http://www.hubbertpeak.com/Hubbert/1956/1956.pdf>.
[7] Hubbert, above n 6.
[8] Matthew Simmons, 'Is the Glass Half Full or Half Empty?' (Proceedings of the 2nd International Workshop on Oil Depletion, Paris, France, May 26-27, 2003). <http://www.peakoil.net/iwood2003/ppt/SimmonsPresentation.pdf>.
[9] President Jimmy Carter, 'Stateof the Union Address, 1979' (Speech Delivered at the Stateof The Union, Washington, 23 January 1980). <http://www.presidency.ucsb.edu/ws/index.php?pid=32657>.
[10] Ibid.
[11] Matthew Yeomans, *Oil: A Concise Guide to the Most Important Product on Earth* (New Press, 2004), 15-18.
[12] Anthony Andrews et al, *Unconventional Gas Shales: Development, Technology and Policy Issues* (Congressional Research Services, 2009), 3.

produced annually since 2005.[13] This represents a twelve-fold increase in shale gas production, now representing 25% of total US gas production[14] and increasing annually. Today shale gas has become an important source of gas for the USA, and shale formations as a source of gas are increasingly examined on a global scale.

Although the process of fraccing has been utilised for over 40 years as a method to develop gas resources, its use has dramatically increased in the last 10 years, particularly in the USA, as a result of advanced resource recovery techniques. The combination of the development of horizontal drilling and fraccing has greatly increased the likelihood for profitable extraction of shale gas from shale formations. Successful large-scale shale gas extraction was undertaken on the Burnett Shale formation in Texas during the 1980s and 1990s.[15] With demonstrated profitability of shale gas extraction, petroleum companies have extracted shale gas from other formations in the USA, notably the Fayetteville and Haynesville Formations, as well as the Marcellus Shales under the Appalachian Mountains.

The development of these shale gas plays became an energy 'game changer' for the USA.[16] Long dependent upon the Middle East for hydrocarbon energy as domestic sources dwindle, the capacity to recover shale gas to meet US energy has become strategically and politically important. Today US shale gas resources are estimated at 862tcf.[17] US total gas reserves are estimated at be 2543 Tcf.[18] As such, SGR constitute 34% of the current US of the US natural gas resource base. Shale gas is projected to comprise 46% of US natural gas production by 2035. This has clear implications for United States' long-term energy security geopolitical strategy. In its assessment of the role of shale gas in national security, the *James A Baker Institute for Public Policy* notes that rising shale gas production has already had profound repercussions in domestic and international markets, impacting on geopolitics, as well as domestic and international gas prices.[19] This is likely to continue.

Shale gas resources have become an energy 'game' changer not only in the USA, but also for other countries. An assessment of 14 gas regions (32 countries) outside the USA by the US Energy Information Administration (EIA) concluded that current recoverable shale gas in these

[13] Ibid, 3.
[14] Richard Newell, 'Shale Gas and the Outlook for US Natural Gas Markets and Global Gas Resources' (Presentation to the Organisation for Economic Cooperation and Development, Paris, 21 June 2011), 11. <http://photos.state.gov/libraries/usoecd/19452/pdfs/DrNewell-EIA-Administrator-Shale-Gas-Presentation-June212011.pdf>.
[15] US Energy Information Administration , above n 3, 1.
[16] Ibid.
[17] Ibid.
[18] Ibid.
[19] Kenneth B Medlock III, Amy Myers Laffe and Peter R Hartley, *Shale Gas and U.S National Security* (James A Baker III Institute for Public Policy, 2011), 9-10.

14 regions (of which one was Australia) is 4760 Tcf.[20] Combined with the US recoverable estimates of the 862tcf, the estimated global recoverable reserves of shale gas as an unconventional source of gas is 5622 Tcf. Given the world's recoverable gas resources in conventional reservoirs of 6609 Tcf, the capacity to recover shale gas almost doubles the amount of recoverable gases from all geological formations, thus providing an essential source of recoverable energy for those countries endowed with such a resource.

3. UNCONVENTIONAL GAS RESOURCES IN WESTERN AUSTRALIA

Major shale gas potential exists in four main onshore Australian geological basins. The Cooper Basin, spanning South Australia and Queensland, is a proved basin containing significant reserves, and the site of Australia's first shale gas well.[21] Other prospective basins are the Perth Basin in southwest Western Australia and the Canning Basin in northeast Western Australia.

Gas resources in Western Australia are divided between the offshore Bonaparte, Browse Perth and Carnarvon Basins and the onshore Canning and Perth Basins. Naturally occurring, conventional hydrocarbons dominate the offshore basins, while shale gas resources (SGR) dominate the onshore basins. A portion of the Bonaparte Basin is served by pipeline connectivity to Darwin, while the Carnarvon Basin is connected to the Perth domestic gas market via the Dampier-Bunbury pipeline. A LNG gas hub is proposed for the Browse Basin at James Price Point, approximately 80km north of Broome. The shale formations in both the Perth and Canning Basins occur at great depth, generally below 2500m.[22] It is important to note that Western Australia is not considered prospective for CSG, and there are currently no coal seam gas operations in Western Australia.[23]

The estimated recoverable reserves of naturally occurring hydrocarbons in Western Australian offshore basins are 156.9 Tcf.[24] Onshore, the EIA estimates that the technically recoverable

[20] Ibid, 2-3.

[21] Beach Energy, 'Major and Historic Success at Australia's First Shale Gas Well' (Media Release, Ref. #085/11, 12 July 2011) <http://www.beachenergy.com.au/IRM/Company/ShowPage.aspx/PDFs/2260-52126057/MediaReleaseHoldfast1>.

[22] Department of Mines and Petroleum, above n 3.

[23] Ibid.

[24] Department of Mines and Petroleum, Government of Western Australia, *Western Australian Mineral and Petroleum Statistics Digest 2010* (2011), 19 <http://www.westernaustralia.cn/File_network/2010%E5%B9%B4%E8%A5%BF%E6%BE%B3%E5%B7%9E%E7%9F%BF%E4%BA%A7%E7%9F%B3%E6%B2%B9%E8%A1%8C%E4%B8%9A%E4%BB%8B%E7%BB%8D.pdf>.

reserves of shale gas are 288 Tcf.[25] Western Australia has demonstrably huge SGR, almost double the recoverable offshore gas reserves. As such, it is inevitable that the recovery of SGR will dominate Western Australia in years to come. Given that well stimulation, including hydraulic fracturing is likely to be required to recover much of the recoverable SGR, there will be an increase in the use of fraccing, requiring an appropriate regulatory framework to ensure the effective regulation of shale gas activities.

