IS THERE A DROP TO DRINK?

An Issues Paper on the Management of Water Co-produced with Coal Seam Gas

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PART I – INTRODUCTION

Overview

Coal seam gas is a mixture of hydrocarbons found in coal seams. Due to the highly fractured nature of coal seams and the phenomenon of adsorption, coal is capable of holding large volumes of gas. The gas is held in the coal by overlying impervious layers of rock and because of burial pressure, the gas starts to flow when the impervious layers are breached and the accompanying water is released. Generally, the more water that is extracted, the more gas a well will yield, with production of gas increasing as production of water decreases.

Substantial quantities of groundwater, known as *associated water*, are pumped out to enable gas to be extracted from coal seams in, especially, the Surat Basin. Current legislation vests entitlement to the water (for purposes consistent with a petroleum activity) in the gas companies. An environmental authority issued by the EPA specifies the requirements for environmental management and disposal. The companies may sell the water to a third party, but it then enters the water licensing regime and is subject to the *Water Act 2000*. Development approval under IPA may also then be required for the third-party activity.

Companies have obtained permission from the EPA to dispose of the water mainly in large evaporation basins, though some are negotiating with landholders to desalinate it for rural use. One company in the Dawson catchment has permission to discharge to the watercourse.

Although the life of individual wells is only 10-30 years, it is expected that gas will be extracted from the Surat Basin overall for 50 years or more. Some thousands of wells will be drilled, up to 120 or even more for a single tenement. Typically, wells will be spaced 1.5 km apart or closer, connected by pipes and tracks. Importantly, there is insufficient field history within Australia to make confident predictions of the likely life or performance of wells.

Many of the waters contain sodium and bicarbonate salts and are unsuitable or only marginally suitable for irrigation or drinking. However, quality is variable and some waters are quite fresh. For example, the salinity in the Fairview/Spring Gully field reportedly varies from "almost zero" (probably several hundred ppm) in the north to about 6000 ppm in the south. These figures should be compared with the quality of water from most of the aquifers in Queensland's Great Artesian Basin, containing between 500 and 1,000 ppm total dissolved solids. Although no environmental approvals are required to use water of this standard, the operator is still required to observe the statutory requirement not to cause environmental harm.

The salts break down the structure of irrigated soils and also potentially add to the salt load of inland streams. Desalination is technically feasible but expensive and leaves an even more highly concentrated (though lower volume) residue. A small reverse osmosis plant to desalinate this waste water has been contracted to augment Dalby's town supply but the $10 million cost requires subsidies: one third of the total will be from the Australian Government, two-thirds from the Queensland Government, Dalby Council and Arrow Energy.

The water management regime that has been established is built on four principles:

- gas producers are entitled to take the associated water as of right;
- the companies accept an obligation to monitor the consequences of this take;
- the companies have an obligation to make good any loss suffered by established users;
- environmental authorities are required for these activities and these may be conditioned.

Purpose of this Paper

This paper investigates the management of water that is produced when gas is extracted from coal seams, in Queensland's Surat Basin in particular. The purpose is to serve as a background paper to identify the issues which this industry presents to governments and to place those issues in context and perspective. Eventually, it should be useful to inform:

- policy formulation by the Queensland Government;
- investment decisions by petroleum and gas companies; and
- planning and investment by local governments and water service providers.

This policy analysis was initiated because regional staff of the former Department of Natural Resources, Mines and Water were fielding questions from various stakeholders (e.g. irrigators' associations, landcare groups, NRM bodies and individuals) wanting some assurance that the Department is monitoring the potential impact of CSG operations on existing water bores and also the potential leakage from evaporation ponds. There is also substantial community concern not to waste a potentially valuable resource.

The coal seam gas industry is an important rapidly developing energy resource for Queensland, as recognised by the Premier's attendance at key events, such as the opening of the Spring Gully and Braemar gas-fired projects. But no strategy for reconciling the concerns identified above with the Government's desire to develop the coal seam gas industry yet exists.

Subjects covered

In particular, this paper:

- references some factual information about the industry;
- reviews the procedures involved in granting environmental and other permits for extracting coal seam gas and associated water and how they interact with each other;
- explores whether the statutory regimes adequately protect the public interest and the interests of those with acknowledged rights over resources, particularly groundwater;
- presents some findings resulting from the analysis, leading to:

- issues requiring policy attention; and
- specific actions which the three main departments (EPA, NRW and DME) should take.

Definitions

ATP = Authority to Prospect

CSG = coal seam gas, coal seam methane, coal bed methane (US)

DA = Development Approval

DME = Dept Mines & Energy

EA = Environmental Authority

EMP = Environmental Management Plan

EPA = Environmental Protection Agency

EP Act = *Environmental Protection Act 1994*

EP Reg = *Environmental Protection Regulation* 1998

EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999* (Clth)

ERA = Environmentally Relevant Activity

IDAS = Integrated Development Assessment System

IPA – *Integrated Planning Act 1997*

LPro = *Land Protection (Pests and Stock Routes) Act 2000*

LWMP = Land and Water Management Plan

ML = megalitre (of water)

MR Act = *Mineral Resources Act 1989*

NRW = Dept Natural Resources and Water; NRMW = former Dept of Natural Resources, Mines and Water

P Act = *Petroleum Act 1923*

PAG Act = *Petroleum and Gas (Production and Safety) Act 2003*

PAG Reg = *Petroleum and Gas (Production and Safety) Regulation 2004*

PL = Petroleum Lease

PPL = Petroleum Pipeline Licence

ppm TDS = parts per million total dissolved solids (seawater is c.35,000 ppm; 500 ppm the upper limit for drinking water and 1000 ppm the upper limit for potable human consumption, 5000 for cattle but lower limits may be appropriate depending on composition, duration of exposure, climatic conditions and other factors)

RPP = Riverine protection permit

State Works Act = *State Development and Public Works Organisation Act 1971*

W Act = *Water Act 2000*

WCM = Walloon Coal Measures

W Reg. = *Water Regulation 2002*

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The input of members of the interdepartmental reference panel is appreciated. I am also grateful for good faith input from a large number of knowledgeable people inside and outside the Government.

Circumstances conspired to cut short by more than two weeks the amount of time available to complete the report.

The analysis is grounded in investigation undertaken primarily in regard to the Surat Basin. Although it is not specifically limited to that area, its findings will not necessarily be applicable to operations in different coal measures and different regions. For example, salinity is not such a concern in the Bowen Basin as in the Surat Basin. The volumes of associated water are lower and there has been a longer association with the coal industry. Also, there are other water-related difficulties in the Bowen Basin: for example, the long lengths of levee banks proposed in the flood plains of major rivers; the proposal by Xstrata to long-wall a 6m coal seam underneath a healthy groundwater field which will

no doubt thereby be dispersed; and the large size of open coal pits exposed to air.

The paper does not assess whether there is a need for additional staff or budget.

Consultation with Stakeholders

The analysis has benefited from selective non-public consultation with landholders' representatives, the gas companies, the Australian Coal Seam Gas Council and APPEA, local governments, the University of Queensland's Centre for Water in the Minerals Industry, State departments and various others.

Two relevant reference panels: an interdepartmental one and the quarterly meeting with the Australian Coal Seam Gas Council, met during the period of analysis.

Although some of the main emerging findings have been discussed with the spokespeople for the industry and would not be a surprise to them, the text as such has not been passed in front of the industry.

Finding: A version of this text, edited to remove some of the more internally-focused criticisms of government authorities, should be made available for managed consultation with representatives of the industry. This is to firstly, validate factual information; secondly, confirm the perspective adopted and the key findings; and thirdly to demonstrate good faith in what is a genuinely shared set of challenges.

Literature Search

There is a rich geological and engineering literature from the USA where coal seam gas has been extracted since the 1980s. While this offers a relevant guide to technical considerations, it is of little relevance to Queensland's statutory regimes and policy which are the main focus of this paper. Also, each field is geologically idiosyncratic.

A 2004 consultants' report by Parsons Brinckerhoff co-sponsored by this Department and industry offers a useful overview of the issues. However, the report by itself is an inadequate foundation for policy formulation, for three main reasons:

- the range of sources on which it has relied is narrow and for many subjects is confined to a single US reference;

- many references are cited or quoted without evaluation and without much context. This gives a cut and paste presentation which detracts from confidence in its depth and scholarship;

- throughout the report, there are references along the following lines "the proposed new petroleum and gas legislation will ensure that monitoring and environmental control are adequate". A consulting company is not a position to make optimistic judgements about how well a regime is administered before it even exists.

The Parsons Brinckerhoff report has not yet been endorsed by the Government and does not represent Government policy. This paper is the next successor to it and has the benefit of the industry's experience over another two years.

Market Considerations

This paper is focused on the management of associated *water*, so the production and marketing of *gas* are outside the scope. However, some comments on the commercial forces driving the industry and the likely trends are necessary to place the production of water in context.

First, the significance of the CSG industry to Queensland's economy is difficult to exaggerate. As industry personality Richard Cottee (QGC) has declaimed, CSG has "moved from the esoteric to essential in a very short time". As global prices for petroleum rise in the wake of peaking production of oil, the existence of a convenient portable fuel such as CSG in large quantities can only grow. Queensland is fortunate to have such a valuable gas resource, which is

remarkable on an international stage. It behoves the Government to ensure that it is managed and husbanded for the long-term benefit of this State.

On the other hand, the predictions by some of the industry's more outspoken enthusiasts of unlimited growth will certainly not come to pass. Even though gas is more greenhouse friendly than coal as a source of electricity/energy, it is substantially less greenhouse friendly than energy conservation. The world is facing severe economic and societal disruption on account of climate change and it is quite certain that there will be major shifts in policy in the forthcoming years. As I write this text, Victoria is grappling with the worst bushfire conditions in memory, *six weeks earlier* than they would normally have been expected even in a dry year. Bushfire and dwindling water supplies will focus governments' attention mightily on the consequences of continuing to consume fossil fuels of whatever kind.

Third, the Government's policy directive that 13% of Queensland's electricity is to be met from non-coal sources has switched on demand for gas. No decision better demonstrates the truth that markets do not enjoy an autonomous existence: they are facilitated by government policy (along with the rules of property, contract and corporations); and they can be shaped by changing the statutory and policy context.

Fourth, the deliberate fostering of a competitive market has had the intended outcome of establishing CSG as a significant player on the Australian energy scene. Indeed, one informant noted that "This industry is about Queensland's cornering the national energy market". However, a competitive market in gas has a number of logical consequences, perhaps unintended, which are manifestly or potentially against the public interest:

- gas, coal and renewables companies are competitors and cannot be expected to cooperate; so macro-energy policy is hobbled;
- keen competition between these sectors will tend to under-price each resource, encouraging waste; policy should instead be aimed at conserving the unique and irreplaceable resources;
- a low price for gas tends to make a transition to renewable sources difficult or to require inefficient subsidies and other governmental interventions; the simplest way to encourage energy conservation is to use the power of the market by pricing the non-sustainable sources to be more expensive;
- a low price for gas places downward pressure on the willingness of companies to spend money on environmental protection and community

development; it also tends to favour low-overhead companies lacking a long-term horizon;

- a low price for gas makes beneficial use of the water more problematic as there may be insufficient profit to allow the gas producers the flexibility to innovate; or, in economic language, fierce competition discourages a producer from internalising the true cost of the operation but instead encourages producers to externalise as much expense as possible onto the public purse;

- gas and electricity are both sectors of interest to the emerging infrastructure funds, which are often highly geared and are keen to promote new projects that have a guaranteed income stream. This motive will tend to encourage over-production;

- on the other hand, if the competition becomes really keen, companies may find that it is scarcely worth bringing new gas projects online; again, macro-energy policy becomes distorted by the market.