The recovery of shale gas is essential to meet growing needs for energy security in many nations, including Australia. Western Australia is particularly dependant upon gas for its energy requirements, with natural gas fired electricity generation in Western Australia far higher than the National Electricity Market (NEM) in the eastern States (60% natural gas in Western Australia compared to 12% coal seam and natural gas combined). The high dependence on gas-fired electricity combined with tight domestic gas supply has led to concerns about electricity production in Western Australia, especially peak production.[26] There are also indications that the demand for natural gas will continue to increase strongly as climate change mitigation policies influence electricity generation.[27] This demand will require an increased investment in domestic supply infrastructure and sources of gas, of which SGR is likely to become a major source of supply in a manner similar to the USA.

The National Energy Assessment recognises that the security of Western Australian natural gas supplies is already low (economic and social needs may not be met and the energy system is significantly affected by major shocks). Over time, and through to 2023, the Assessment suggests that domestic natural gas supplies in Western Australia will be increasingly dependent on the economies of scale achieved in production infrastructure developed to supply LNG exports.[28] Indeed, technological advancements in LNG processing and transport in the last 10 years has strongly contributed to the strengthening of the role of gas in the global energy market. Gas transportation from source to market is no longer a victim of 'tyranny of distance', dependent upon the construction of expensive pipelines. Instead, LNG transportation has enabled greater globalisation of gas markets, mirroring the experience of oil markets in the 1970s.[29] This is likely to create a greater desire to export gas rather than sell to the domestic market.

Engineers Australia has expressed reservations regarding the likely effectiveness of the domestic

[25] US Energy Information Administration, above n 3, 9-11.

[26] Engineers Australia, *WA Energy 2030 Strategy: Comments on the Strategic Energy Initiative Discussion Paper* (Engineers Australia, 2010) , 7 <http://www.engineersaustralia.org.au/sites/default/files/shado/Representation/Government%20Submissions/2010/western_australia_energy_2030_strategy_feb_2010.pdf>.

[27] Ibid, 6.

[28] Ibid, 5.

[29] Paul Stevens, *The 'Shale Gas Revolution': Hype and Reality* (Chatham House, 2010), 1.

use reserve policy for gas from the Gorgon, Wheatstone and Pluto fields in meeting the future domestic energy needs of Western Australia, noting that it is not the resources but rather getting the gas to markets that poses the greatest challenge to domestic gas supply. The location of 8-12 Tcf (trillion cubic feet) of recoverable SGR in the vicinity of existing pipelines would provide Western Australia with enough energy to power a city of one million people for a period of twenty years. The development of these SGR is essential for the energy security for Western Australia. However, the development of unconventional gas resources, particularly CSG resources in eastern states, has raised many questions regarding the safety of the techniques used to extract the shale gas from its surrounding geology.

4. ISSUES IN THE EXTRACTION OF UNCONVENTIONAL GAS RESOURCES AND THE CAPACITY OF WESTERN AUSTRALIA TO ADDRESS THESE CONCERNS

Shale gas is differentiated from conventional gas sources by the rock formations it is held in, and the technique required when extracting the gas. Whereas gas from sandstone and carbonate fields flow freely, the gas contained in shale formations (and other unconventional gas formations) requires well stimulation to liberate the gas and enable recovery. Fraccing increases the rate at which gas can be produced from a reservoir, providing access to resources that would otherwise be inaccessible or commercially unviable.

What is Fraccing?

One of the primary techniques used for the stimulation shale wells to aid the recovery of this otherwise unrecoverable source of energy is hydraulic fracturing, commonly known as fraccing (or fracking). This technique involves isolating sections of a well in the shale formation, and the pumping of fluids and a proppant (generally grains of sand or other material used to hold the cracks open) down the wellbore through perforations in the casing and out into the shale.[30] The pumped fluid is usually pressurised to over 8000 psi, generating sufficient pressure to fracture the shale formations as much as 1000 feet (300 metres). Fracturing fluids are used in the fraccing process in two ways: to assist in opening up the fracture and to transport the proppant along the length of the fracture.[31]

Chemical Use in Fraccing

The use of chemicals in the fraccing process is necessary for the opening and 'propping' of the shale formation to extract the gas. However, the chemicals that are used have been the subject of

[30] US Environmental Protection Agency, *Hydraulic Fracturing Research Study* (June 2010) <http://www.epa.gov/safewater/uic/pdfs/hfresearchstudyfs.pdf> .

[31] US Environmental Protection Agency, *Hydraulic Fracturing Background Information* (2011) <http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_hydrowhat.cfm>.

much controversy. Such controversy has particularly surrounded the use of the chemicals Benzene, Toluene, Ethylbenzene and Xylenes, commonly known as BTEXs. These chemicals are mainly found in petroleum products, and have been implicated in health issues such as cancer and nervous system disorders.[32] There has been a major call to ban BTEXs both in Australia and internationally. NSW announced a permanent ban on BTEX compounds on 21 July 2011, citing 'community concerns', particularly in major agricultural areas in the Gunnedah Basin.

Given the controversy over fraccing chemicals, some companies involved in fraccing have commenced publishing the chemicals that are used in shale gas operations. The public appreciates such transparency. Halliburton is one such company, disclosing all fluids used in the fraccing process.[33] The disclosure of chemicals that may be used in the fraccing of unconventional gas reserves has been embraced by Australian industry, with disclosure of the chemicals that may be used in fraccing fluid found on the industry association website in the public domain.[34] This provides the public with the capacity to access information about the chemicals that are generally used in the fraccing process.

This disclosure of the chemicals that are used in the process does not provide information or assurance to the public as to what chemicals are being used in an area of fraccing activity. In order for the Western Australian community to be fully informed on the use of chemicals in fraccing activities, the Western Australia government should consider the listing of chemicals used in individual fields and well activities. Whilst it will not be possible to disclose chemical formulations and percentage, the names of chemicals used in each field or well should be provided to the public. In doing so this may assist in not only ensuring openness and transparency in the use of fraccing operations within the Western Australian community, but also assist companies in building trust with the Western Australia community who are concerned with the use of such chemicals in their local areas.

Impact of Hydraulic Fracturing on Water Resources and its possible effect in Western Australia

Although fraccing has been a technique employed for the recovery of gas for over 60 years, its recent use to recover shale gas deposits has increasingly been scrutinised, primarily related to the use of water in the fraccing process. This concern over the impact of fraccing on water resources

[32] Frederic Leusch and Michael Bartkow, Griffith University, Smart Water Research Centre, *A Short Primer on Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) in the Environment and in Hydraulic Fracturing Fluids* (7 November 2010) < http://www.ehp.qld.gov.au/management/coal-seam-gas/pdf/btex-report.pdf>.