One departmental insider observed that the circle in which he moves is populated with people with ideas about the next power station, and how to get it up and running before the competition. In a pro-growth atmosphere of this kind, considerations of resource efficiency, environmental sustainability, macroeconomic policy, land-use planning and community development fall by the wayside all remain simply fortuitous side-effects.

If it can be shown that the price of gas is too low to support safe and beneficial disposal, the Government would be challenged to find a way of increasing it without confronting other strands of policy and without gifting a windfall profit to the companies. This paper is not the place to explore how that might be achieved. Suffice to say that the competitive gas market is anti-conducive to market-based solutions to the benign disposal of associated water. Gas producers under conditions of low gas price will turn to governments or user industries to subsidise the cost of disposing of the water that is an inevitable externality from their operations. A low gas price is the corollary of resistance by industry to having higher standards imposed by regulation. Under fierce competition, environmental and social responsibility will require greater effort by ethical company people who will be disadvantaged in the marketplace.

Finding: It is offensive to economic theory to allow the consumers of a resource to purchase at a price below the true cost of provision. This amounts to a subsidy to the consumers from the landholders and others who suffer the adverse consequences. This is what will happen if the full cost of benign disposal of associated water is not borne by the companies profiting from the sale of gas. The market will not internalise these costs unaided.

Finding: That DME re-think its policy stance of support for an independent gas market and lead a Cabinet submission positioning the CSG industry in Queensland's energy future, taking into account the changes in external conditions (such as peak oil and climate change) since the 2000 policy.

Finding: That the submission present a strategy for adjusting the bounds of the gas market so that companies can internalise the cost of benign disposal without threatening their viability.

The Nunan Summary

Lawyer and member of the Australian Coal Seam Gas Council, Tony Nunan, has summarised (2006) the legislative framework of the gas and water regime.

"Queensland's new petroleum regime, in the form of the *Petroleum and Gas (Production and Safety) Act 2004* (PAG Act) and the *Petroleum and Other Legislation Amendment Act 2004,* was long anticipated and was introduced to provide certainty and stability to enable the development of Queensland's significant coal seam gas and coal resources.

Since the new petroleum regime's commencement the CSG industry has continued to expand due to new drilling technologies, greater market opportunities and the encouragement of government through the Queensland 13% gas scheme. The new petroleum regime is a significant upgrade from the former *Petroleum Act 1923* (P Act) which did not contemplate the overlap between coal and petroleum tenure which is inherent in the coal seam gas industry. …

CSG is extracted by removing water from a coal seam. The removal of the water reduces the pressure in the coal seam and allows the CSG to be released... While no two wells or coal seams behave identically, an average CSG well in the Surat Basin can extract between 140,000 and 470,000 litres of water per day during dewatering [50-170 ML p.a.] and an average CSG well in the Bowen Basin can extract between 80,000 and 160,000 litres a day.

With the rapid expansion in the total number of CSG wells drilled from 72 in 2000-2001 to 167 in 2004-2005 there has also been a large increase in the amount of water that is extracted. …

Water extracted during the course of extracting CSG (or another authorised activity for the tenure) is referred to as "associated water" under the P&G Act. A petroleum tenure holder that is desirous of on-supplying associated water must comply with the provisions of each of the P&G Act, the *Environmental Protection Act* 1994 and the *Water Act 2000*.

Unlike water extracted by a landowner via a water bore, associated water is considered to be a regulated waste for the purposes of the EP Act. The storage, treatment, processing or disposal of a regulated waste is an "environmentally relevant activity", which requires the person proposing to undertake the activity (the petroleum tenure holder) to apply for and be granted an environmental authority that authorises the activity. The holder of a petroleum tenure that extracts water from a coal seam is required to obtain

an environmental authority to allow the holder to dispose of or on-supply the associated water. …

"Regulated waste" is defined very broadly under the EP Act and effectively means any non-domestic by-product of another activity (or material surplus to another activity) which has one of the properties set out in schedule 7 of the *Environmental Protection Regulation 1998* (which includes chlorates. arsenic, boron and acid or alkaline solutions) and whether or not the material has value. The EPA and NRMW have taken the view that water extracted from coal seams during the extraction of CSG is considered a regulated waste. S.426(1) EP Act states that a person must not carry out a petroleum activity that is a level 1 environmentally relevant activity unless the person holds, or is acting under an environmental authority (petroleum activities) for the petroleum activity. …The disposal of a regulated waste is a level 1 activity under part 75b, schedule 1 of the EP Reg).

The PAG Act and the amendments to the Water Act have established a detailed and comprehensive regime that regulates the on-supply of water from petroleum tenure and imposes obligations on petroleum tenure holders to monitor and make good any impacts that the extraction of water has on underground water reservoirs within the area of the tenure.

The PAG Act grants the holder of petroleum tenure the right to extract associated water providing the extraction happens during the course of or results from the carrying out of an authorised activity for the tenure. The PAG Act prohibits a petroleum tenure holder from drilling a water bore which is not for the purposes of an authorised activity. Once the water is extracted, the holder may use the water for the holder's authorised activities or on-supply the associated water to the owner or occupier of land within the area of the tenure or land that adjoins land in the area of the tenure provided the owner of the joining land is the same owner of the land within the area of the tenure. However, the associated water on-supplied can only be used by the owner or occupier of the land for stock or domestic purposes.

The Water Act was amended with the introduction of the PAG Act to enable a petroleum tenure holder to apply for a water licence to on-supply associated water for all other purposes that are not expressly authorised under the PAG Act.

Probably the most notable amendment to the Water Act was the inclusion of a regime which acknowledges that the extraction of associated water may impact on land owners' ability to extract water from the same aquifer. The Water Act places conditions on a water licence granted to a petroleum tenure holder requiring the tenure holder to supply stated volumes of water to persons who have applied for, but have been refused, a water licence to take underground water because of the petroleum tenure holder's activities (known as the priority group).