[33] This disclosure can be seen at: Halliburton Hydraulic Fracturing, *Australia: What's in the Fluids?* (2011) <http://www.halliburton.com/public/projects/pubsdata/hydraulic_fracturing/fluids_disclosure.html>.

[34] Australian Petroleum Production and Exploration Association (APPEA), *CSG Fraccing Chemicals* (January 2011) <http://www.appea.com.au/csg/factsheets/1050-fraccing-chemicals.html> .

has prompted the US Environmental Protection Agency (EPA) to undertake a study on the potential impacts of hydraulic fracturing on drinking water resources.[35]

The overall purpose of the study is to understand the relationship between hydraulic fracturing and drinking water resources, examining the conditions that may be associated with the potential contamination of drinking water resources, and to identify the factors that may lead to human exposure and risks.[36] Highlighting the importance of analysing the impact of fraccing on water resources, the EPA study will address the full lifecycle of water in hydraulic fracturing: water acquisition, the mixing of chemicals, the fracturing process and the post-fracturing stage, including the management, treatment and disposal of flowback and produced water.[37]

Fraccing is a water intensive operation, since it requires millions of litres of water in each fraccing. Estimates from US fraccing in the Marcellus formation indicate that water use of up to 5 million gallons per well would not be unexpected,[38] and in the Burnett formation, water use per well varies from 1.2-3.5 million gallons.[39] Water, along with chemicals and sand, is pumped into a geological formation at high pressure during the fraccing process, where it serves two purposes. Firstly, when the fluid pressure exceeds the rock strength, the fluids and associated chemicals open or enlarge the fractures in the rock.[40] Once these fractures have been created, the water transports the chemicals and proppants necessary to assist the formation pores to remain open, enabling gas to escape.[41]

Such high use of water requires adequate water management policies to manage its use. Such a policy needs to be balanced with other uses of water, particularly for agricultural and drinking purposes.

Use and Depletion of Ground Water Resources

As the development of shale gas increases, it is likely that shale gas development could compete with other users for the same groundwater resources. This is a particularly important issue in Australia where groundwater is a significant fraction of water used for agricultural purposes,[42]

[35] US Environmental Protection Agency, *Draft Plan To Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources* (February 2011) <http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/upload/HFStudyPlanDraft_SAB_020711-08.pdf> .
[36] Ibid, vii.
[37] Ibid, vii.
[38] Calculated from reports relating to water use in Anthony Andrews et al, *Unconventional Gas Shales: Development, Technology and Policy Issues*, above n 12, 11.
[39] Anthony Andrews et al, above n 12.
[40] US Environmental Protection Agency, above n 35.
[41] Ibid.
[42] Ibid.

particularly from the Great Artesian Basin (GAB).[43] In some rural and remote areas groundwater sources, especially the GAB, also provides drinking water for those communities. The use of additional groundwater for shale gas extraction creates conflict in the use and management of groundwater resources. This conflict arises as many competing water uses vie for the use of the limited water resources available, and this competition is especially crucial in the use of the GAB. Indeed, the *National Water Initiative* (NWI) has long recognised the special water requirements of the mining and petroleum sector. Clause 34 of the NWI[44] notes that specific mining and petroleum proposals need to be assessed according to environmental, social and economic considerations. But further management arrangements for water use in these sectors fall outside the NWI.

In the past few years, there have been many mining and petroleum activities that have competed for the use of water resources.[45] Arguably, the thirstiest of all of these activities is the extraction of CSG in eastern Australia. Studies undertaken for the National Water Commission indicates

> that the Australian coal-seam gas industry could extract around 7500 GL of co-produced water from groundwater systems over the next 25 years, or about 300 GL per year, based on currently known reserves. In comparison, the current total extraction from the Great Artesian Basin is approximately 540 GL per year. These estimates are conservative—other industry and government agency projections show a high level of uncertainty about the scale of the impact. Additional water resource impacts of CSG

[43] A L Herczeg, *Background Report on the Great Artesian Basin: A Report to the Australian Government from the CSIRO Murray-Darling Basin Sustainable Yields Project* (CSIRO, 2008) 2.

[44] Clause 34 of the *National Water Initiative* states:

> the Parties agree that there may be special circumstances facing the minerals and petroleum sectors that will need to be addressed by policies and measures beyond the scope of this Agreement. In this context, the Parties note that specific project proposals will be assessed according to environmental, economic and social considerations, and that factors specific to resource development projects, such as isolation, relatively short project duration, water quality issues, and obligations to remediate and offset impacts, may require specific management arrangements outside the scope of this Agreement.

National Water Commission, Australian Government, *Intergovernmental Agreement on a National Water Initiative* (25 June 2004) <http://nwc.gov.au/__data/assets/pdf_file/0008/24749/Intergovernmental-Agreement-on-a-national-water-initiative.pdf>.

[45] An excellent example of this has been the expansion of the Olympic Dam uranium mine in South Australia. For information regarding the Olympic Dam expansion refer to: Minister for Mineral Resources Development and Minister for Urban Development, Planning and the City of Adelaide, Government of South Australia, *Assessment Report: Environmental Impact Statement Olympic Dam Expansion* (2011), 39-41 <http://sa.gov.au/upload/franchise/Housing,%20property%20and%20land/PLG/Olympic_dam_assessment_report.pdf>.

> extraction include impacts on connected systems that are already fully or over allocated, changes to aquifer structure leading to increased inter-aquifer connectivity, and changes to water availability for other users and the environment.[46]

The extraction of unconventional gas resources, be it CSG or shale gas, utilise the fraccing process, which is heavily dependant upon water resources. The use of water resources from the GAB in NSW and Queensland for CSG extraction has led to conflict over the use of groundwater, with farmers concerned that unconventional gas extraction, in this instance CSG activities, are leading to marked depletion of aquifers in prime agricultural regions. These risks to aquifers are supported by the National Water Commission, which noted that potential impacts of CSG developments, especially the cumulative impacts of multiple projects are not well understood.[47] Further, they conclude that potential risks of CSG activities on water resources include impacts on water users and the environment due to changes in pressure of adjacent aquifers, with consequential changes in water availability.[48]

Currently there are no specific legislative provisions relating to the regulation of CSG Water in Western Australia.[49] The use and management of CSG Water is instead regulated under the State's approval process, including through approval of the Environmental Management Plan (EMP). Under the DMP/Environmental Protection Authority (EPA) Memorandum of Understanding (MoU), when a petroleum activity is likely to impact a water resource area, including a water reserve, a declared or proposed water supply catchment area or groundwater protection system, the Western Australian Department of Mines and Petroleum (WADMP) is required to liaise with the EPA[50] on the proposal, regardless of whether it meets the Significant Outcome Test for referral to the EP Authority under the DMP/EP Authority MoU.

The NWC recommends a number of principles for the management of water use associated with the extraction of CSG (and which apply equally to the use of water for the extraction of other sources of unconventional gas through fraccing). This includes:

- the licencing of water used by fraccing to ensure it is integrated into the water sharing process;

[46] National Water Commission, Australian Government, *The National Water Initiative – Securing Australia's Water Future* (2011), 43.
[47] National Water Commission, Australian Government, *Submission to the NSW Parliament Inquiry into Coal Seam Gas* (2011) Submission No. 100, 1.
[48] Ibid.
[49] Water use and licencing is regulated under the *Rights in Water and Irrigation Act 1914* (WA). The Western Australia government is reviewing this Act and associated regulations at present.
[50] The Office of the EPA is a Western Australian StateGovernment department set up to support the Environmental Protection Authority.

- adequate monitoring of surface and groundwater systems;
- jurisdictional cooperation to ensure consistent approaches to manage cumulate impacts of gas extraction;
- minimise the cumulative impacts of extraction on the water balance, including aquifer reinjection and groundwater trading; and
- integrate water and land-use planning and management to ensure that water planning implications of projects are addressed prior to final development approval.[51]

The management of water resources in Western Australia is undertaken by the Department of Water (WADoW), which regulates access to water under the *Rights in Water and Irrigation Act 1914* (WA). Division 3 of the Act addresses *Underground Water Resources*, and division 3D addresses *Plans for the Management of Water Resources*. Whilst an analysis of the allocation of water rights in Western Australia is outside the scope of this paper, evidence suggests that the current framework for water resources in Western Australia is no longer adequate to meet the State's need to manage water sustainably.[52] Western Australia adopted the NWI in 2006, recognising that the NWI represents contemporary practice for water resources management.[53] In its 2011 Assessment, the NWI recognised that access to and use of water by the burgeoning unconventional gas sector (especially CSG at present) has a number of unique features that need to be addressed by that sector.[54] Further, it recognised that CSG activities have an impact on ground water and surface water resources through both the fracking process and dewatering, having a substantial impact on the water system as a whole.[55] In order for Western Australia to meet the expected water resource requirements for shale gas extraction in a sustainable, integrated manner as recommended by the NWI, the Western Australia government will need to undertake extensive reform of the current water legislation regarding access to water resources. In doing so, it is important that Western Australia incorporates unconventional gas extraction activities into NWI-consistent planning and management arrangements.

Production and Disposal of 'Produced' Water

If millions of gallons of water are pumped into a well, it is logical that this water is returned to the surface as used or 'produced' water. There has been much controversy surrounding produced water, particularly in the extraction of CSG in NSW and Queensland. Produced water from CSG

[51] Department of Water, Government of Western Australia, *Discussion Paper: Water Resources Management Options* (The Department, 2009) 1, 2 <http://www.water.wa.gov.au/PublicationStore/first/89895.pdf>.
[52] Department of Water, Ibid 1.
[53] Ibid.
[54] National Water Commission, above n 47, 13.
[55] Ibid.

differs markedly from water produced from fraccing processes to extract shale gas. Water from CSG is generally briny, as a consequence of the salts in the coal formations.[56] In addition, when fraccing occurs in CSG formations, it is used to assist in dewatering the coal seams. This contributes markedly to the salinity and volume of produced water from CSG activities.[57]

Fraccing produces large volumes of water that contain salts and chemicals. This produced water poses two serious threats to water resources. The first is the contamination of surface water, and is linked to the management of produced water. If the produced water is not sufficiently contained, there is a possibility that runoff from the pond in storm events, or higher than normal rainfall periods may result in overflow of evaporation ponds. This water then contaminates other water sources through runoff. Adequate climatic and hydrological studies are required to assess the risk of contamination form surface water runoff. The second source of water contamination is groundwater. Where unlined evaporation ponds are used, there is risk that contaminants may enter the groundwater system, thus contaminating the ground water resources. Therefore, it is necessary that any undertaking of fraccing must include an adequate management plan for produced water.

Until recently, many management plans for the extraction of shale gas in other jurisdictions have included the use of evaporation ponds and containment pits (lined or unlined) that essentially concentrate the salt of chemicals contained in the produced water.[58] However, unusually high or unexpected rainfall, poor pond design and/or construction has contributed to incidents involving such ponds, with the produced water and its associated salts and chemicals finding their way into ground and surface water resources. In some jurisdictions, including eastern Australia, there is a shift away from the use of such ponds for the treatment of produced water. The use of evaporation ponds for CSG extraction is banned in NSW and Queensland.[59] A report commissioned by the Western Australian Government in July 2011 (the Hunter Report)[60] noted that the WADMP and the Western Australian Department of Water (DoW) currently do not have regulations in place governing the appropriate methods for storage and disposal of CSG **Water.**

[56] Department of Environment and Resource Management, Queensland Government, *Salt and Brine Management in Coal Seam Gas Production* (2011), <http://www.ehp.qld.gov.au/factsheets/pdf/environment/en9.pdf>.

[57] Department of Environment and Resource Management, Queensland Government, *Coal Seam Gas Water Management Policy* (2010), 1.

[58] US Environmental Protection Agency, *Draft Plan To Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources* (7 February (2011) <http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/upload/HFStudyPlanDraft_SAB_020711-08.pdf>.

[59] Under recent amendments to the *Environmental Protection Act 1994* (Qld) the construction of CSG evaporation dams are prohibited. See Department of Environment and Resource Management (Qld), *Coal Seam Gas Water Management Policy* (2010), 3.

[60] Tina Hunter, *Regulation of Shale, Coal Seam and Tight Gas Activities in Western Australia, Final: An Analysis of the Capacity of the Petroleum and Geothermal Energy Resources Act 1967 (WA) to Regulate Onshore Gas Activities in Western Australia.* (2011) <http://www.dmp.wa.gov.au/documents/000041.jason.medd(1).pdf> .

Furthermore, the report noted that most EMPs in WA to date have included the use of evaporation ponds and containment pits (lined and unlined).