Once the water licence is granted, the petroleum tenure holder can on-supply the water but must not charge a fee to the recipient of the water unless the petroleum tenure holder is registered as a water service provider under s.370 of the Water Act.

In addition to the Water Act acknowledging that persons within the area of an aquifer where petroleum activities are taking place may be refused water as a result of the petroleum activities, the PAG Act places a general obligation on petroleum tenure holders to ensure that they:

- undertake restoration measures to restore the supply of water to the owner of the bore; or
- compensate the owner of the bore for being affected by the dewatering.

This "make good" obligation as it is referred to in the PAG Act is not restricted to the area of the petroleum tenure or the property on which the petroleum activities are being undertaken. The make good obligation includes the extent of the underground aquifer that the petroleum tenure holder is dewatering. Any bores that have been unduly affected as a result of these activities must be made good by the petroleum tenure holder.

A bore is considered to be unduly affected if the drop in the level of water in the bore because of the exercise of the water rights for a petroleum tenure is more than a trigger threshold for the aquifer set by the Chief Executive of…NRMW [now NRW].

The aquifer from which a petroleum tenure holder is dewatering may be a significantly large area. The broad obligation to make good affected bores places a significant burden on the petroleum tenure holder to identify and monitor bores within the aquifer that may be affected by the petroleum tenure holder's activities.

In order to ascertain if bores within the aquifer will be unduly affected the petroleum tenure holder may request that the Chief Executive of NRMW set a trigger threshold for the aquifer from which they are dewatering. This trigger threshold will be the water level drop in the aquifer that the Chief Executive considers will be a level that causes a significant reduction in the maximum pumping rate for the bores in the area affected.

In fixing the trigger level, the Chief Executive must consider the permeability and geology of the aquifers and the water levels in the aquifers. The petroleum tenure holder must be given a reasonable opportunity to make submissions about the trigger threshold proposed by the Chief Executive.

The PAG Act does not provide any detail on how the Chief Executive will obtain the information necessary to determine the trigger level, nor how the Chief Executive will determine the nature and extent of the aquifer. However, the Chief Executive may ask the petroleum tenure holder to give the Chief

Executive documents or information the Chief Executive reasonably requires to fix the trigger threshold.

If the trigger threshold is reached and the landholder is no longer able to use the bore for the purpose or to the potential that it was used prior to CSG extraction, then the petroleum tenure holder must "make good" the bore.

The new petroleum regime gives the petroleum tenure holder two options to make good a bore which has been unduly affected by the petroleum activities.

First, the petroleum tenure holder may undertake restoration measures to ensure that the bore will no longer have an impaired capacity. This may be done by deepening the bore or by providing the landowner with an alternative and equivalent supply of water. Second, the petroleum tenure holder may pay reasonable compensation for the loss of value of the owner's land on which the bore is located; the loss of use the owner has made, or may make, of water from the existing bore; or any cost or loss the owner suffers that is caused by the impaired capacity of the bore.

The inclusion of the make good obligation places significant scientific and factual obligations on the Chief Executive in order to determine trigger thresholds for aquifers. Such a requirement is burdensome on the Chief Executive and NRMW as it is required to set a trigger threshold for every aquifer from which a petroleum tenure holder is extracting water. While there is no specific obligation on the Chief Executive to prepare a trigger threshold for each aquifer, every petroleum tenure holder must prepare and lodge an underground water impact report which states the trigger threshold determined by the Chief Executive for aquifers in the area affected by the activities of the petroleum tenure holder. The only way a petroleum tenure holder can obtain this information is by requesting the Chief Executive to set a trigger level for the aquifer.

A petroleum tenure holder must lodge an underground water impact report for the aquifer from which they are dewatering by the date by which the petroleum tenure holder is first required to lodge a royalty return for petroleum production on their lease or in the case of an ATP, 20 business days after the end of the first year of petroleum testing. The report must detail:

- the trigger threshold (determined by the Chief Executive) for aquifers in the area affected by the dewatering;
- an underground water flow model;
- the area of aquifers predicted to be affected;
- the bores within the area that may be affected;
- an estimate of when each bore will become affected;
- details of a monitoring program; and
- other information and matters prescribed under regulation.

The petroleum tenure holder is then required to monitor the aquifer and

review the predicted effect that their activities will have on the underground water impact report to demonstrate that the report continues to be appropriate.

While the new CSG regime has introduced novel and burdensome provisions regarding the production of water from CSG wells, we are yet to see how these provisions will be implemented in practice. With the continued expansion of the CSG industry and the greater impacts that petroleum production may have on underground water aquifers it is likely that these provisions will place significant long term monitoring obligations on both the petroleum tenure holder and the Chief Executive."

PART II – TECHNICAL EXPLANATION

Overview

Coal methane has long been a hazard in coal mining but has been recognised as a resource for only 20 years. Not all and on some accounts not many seams are suitable for this kind of production. Moura was the first field in Queensland, Peat Scotia the first in the north-eastern Bowen Basin and Fairview the first field in the main Bowen Basin – Fairview commenced production in 1998. The local industry spent 20 years before it developed techniques suitable for extracting the resource in Queensland. Even then, the fields are so different from conventional gas fields that predictions as to volumes of water and gas likely to be produced have been astray, in some cases by tens of percent.

Gas is retained in coal seams in several ways: adsorbed in micropores (most); trapped in matrix pores; free in cleats (macropores) and fractures; free in openly connected pore space of a porous substrate (such as a sandstone); or dissolved in groundwater.

Adsorption is a physical process by which separate molecules of gas lodge in the crystalline structure of a substrate, in this case carbon and other compounds. The process is dependent on the ability of the gas to diffuse through the compound and is greatly enhanced by fracture systems that provide a greater surface area for easy access. Cleats are fractures and increase the surface area of coal accessible for adsorption. Solubility of methane is not high so not much is dissolved.