Necessarily, as Western Australia undertakes fraccing it will need to develop a strategy for the management of wastewater in line with its commitments to the NWI and the need to integrate water planning as part of its management of petroleum activities. In its NWI Assessment the National Water Commission also recommended that states particularly Western Australia, review their existing mining and petroleum regulatory arrangements to ensure they address water resource impacts. In considering what is an appropriate shale gas produced water management strategy in Western Australia would entail, the Hunter Report noted that the WADMP as regulator of the petroleum activity should consider the physical geology, hydrology, climate and rainfall of the area of activity. In a Statethe size of Western Australia, there may be a need for regional management plans, since there is a diverse range of climates in Western Australia, from the tropical north to the temperate south.

Fracturing of Surrounding Formations Affecting Aquifers

A concern surrounding fraccing in shale gas extraction is the danger of penetrating surrounding aquifers, thereby contaminating the aquifers. This arises since hydraulic fracturing induces new fractures into the shale and propagates fractures for hundreds of metres along the bedding plane of the formation, with the potential to propagate fractures to an overlying aquifer.[61] Such fractures into overlying aquifers have occurred during the fraccing of Marcellus Shale formations in eastern USA, since these formations lie close to the drinking water aquifers for New York State. This has resulted in contamination of drinking water in these formations, and led to the banning of fraccing in the some parts of the Marcellus Basin.[62].

Geomechanics research into fraccing has demonstrated no contamination of drinking water aquifers from thermogenic gas as a result of fracturing outside of the target formations. Instead aquifer contamination has been confined to poor well design and cementing rather than overstimulation of a well leading to fracturing beyond the target formation into drinking water aquifers.[63] A study by several geomechanics from Duke University has concluded that the primary cause of aquifer penetration is poor well design, resulting in aquifer contamination

[61] Anthony Andrews et al, above n 12, 26.

[62] Judge Susan Tucker in the Monongalia County Court, who ruled that the restrictions regarding drilling of the West Virginia Department of environmental Protection, rather than the Morgantown City Council, recently overturned this ban. The Council had banned the practice in response to fears that the activity could contaminate the city's water supply.

[63] Stephen Osborn et al, ' Methane Contamination of Drinking Water and Accompanying Gas-well Drilling and Hydraulic Fracturing' (2011) 108 *Proceedings of the National Academy of Sciences* 8172, 8172- 6 <www.pnas.org/cgi/doi/10.1073/pnas.1100682018>.

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through well failure.[64] The issue of well design and the regulation of well activities are crucial in the regulation of shale activities in Western Australia. It is addressed in section 5 below.

The fracturing of formation into drinking water aquifers has been particularly prevalent in some shale formations in the USA, particularly in the Marcellus Shale Formations where aquifers are close to the shale formation (usually within a few hundred metres), and the shale formations are narrow.[65] Aquifer penetration in the Perth and Canning Basins in Western Australia as a result of fraccing in the shale formations is less likely, since the shale formations are at great depth (over 2000 metres) and well away from aquifers, as well as generally being thick (generally over 100 metres).[66]

5. REGULATION OF UNCONVENTIONAL GAS ACTIVITIES IN WESTERN AUSTRALIA

Although shale gas is the same gas as that contained in conventional gas formations, the recovery of this gas is difficult due to the porosity and permeability of the source rock. However, at present, the policy for the development of shale gas is the same as that for the development of all petroleum resources in Western Australia: the policy of WADMP is to provide a lead agency role in attracting investment in the exploration and development of the state's petroleum resources through the provision of geoscientific information on energy resources, and the management of an equitable and secure titles system. Therefore, the WADMP has two roles in the development of Shale gas resources in Western Australia: a promotional or development role in ensuring the development of the shale gas resource (the government as the developer) and the role of regulating the exploration and production of shale gas resources (the government as the regulator). This duality of function has been criticised for a conflict of interest, most recently in the Montara report relating to the Montara well blowout and subsequent oil spill.[67] The Montara Report was critical of a single agency combining these two functions, recommending that the two functions be split between separate agencies. This issue should be taken under consideration by the WADMP.

As part of its policy to encourage the development of the State's energy resources, the Department of Mines and Petroleum encourages and facilitates responsible exploration and development of production of all petroleum resources. It administers and regulates petroleum exploration and production in accordance with the following Acts and the associated relevant regulations:

[64] Ibid.
[65] Ibid.
[66] Department of Mines and Petroleum, above n 24.
[67] David Borthwick, *Report of the Montara Commission of Inquiry* (2010), 24 <http://www.ret.gov.au/Department/Documents/MIR/Montara-Report.pdf>.

- Offshore petroleum activities in Commonwealth Waters: the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) (OPGGSA;
- Offshore petroleum activities in State Waters: *Petroleum (Submerged Lands) Act 1982* (WA) (PSLA); and
- Onshore petroleum activities: *Petroleum and Geothermal Energy Resources Act 1967* (WA) (PGERA).

Shale gas represents an opportunity for Western Australia to establish security in energy supplies for the State, particularly for urban energy consumers in the greater Perth region. The Varanus Island incident and subsequent major interruption to gas resources in the Perth area highlighted the vulnerability of reliance on gas supply from the North West Shelf and transported along the Dampier-Bunbury Gas Pipeline.

Department of Mines and Petroleum estimates that the Perth Basin holds 9-12 Tcf of recoverable shale gas resources within the vicinity of existing pipelines. This represents a significant gas resource for Perth, since 1 Tcf of gas can provide enough energy to power a city of one million people for 20 years. The use of shale gas from the Perth Basin would provide much needed security of energy supply for the Perth region, independent of the North West Shelf.

Estimates of 288 Tcf shale gas reserves in onshore basins in Western Australia provide unrivalled opportunities for the State to greatly expand its export of LNG resources. Much of the shale gas is found in the Canning Basin, which is located near the proposed LNG processing hub at James Price Point. The recovery of shale gas from the Canning Basin could link with gas recovery offshore, contributing significantly to LNG exports.

Landholder and Land Access Issues in the Development of Shale Gas Resources

When developing its shale gas resources, Western Australia needs to be mindful of conflicting land use and landholder access in shale gas extraction areas. The Perth Basin will present challenges in managing land use conflict and land use access. Of particular difficulty has been the management of agriculture and tourism in the Margaret River region alongside coal seam gas and shale gas activities. However, in July 2012 the Western Australia government issued a permanent blanket ban on coal mining activities (including CSG) over the Vasse coal Resource Area in the Margaret River region in southwestern Western Australia.[68]

At present the Western Australian government has not developed a statewide land access policy framework, or legislative provisions regarding land access. This is not unusual, given that

[68] Council of Minerals and Energy Western Australia, 'Coal Mining Excluded from Margaret River' (Media Release, 24 July 2012) <http://www.cmewa.com/News,_Events_and_Media/News/NewsDetails/Coal_Mining_Excluded_From_Margaret_River>.

Queensland only developed the policy framework and Access code in 2010, many years after commercial CSG production commenced in that State.[69] In Queensland, the Land Access Code was crucial, given the overlap of coal mining, coal seam gas, and agricultural activities in the Bowen and Surat Basins in Queensland. In the Canning Basin will present its own particular challenges. In particular, there will be a need to manage indigenous land use and native title claims with fraccing operations. Although overlapping land use is not as great an issue in Western Australia as it is in Queensland, there are numerous challenges in developing Western Australia's unconventional gas resources. These particularly relate to the use of groundwater (especially in areas of low rainfall), the management of produced water (especially in areas of high rainfall), and well integrity, especially where hydraulic fracturing techniques are employed.

Historical Use of Fraccing in Western Australia

Fraccing was established as a method of well stimulation for commercial use in gas wells since the 1940s. The technique has been used infrequently in Western Australia for over 40 years, to assist with the recovery of gas from conventional wells. In particular the micro fraccing processes has been utilised to recover the Barrow Island gas deposits since the 1970s.

Current Shale Gas Activities in Western Australia

The use of fraccing for the recovery of shale gas is a relatively recent phenomenon in Western Australia, and very much in its infancy. To date four wells utilising fraccing of onshore shale gas reservoirs have occurred.[70] This is compared to more than 5000 CSG wells that have been drilled in Queensland in the last 15 years.[71] In each well, in Western Australia, fraccing occurred at depths greater than 2500m, substantially below groundwater aquifers.

It is important to note that shale gas activities in Western Australia are still at the exploration and appraisal phase. There have been only a handful of wells drilled in the Perth and Canning Basin. All have been exploration wells, used to determine the extent of the shale gas reserves in that field. To date small players have undertaken the exploration activities in the shale gas basins. This presents particular challenges to WADMP as regulator, since these operators may not have

[69] Refer to: Department of Natural Resources and Mines, Queensland Government, Mining Exploration and Petroleum, *Land Access Policy Framework* (2011) < http://mines.industry.qld.gov.au/mining/land-access-policy-framework.htm> and Department of Employment, Economic Development and Innovation, Queensland Government, *Land Access Code, November 2010* (2010) <http://mines.industry.qld.gov.au/assets/land-tenure-pdf/land_access_code_nov2010.pdf>.

[70] Department of Mines and Petroleum, above n 24.

[71] Michael Roarty, *Background Note: the Development of Australia's Coal Seam Gas Resources* (Parliament of Australia, Department of Parliamentary Services, Parliamentary Library, 2011) <http://parlinfo.aph.gov.au/parlInfo/download/library/prspub/957068/upload_binary/957068.pdf;fileType=application/pdf#search=%22background%20note%20%28parliamentary%20library,%20australia%29%22>.

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the personal or corporate knowledge of well design that may be available to large, international companies. Such lack of company knowledge and/or experience was identified by the Montara Commission Of Inquiry (MCI) as a root cause of the Montara well blowout and subsequent oil spill.[72] The entry of inexperienced companies into unconventional gas exploration and production activities places responsibility on the regulator (in this instance the WADMP) to not only ensure that the fraccing operations are conducted in a manner that will ensure the integrity of the wells and the management of produced water to avoid contamination of water resources, but also that the public has confidence in the regulator as they carry out this role. It is only robust regulatory framework executed in a transparent manner by a knowledgeable and independent regulator.

Regulatory Framework for Onshore Shale Gas in WA

Onshore petroleum activities in Western Australia, including shale gas activities (since shale gas is petroleum as defined under PGERA the same gas as gas recovered from other reservoirs), are regulated under the *Petroleum and Geothermal Energy Resources Act 1967* (WA) (PGERA) and the associated *Schedule of Onshore Exploration and Production Requirements – 1991* (the 'Schedule'). The Schedule contains many provisions that are generally found in Regulations, including environmental, drilling, reporting and data, regulation of production, geological and geophysical surveying and reporting requirements.

The Schedule was established in 1991 when there was a clear focus on the recovery of conventional oil resources, and the regulation of petroleum operations tended to be prescriptive than objective based.[73] Regulations attached to PGERA include the *Petroleum and Geothermal Resources (Management of Safety) Regulations* (PAGER (MoS)R) and the *Petroleum and Geothermal Energy Resources (Occupational Health and Safety) Regulations* (PAGER(OHS)R).

The PGERA purports to regulate across the entire petroleum chain (outlined in figure 1 below), from exploration, through the appraisal, development and production phases to abandonment of the field as petroleum activities cease.

[72] The MCI concluded that PTTEPAA did not observe sensible oilfield practices at the Montara Oilfield. Major *shortcomings in the company's procedures were widespread and systemic, directly leading to the Blowout.* See Borthwick, above n 67, 6.

[73] Objective-based regulation replaced the more prescriptive-based regulation that dominated petroleum activities from the late 1960s. The use of objective-based regulation arose out of the Cullen Report, in response to the Piper Alpha platform accident in the North Sea in 1988. For a discussion on the development of objective-based regulation see Tina Hunter and John Paterson, 'Offshore Petroleum Facility Integrity in Australia and the United Kingdom: A Comparative Study of Two Countries Utilising the Safety Case Regime' (2011) 9(6) *Oil Gas and Energy Law Journal* <www.ogel.org>.

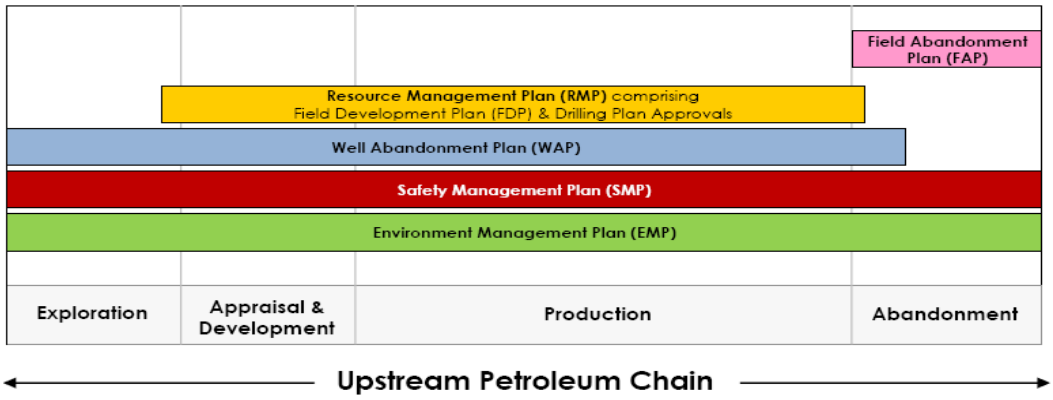

Figure 1: The upstream petroleum chain. Source: Compiled by Author

The PGERA regulates the drilling of wells (Division 2), the granting of production licences (Division 3) and the registration of the titles (Division of 4), as well as providing general provisions under Division 5. Royalties and fees are regulated in Division 7 of the PGERA.