The cleats in coal are typically much closer together than fractures in other rocks meaning that any gas that can move through the cleats has access to a greater area of the rock; however it is the high propensity for coal to adsorb methane and other gases that really makes the difference. There could be an equal area in a porous fine-grained sandstone but the silica hardly adsorbs any gas so the quantity of gas would depend on the pore space, pressure and presence of other fluids, especially water (and carbon dioxide). The likelihood of connections between a coal seam and an artesian aquifer depends on larger scale geological features such as the stratigraphic sequence (eg. aquicludes) and faulting and folding.

Gas desorbs, diffuses through the matrix and flows from natural fractures. The

moisture content has a marked effect on the adsorption capacity.

The Basins, the Coal Measures, the Waters and the Producing Companies

Loosely, the stratigraphy of the subject areas in the Surat Basin runs as follows:

- local aquifers and seepage zones: less than about 10 m to the surface;
- Condamine Valley aquifers, e.g. the Condamine Alluvium;
- Walloon Coal Measures, themselves consisting of several strata;
- deeper Great Artesian Basin (GAB) aquifers.

Walloon Coal Measures are an aquifer of the GAB and supply numerous artesian bores. They occur between the Gubberamunda Sandstone/Kumbarilla Beds (and further west the Hooray Sandstone) above and the Hutton Sandstone and the Precipice Sandstone below. When subcropping they are overlain in part by Condamine Alluvium. They are geologically and hydro-geologically part of the GAB.

Depths of the measures depend on folding and faulting. Typically, gas wells target the Walloon Coal Measures at a depth of 200-1000 m. The depth of a well varies from field to field and is dependent on the nature of the coal stratigraphy and the zones targeted by the company. The different companies have indicated different depths for their operations. At Spring Gully, Origin CSG extracts CSG from a depth of 600m. QGC in the Walloon area starts at 300 m: three to five seams are tapped for gas. Coals shallower than that tend to be under-saturated; deeper coals are too “tight” so 200 to 700 is the target range. These wells are substantially more shallow than in conventional gas fields.

Origin is involved in three current operations, two in the Bowen: Peat near Wandoan (produces negligible water so need not be further considered) and Spring Gully; as well as a pilot at Talinga and Orana in the Walloon area of the Surat Basin.

Santos runs two operations in the Bowen Basin: Scotia (producing negligible water); and Fairview. It has another operation near Roma just commencing.

Arrow is producing from Kogan North, Daandine and Tipton West. There is a small production from Moranbah in the Bowen Basin.

QGC has operations in the Surat Basin at Berwyndale (Windibri) south-east of Chinchilla. It has test facilities at Argyle (Wambo Downs South) and Lauren nearby.

It is thought that much of the water being produced is 25-75,000 years old. Although for the better known GAB aquifers, age and origin are understood (within ranges), for the water in coal seams, overall, it is uncertain how old is this water, its origin and how rapidly it moves, what kinds of processes are occurring and whether water is seeping between aquifers. These parameters are researchable.

The Production Process

The footprint of each well is about 8 m by 20 m. Wells are connected to a central compressor on the field by pipelines that are generally laid on the land surface or buried to shallow depths. Exploration in this industry is intensive, conducted on a 1 km grid, and requiring extraction of large volumes of water (and hence construction of evaporation ponds) even to prove the resource.

Typically the company may pump for six months before gas is produced. Some wells must be de-watered for 12-18 months before usable quantities of gas emerge; some produce gas after couple of months. Wells are predicted to last 10-30 years, with an estimated 30-50 years being the lifespan for each field.

Each well costs slightly more than $1 million compared with $2.5-3 m for a deeper conventional field. The plant required for extraction is rather basic.

On exiting the surface and the field separator, the water then requires power to pump it beyond the plant.

Gas Production

Current total demand for gas in Queensland is 120 petajoules p.a., equivalent to 30 years' supply from the Walloons. The State is producing 170 PJ of which 70 PJ is produced from coal seams. Fifty PJ are sold interstate. Proven and probable reserves in the Surat Basin are some 3000 PJ. Walloon coal measures have officially reported reserves of 1064 petajoules, Bowen Basin 2626. Origin alone has committed to produce at least 450 PJ of gas under long-term contract.

The industry estimates that there may be more than 15,000 PJ of recoverable coal seam gas reserves in Queensland alone, enough to supply the gas needs of the eastern States for 20 years at current rates of consumption. Spring Gully and Fairview alone can supply the Queensland market for 40 years.

The industry has invested $0.5 bn in developing the fields which now supply 50% of Queensland's gas.

CSG gas is greenhouse friendly (as far as gas can be) with low sulphur and nitrogen oxides, 95-98%+ methane. Surat Basin gas has good prospects for conversion to diesel.

Water Production

Spring Gully produces approximately 3-4ML per day of water, Talinga pilot project about 1-2 ML per day. At Spring Gully, production of water from individual wells is declining by 20% per annum. The amount of water produced is unrelated to the final volume of gas produced. Successful reverse osmosis trials have been conducted at both Spring Gully and Talinga.

Fairview is producing up to 5ML per day (2001). Water is used for stock and domestic supply, discharged to the Dawson River system (licence issued by the previous Department of Mines and Energy, now overseen by EPA), run through a reverse osmosis unit, reinjected to a fractured clay basement or used around the plant. Santos expects Fairview to expand to about five times its present size, producing perhaps 16 ML (100,000 barrels) of water per day.

Arrow is producing 2.86 ML per day from Kogan North, 2 from Daandine and 3.5 from Tipton West. There is a small production from Moranbah in the Bowen Basin.

An earlier estimate is that QGC was expecting to produce 1 ML per day (350 ML p.a.) for 35 years but this is probably now too low.