Regulation of onshore petroleum resources is premised around three pillars, illustrated in figure 2 below:

1. Safety;
2. Environment; and
3. Resource management.

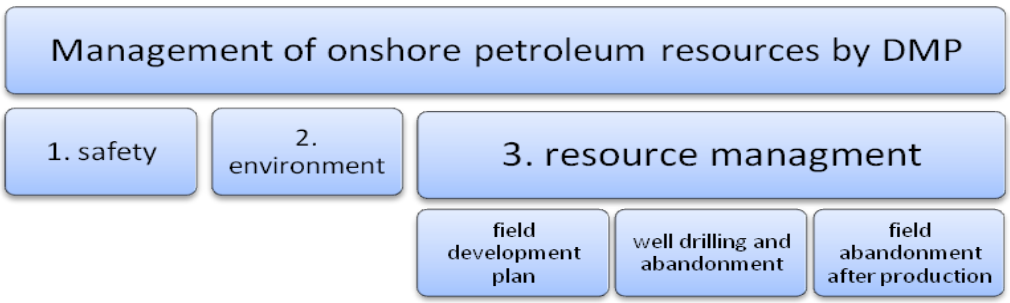

Figure 2: The regulation of the upstream petroleum chain at WADMP. Source: Compiled by Author

Each of these pillars contains penalties that are prescribed when an offence is committed under the relevant legislation. This paper examines the capacity of the Schedule to not only outline the

offences and commensurate penalties, but to also determine whether the relevant Schedule contains provisions for the enforcement of those penalties.

1. Regulation of Safety in Shale Gas Activities in Western Australia

Comprehensive legislative provisions outlined in Part IIIA and Schedule 1 of the PGERA regulate the safety of onshore petroleum operations. In addition, the PAGER (MoS)R and PAGER(OHS)R establish a comprehensive regulatory regime for the occupational health and safety of workers and the management of safety through the application of a safety case regime. Together these establish a comprehensive framework for the regulation of safety at onshore petroleum facilities, including offences, penalties, and enforceability of those penalties. The effectiveness of the petroleum safety framework is outside the scope of this paper.

2. Regulation of the Environment in Shale Gas Activities in Western Australia

The regulation of the environment in relation to petroleum activities is undertaken by the WADMP under the PGERA. All applications for permits and licences for petroleum exploration or production in Western Australia are required to be accompanied by an Environmental Management Plan (EMP).[74] Where a proposed petroleum activity potentially impacts upon declared/reserved/managed lands under the *Conservation and Land Management Act 1984* (WA), the WADMP liaises with the Department of Environment and Conservation (DEC) on case-by-case basis to determine whether the EMP should be referred to the DEC. The WADMP/EPA MoU sets out a process that will determine whether referral to the EPA is required. It also outlines any factors that need to be considered.[75] If the DEC determines an assessment is required, recommendations are made to the WADMP subsequent to this assessment process, establishing conditions of approval for the proposed petroleum activity. [76]

Where there is no referral to the DEC, regulation of the environment will be governed by the PGERA. There are no provisions in PGERA that specifically pertains to the management of the environment in onshore petroleum activities. Environmental protection is provided under s 95 of

[74] *Petroleum and Geothermal Energy Resources Act 1967* (WA), *Schedule of Onshore Exploration and Production Requirements – 1991*, clause 114 <http://www.dmp.wa.gov.au/documents/schedule_onshore_PGERA67%281%29.pdf>.

[75] Memorandum of Understanding between the Department of Mines and Petroleum and the Environmental Protection Authority in Relation to the Referral of Mineral and Petroleum (Onshore and Offshore) and Geothermal Proposals (26 June 2009) < http://www.dmp.wa.gov.au/documents/Environmental_Protection_Authority.pdf> and <http://edit.epa.wa.gov.au/EPADocLib/EPA-DMP-MOU.pdf>.The conditions of referral are set out under Part 5 and Schedule 2 of the MoU.

[76] Department of the Environment, Water, Heritage and the Arts, Australian Government, *Environment Protection and Biodiversity Conservation Act 1999, Guidelines for an Environmental Impact Statement for the Proposed Prelude Floating Liquefied Natural Gas Facility Western Australia Shell Development (Australia)Pty Ltd* (EPBC 2008/4146) <http://www-static.shell.com/static/aus/downloads/about_shell/prelude/appendix.pdf>.

PGERA, which confers authority on the Minister (or delegate) to give a direction to the leaseholder. The direction to protect the environment arises in clause 114 of the Schedule. Under cl 114 (3), the Operator is required to have an approved code of environmental practice relevant to the area of operations. This establishes an implied legislative authority by the WADMP to demand an Environmental Plan (EP) or Environmental Management Plan (EMP) from the titleholder. Otherwise, legal enforceability of environmental protection (the requirement of an EMP or EP) can be required as a condition of a title or an approval for an operation (eg. drilling or seismic).

Under the current legislative framework, the PGERA requires compliance with a Direction under s 95. Failure to comply with a direction will result in a fine of $5000 or $10000 under s95 (2c), s95 (6) or s96. Compliance with environmental requirements could also be achieved by cancellation of a title, although to date this has not occurred. Hence, there are few enforceability tools that enable the protection of the environment under the Schedule.

Legal requirements for, and enforceability of EMPs under the PGERA is at present merely a requirement for an 'approved code of practice' under The Schedule. In order for the requirements to be clear and unambiguous, Regulations for environmental aspects of shale gas extraction should be implemented as soon as possible under the authority granted by s153 of PGERA.[77] These Regulations should be similar in structure and substance to the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations* wherever possible, in order to reduce regulatory burden on titleholders and ensure uniformity in the regulation of the environment in onshore and offshore jurisdictions.

3. Regulation of Resources Management and Administration in Western Australia

Drilling Program Approvals

The drilling or fraccing of an onshore well is regulated in a manner similar to the regulation of the environment and EMPs for onshore petroleum activities. Well drilling and workover is legislated under s95 of PGERA, which confers authority on the Minister (or delegate) to give a direction to the leaseholder. The direction to regulate drilling arises under Part V of the Schedule, requiring the Operator to have an approved drilling program in order to undertake drilling operations. Similar to the penalty of failing to comply with environmental directions such as the EMP under cl 114, failure to comply with a drilling direction under the Schedule will result in a fine of $5000 or $10000 under s95 (2c), s95 (6) or s96. Whilst an offence (failure to comply with a drilling direction) and penalty for the offence under s 95 of the PGERA), the

[77] Section 153 of PGERA provides that the Governor of Western Australia may make regulations prescribing all matters that by the Act are required or permitted to be prescribed, are necessary, or convenient to be prescribed for carrying out or giving effect to the Act.

Schedule does not make provisions for the enforcement of the penalties. In order for drill programs executed under the Schedule to become legally enforceable, resource management regulations should be drafted to include enforcement provisions similar to those under the PAGER(MoS)R and PAGER(OHS)R, which are presently lacking in the Schedule. These Regulations should be similar in structure and substance to the *Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations* wherever possible, in order to reduce regulatory burden on titleholders and ensure uniformity in the regulation of the petroleum resources in onshore and offshore jurisdictions.

Management of Produced Water after Well Abandonment

Well abandonment can occur at any stage of the upstream petroleum chain. Generally wells are abandoned in exploration and appraisal phases of the petroleum chain, although wells are also abandoned during the production phase. The abandonment of the well is considered and approved as part of the drill program approval process. Usually this is adequate, since well abandonment is relatively straightforward in most formations. However, in shale gas wells that have been fracced, there is the added need to regulate water that has been produced from a well (be they exploration, appraisal or production wells. At present s95 of PGERA regulates this produced water under the general authority conferred on the Minister (or delegate) to give a direction to the leaseholder. The management of such water should form part of an EMP; however at present there is limited capacity to enforce a management plan under PGERA and the Schedule. Therefore, the regulation of produced water should be included as part the Regulations for environmental management of onshore petroleum activities,

Abandonment of Licence Area

The abandonment of a licence area, at the end of petroleum activities is regulated under the broad umbrella of s95 of PGERA, which confers authority on the Minister (or delegate) to give a direction to the leaseholder. Although sections 98 and 99 of the PGERA addresses the surrender of a title or permit, the Act fails to specifically address the abandonment of an onshore licence area after the area has either completed production, or abandoned due to lack of prospectivity. This is possibly attributable to the age of the legislation (it was drafted in 1967), and the phase of onshore activities, which are presently focussing on exploration, development and production. However, there is a need for legislative provisions to regulate field abandonment. Therefore, it is prudent that legislative amendments be introduced to implement legal regulation of field abandonment. These legislative requirements will be required in both the PGERA, and associated resource management and administration Regulations that require drafting and implementing.

6. IS THERE A NEED FOR A SPECIFIC SHALE GAS REGULATOR IN WESTERN AUSTRALIA?

In 2011 the Queensland Department of Environment and Resource Management (DERM) established an LNG Enforcement Unit (LNGEU). This unit was established to monitor CSG operators and operations, to ensure compliance with laws and policies that affect the extensive LNG industry within the state.

The strength of the LNGEU is the multi-disciplinary nature of the unit, comprising staff from DERM and the Department of Employment, Economic Development and Innovation (DEEDI). It includes environmental, groundwater petroleum and gas safety specialists, as well as staff specialising in land access issues.

The major role of the LNGEU is the regional coordination of compliance activities and a whole-of-government approach to managing complaints. It is designed to act as a one-stop shop to respond to land access and environmental concerns for CSG issues, as well as managing and investigating complaints relating to CSG activities.

The scale of CSG operations in Queensland (over 40,000 wells are expected to be drilled in the next five years) and the organisational structure for the regulation of CSG and LNG activities in Queensland has necessitated the establishment of the LNGEU. However, the low number of fracced wells that have been drilled in Western Australia to date does not warrant the establishment of a similar LNGEU in Western Australia at present. However, should the volume of onshore shale gas wells increase markedly, coupled with community concerns over land access and environmental issues, it may be necessary for the WADMP to reconsider the establishment of a LNGEU similar to that established in Queensland.

It is also important to note that it is likely that large-scale shale gas extraction activities are likely to fall under the auspices of the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (EPBCA), particularly in relation to fraccing activities. Should the EPBCA apply, the Commonwealth Department of Sustainability, Environment, Water, Population and Communities will be involved in the regulation of unconventional gas activities. The regulatory role of the Commonwealth in the development of unconventional gas resources is the topic of intense consultation at the time of publication, as part of the development of the *National Harmonised Framework for Coal Seam Gas* (NHFCSG).[78]

CONCLUSION

Current shale gas activities in Western Australia are regulated under the *Petroleum And Geothermal Energy Resources Act 1967* (WA). This paper has assessed the capacity of the Act to

[78] For information on the NHFCAG, refer to Standing Council on Energy and Resources, *Coal Seam Gas*, (2011) <http://www.scer.gov.au/workstreams/land-access/coal-seam-gas/.

regulate all aspects of the exploration and development of shale gas resources, and found the Act lacking in many areas. Whilst this act provides the legal framework for regulation of titles and safety for petroleum and geothermal energy resources, it does not adequately regulate access to land, well operations and well design, or environmental management. In addition, it has identified that the regulation of water, both its use and the management of produced water, needs to be integrated into the regulation of shale gas activities in Western Australia. In addition, the Act fails to adequately address the management of well abandonment.

This lack of regulation is primarily attributable to the use of a Schedule to regulate all aspects of well operations and design, as well as environmental management, rather than the use of Regulations as delegated legislation. In order to ensure the legally enforceable and binding regulation of all aspects of petroleum activities, including environmental management plans, it is essential that the Western Australia government implement resource management and environmental regulations under section 153 PGERA. In addition, the resource management regulations will also need to address the issue of land access to ensure that conflict in land use is minimised.

To date, there have been very few instances of fraccing of shale formations in Western Australia. However as petroleum majors such as ConocoPhillips begin to acquire interests in onshore shale gas industry, it is only a matter of time before the number of wells fracced will increase dramatically, similar to the exponential growth in the number of wells fracced in Eastern Australia as CSG resources are developed. Rather than playing regulatory catch-up, it is essential that the Western Australian regulatory framework for the exploration and development of shale gas is comprehensive, implemented prior to the increase in fraccing activities. By implementing resource management and environmental regulations and integrating water management with the resource development legal framework, as recommended by the National Water Commission, the regulation of shale gas activities in Western Australia will be comprehensive, capable of adequately managing the expected increase in shale gas activities and concurrent community expectations.