Arrow is supplying Peabody's Wilkie Creek mine with up to 3 ML per day. It has signed a contract to supply Dalby Town Council with a guaranteed 2.65 ML per day with options up to 5 ML per day, over 15 years; on a "best endeavours" basis.

The total production from all the fields itemised above sums to up to 20 ML per day or 7000 megalitres p.a. How significant is this? This question can be viewed relative to either extraction of groundwater or of disposal.

Looking first at extraction, 7000 ML/yr from an aquifer such as the Walloons is significant, given that 35,000 ML/yr has already been allocated and capped at that level. It represents an increase in water diversions of 20%. There would be no way a cotton farm could get a water licence to support this level of extraction from the Walloon Coal Measures. A cotton irrigator could not access 50 ML/day from this aquifer within a 500 ha property without locally dewatering the aquifer. But, assuming that they could get a water licence, it would effectively rule out any other non-stock or domestic bore for a distance greater than 100 km. This is based on the bore separation distance criteria for the Walloon Coal measures in the Great Artesian Basin Resource Operations Plan, which is to commence in late February 2007.

Referring to disposal, 7000 ML/yr is not large considering the total quantities consumed by for example the irrigation industry. The water demand by a single 500 ha cotton farm could be as much as 50 ML per day during summer for a growing season of 100 days (5000 ML p.a.). However, the total demand would normally not come from just one source. The scale of the disposal "problem" should be seen in context: the volumes are not insignificant on a local scale, but in terms of Queensland's water shortage, they are very small.

Water Quality

At Spring Gully, the water is typically 5-7000 ppm. At Talinga, commonly 2-3000 ppm.

Fairview has dissolved salt values varying from a few hundred to 6000 ppm

(most being at the lower end, regarded as brackish). There are no evaporation ponds at Fairview.

During discussions between departments and the industry, Arrow has mentioned that they are currently supplying feedlots with better quality water than their alternative supplies (but this seems to be illegally).

QGC claims that its water is 2000-3000 ppm. It is irrigating 40 acres of barley at 3000 ppm. This does not fit the purposes authorised under the P&G Act. National water quality guidelines do not recommend irrigation at levels above 1500 ppm TDS for poorly drained soils and then only for appropriate species of plants. Water above 3500 ppm should not be used for any form of irrigation.

Quality in a given aquifer does seem to remain fairly stable as it depletes. However, water composition varies greatly from field to field and has a major impact on the options practicable for treatment. Samples assayed at 4500-6000 ppm dissolved salts have had a sodium content of 1840-3461, chloride 2060 ppm, calcium only 5. The sodium absorption radio is one of the most pernicious parameters: it can be as high as 600. This water will can destroy the structure of friable soils.

Typical alkalinity is pH 7.6-8.9. It is not biologically inert, but has a rather diverse bacterial flora.

There are possibly some toxic materials in some waters, including fluorides and strontium as well as some hydrocarbons (10-11 ppm has been mentioned but industry representatives question this and state that generally, if there are trace levels of hydrocarbons, they are negligible). Some of the lower seams are contaminated with difficult substances. A hint can be given by the reported composition of a surface pond at the Kogan Creek Power Station: arsenic, lead, selenium, iron and acidity are present as is typical of an open cut coalmine. (It is not clear whether the associated water would be free of contaminants of this kind because it is sourced from anaerobic strata).

Industry has claimed that any substantial hydrocarbon residue would be a disaster for the reverse osmosis technology and in any case, benzene and other hydrocarbons are completely unacceptable in water destined for town supply.

PART III – SOME KEY ISSUES

(Other than Statutes and Information as Discussed Separately Below)

The lack of widespread agitation in the media is not necessarily a good indicator of the depth of feeling in the community. The perception that there is a genuine concern by the community about the extraction of water by the coal seam gas industry in the western Darling Downs passed a quick 'cabbie test': on 6 December two out of two cabbies interrogated in Toowoomba left this author in no doubt about the depth of their feeling – and their knowledge. A term used: "plundering our resource" conveys the flavour of their views. How valid are views of this kind and can they be readily assuaged?

Landholders and the community are primarily concerned about the effects of this industry on:

- groundwater resources, especially existing bores;
- farming operations, especially cropping paddocks requiring long machinery runs;
- contamination of the surface through saline water and large permanent evaporation ponds (One informant: "It is almost morally reprehensible to discharge unusable water into the community");
- the waste of a precious resource (One informant: " Deliberately evaporating water in this day and age is a crime").

However, these do not exhaust the sum of the concerns of the State departments who are charged with protecting the undivided public interest. This section introduces some of the issues that have come to light.

The Effects of Gas Production on the Coal Resource

Mostly, the implications of gas extraction for coal extraction are outside the scope of this paper. However, a couple of aspects are water-related.

Condition of coal resource after extraction of gas

Realistically, it is unlikely that coal will ever be recovered from the deep but thin seams used for gas production. Greenhouse considerations alone will militate against this. However, a prudent government would ensure that as many options as possible are kept alive for the future. Even 30 cm thick bands can be mined and burnt in a local power station as that use may not require washing. Dewatering of the coal beds *may* compromise the prospect of later mining them for their coal content (advices on this matter have been mixed).

Where there is any prospect that the coal may be mined later, the water should be regarded as a resource to be co-extracted, as it useable for washing coal and for mining operations.

Finding: That the gas producing companies, the State departments and the regional NRM body cooperate to produce strategic plans at a district scale for the development of the CSG industry and that these plans deal with the question of future extraction of coals.

A special case is presented by Linc Energy which has commenced a project south of Chinchilla upon underground coal gasification. The intention is to convert some of Queensland's "stranded" coal deposits into fuels. The technique of in situ gasification requires setting fire to coal seams underground.

There are several negatives associated with this process. First, the strategy of setting fire to coal seams is regarded sceptically by geologists. There are many places worldwide where fires in coal seams have burnt uncontrollably for years and even decades. To this author, it is difficult to conceive of any circumstances in which the practice of igniting a fire underground can be regarded as prudent.

Second, the Linc project, authorised under the MR Act, is incompatible with the CSG industry.

Third, the process of burning coal under anoxic conditions can produce phenols, benzene and other unpleasant combustion products. Linc is promoting the fact that the diesel fuel it will produce will be cleaner (specifically in sulphur) than conventional refinery diesel, but this advantage says nothing about the cleanliness of the process underground. This study has not had time to explore whether such products are likely to contaminate aquifers tapped by landholders or by CSG-producing companies in the locality. If there is any risk of this happening, it would be better to compulsorily acquire Linc's lease and close the operation down immediately.

Finding: That DME investigate the risk of contaminating aquifers with poisonous combustion products during underground coal gasification; and if the risk is significant, that it retrieve the mineral development licence, regardless of cost.

Capacity to pause

Industry has confirmed that once a field is established, it is very difficult to switch it off or to pause or close it down without seriously compromising its ability to produce gas later. Apparently re-watering of the seams is not easily reversible.

This feature of the production process is problematic if negative consequences for a local aquifer are demonstrated. This feature coupled with the economic investment the company has made will motivate it to resist fiercely a pause or close down.

Finding: The apparent inability of gas producers to pause a project once pumping has commenced places a heavy burden upon industry and DME to be absolutely confident that the consequences can be managed satisfactorily before launching a new project.

The Effects of Gas Production on Groundwater

Generally speaking, in the Surat Basin the CSG industry is being established in groundwater and surface water catchments that are already stressed. A feature of the PAG Act regime is acceptance that aquifers will be dewatered, but this acceptance is conditional on compensation of the affected water users. Aquifers are not made good, but water bore users are.

Connectivity between the coal seam aquifers and the Condamine aquifers

Connectivity with the overlying aquifers particularly freshwater production aquifers such as the Condamine Alluvium and sandstones is one of the four major concerns to landholders. It is also very much on the industry's agenda: connectivity was the focus of negotiations when the new petroleum legislation was being drafted; and was the basis of the monitoring and reporting regime.

The hydrological evidence suggests that the surface aquifers in the Condamine

valley are more likely to be affected by leakage from the evaporation ponds above than by direct extraction of water from the Walloon Coal Measures below.

Though not proven, there is evidence suggesting that there is a connection between the WCM and Condamine Alluvium in the vicinity of Dalby. The evidence includes:

- inferred groundwater flow direction within the WCM is toward the centre of the Condamine valley, based on contours from monitoring bores;
- measured groundwater heads in the Walloons are greater than in the Alluvium;
- dramatic increase in salinity within alluvium to the west of Dalby could suggest an inflow of saltier Walloons water.

Some WCM gas fields such as, reportedly, Arrow's Tipton field, are quite close to the alluvium-based aquifers above, while other fields are quite isolated.

Finding: That potential connectivity be monitored short-term through the water impact reporting regime and long-term through the preparation of strategic water management plans for each field.

Connectivity between the Great Artesian Basin and the coal seam aquifers

Consultants Parsons Brinckerhoff stated "Based on geological information and inferred groundwater information… the Walloon Coal Measures …are not considered to be hydraulically connected to the Great Artesian Basin" but heavily qualified this conclusion, even calling it an "assumption" reached without "detailed, site-specific groundwater assessment".

It is more than an assumption, it also muddies the analytical and metaphorical water significantly. Hydrologists regard the Walloons as part of the GAB and they are shown as such on geological maps and in the GAB Water Resource Plan. There are artesian bores within the Walloons. Perhaps the consultants were saying that the coal seams within the Walloons are not hydraulically connected to the rest of the WCM aquifers, or the Hutton sandstone or the Kumbarilla beds.

Some industry figures have presented two pieces of evidence to indicate that the WCM aquifers are isolated. First, where there are major geological faults, the gas may have slipped out anyway. Second, if there is a significant fault or connectivity between the WCM and other known aquifers, it will not be possible

to de-water the field and so this risk will become fairly obvious fairly quickly. Significant faults would be a major concern for the companies.

However, departmental hydrologists regard both arguments as simplistic. The view that the presence of the gas implies there is no connection with other aquifers is fallacious. First, gas adsorbs to the coal. So even if water can move, gas doesn't necessarily move with it. But even if one assumes (wrongly) that gas moves as one with the groundwater, its presence does not prove a lack of connection with other aquifers. It could simply be that there has not been a suitable pressure gradient to make the groundwater move. This situation can dramatically change with dewatering, as anybody involved with mine pit or tunnel dewatering will attest. With the large induced pressure gradients induced by dewatering, hydraulic connections with other seemingly isolated aquifers can easily appear, resulting in cost blow outs, and sometimes in abandonment of a mine or tunnel. In other words, the reduction of pressure in the aquifer because of dewatering could induce a noticeable hydraulic connection in places where it was not noticeable previously. This is often seen in alluvial aquifers such as in the Murray Darling Basin, where depressurisation in a good aquifer can induce flows of very salty water into the good aquifer from or through overlying aquitards (clays) – which would normally have been considered relatively impermeable. Water flows through a porous medium according to Darcy's Law – and the significant criteria are the properties of the aquifer and the pressure gradient.

Of most importance for our current purpose is the pressure gradient between two points. Groundwater can be induced to flow over a distance greatly separated from the local extraction. Relative pressures between aquifers can be reversed, and where the relative difference in pressures is increased, it can become a noticeable flow where it previously was a virtually non-existent trickle. Hence, gas could be contained locally within the coal seam, and not have moved over a long period; however once pumps are started up, water can be induced to flow in directions and ways that it never has previously.

The information available to this analyst is simply not adequate to form a judgement on the likely risk of compromising the significant regional aquifers of the Great Artesian Basin. The water impact report and monitoring regime within the PAG Act recognises this reality. No one can realistically know in advance what will happen, and what hydraulic connections with other aquifers will appear once the coal seams are dewatered. However, it is reasonable to regard the Parsons Brinckerhoff conclusion as simply "spin".

Finding: That potential connectivity be monitored short-term through the water impact reporting regime and long-term through the preparation of strategic water

management plans for each field.

Finding: That funds be provided to commission studies by geologists of known and suspected faults with a view to plotting their potential effects on the relevant aquifers. (This should be funded by DME if it is arranged as part of foundation geoscience mapping; or by the companies if it is a preliminary to gaining approvals. Monitoring to verify the predictions should be by the companies).

Leakage between aquifers via bores

Double-slotted monitoring bores can cause leakage between aquifers. Bores are often simply capped at completion and not fully plugged, placing fresh aquifers at risk. There are no accepted and consistent standards for abandonment of bores. Schedule 3 of the PAG Reg deals with this, and there is a decommissioning standard for licensed water bore drillers (*Minimum Construction Requirements for Water Bores in Australia*, 2nd edition 2003). However there is a lack of consistency between these documents, and in any case regulatory supervision of this activity is weak.

It is unclear who is responsible to fix any leakage between a salty layer and a fresh layer (and whether post facto repair is even possible) once the gas producing company completes its occupation. It is unclear whether the risk posed by the CSG industry is any greater than that posed by the operation of ground water bores generally, which now outnumber CSG bores by approximately an order of magnitude, although the ratio is shifting.

The information available to this analyst is not adequate to form a judgement on the likely risk of mixing waters.

Finding: That DME prepare a best practice manual for the sinking, operation and decommissioning of CSG wells and link adherence with this manual to one or other of the statutory regimes by conditioning permits.

The practicability and the consequences of re-injection

There is currently minimal information regarding the feasibility and cost of re-injecting the associated water after extraction back into the same coal beds or neighbouring beds. It is understood that Santos is successfully reinjecting at Fairview South, but they are fortunate to have a suitable fractured base stratum beneath their wells. At Surat that option has been described by some informants as unavailable as it is not practicable to reach below the GAB but by

another informant in these terms: "The geological sequence is probably very similar. The difference is that the operator at Surat hasn't tried to find a suitable stratum". Aquifers suitable for re-injection are rare and dispersed. To be able to reinject while being confident that the water is not simply disappearing into some other potable aquifer, there must be a unique set of geological circumstances. The process is most common in alluvial sands and limestone: there is little experience in Australia with fractured rock aquifers. (There is considerable experience in the USA with injecting wastes but success has been mixed: there have been some disasters resulting in extensive contamination of aquifers).

In short, the seams available for re-injection aren't necessarily suitable. The deep ones are commonly suitable but they are hard to reach. Pressures required are very great and the operation is expensive. Pores can become clogged with for example biological precipitates triggered by iron bacteria. Certainly, pulling water out of coal seams is much easier than injecting it back in.

Normally, a field would not be available for re-injection for 20-25 years. It is not possible to consider re-injection on a well-by-well basis: the whole field must be considered.

Re-injection should occur only into an aquifer of equal or lesser quality and into a geologically isolated zone. Not all aquifers are saline. In Surat , there is no aquifer that is saline enough. In the Surat Basin, the permeable aquifers other than the coals tend to be fresh GAB aquifers into which re-injection would be inappropriate.

There is always a risk that a company will nominate an aquifer which they claim is isolated and not of social, environmental or economic importance only to find out later that it is connected to other useable systems. However, if the re-injection is restricted to systems of equal or poorer quality it is unlikely to have an adverse impact.

Finding: Gas producers should be encouraged to re-inject associated water into isolated aquifers of equal or lower quality but the authorities should not assume that this technique will be a commonly available solution.

The Effects of Gas Production on the Land Surface

Debate over the effects of the disposing of associated water has to date focused on the *concentration* of salts in the water. However, a process that brings any water of other than perfect purity to the surface is depositing *additional* salts into the landscape. In the Surat Basin, all significant watercourses are already stressed. Further, any watercourse that drains to the Murray River is adding to what is now recognised as being an intolerable problem downstream. Concentration is irrelevant.

There are issues other than disposal of salts to watercourses and a few are presented here.

The intensity of the gas infrastructure

Laser levelling for cropping operations nowadays means that long runs are required by grain and cotton farmers to operate machinery; and controlled traffic techniques require runs to be on established configurations. A network of even small obstacles in a paddock may make cultivation impracticable, indefinitely, and the loss of production maybe far greater than the value of the land itself and greater than the value of enhanced farm infrastructure, such as new roads and waters and fences.

Compensation is determined by the Land & Resources Tribunal which is not constituted to bring traditional valuation methods into the deliberations (as is the Land Court). In recent decisions subject to the Mineral Resources Act, the Tribunal has effectively rejected claims for injurious affection on the balance of land not physically disturbed. It is highly likely that this “black letter law” approach to compensation will be extended into claims under the PAG Act making it impossible for landholders to be compensated for the loss of value on a “before and after” basis which is a traditional method of valuation.

QGC has publicly announced its intention to increase well spacing from 750 m to 1 km which will cause a reduction of 40% in the number of wells. Such intentions are to be applauded. Even at 1 km, however, the network of well heads is a severe constraint upon farming operations.

Companies must “make good” the detriment to other established users, but there is no known way of restoring contaminated evaporation ponds, and pipelines are a long-term constraint upon property management. Also, one cannot be sure from the literature how each water will react with surrounding soils.

Finding: That the appropriateness of the compensation regime as overseen by the Land & Resources Tribunal be subject of a focused review involving the Valuation directorate.

Finding: That the CSG industry be encouraged to develop low-impact techniques such as burying facilities and wider spacing of wells and compressors as best practice.

Evaporation ponds

Disposal of associated waters through evaporation in surface tanks is not favoured by EPA or any non-government stakeholders. However, in the absence of demonstrably practicable alternatives, several have been approved. Origin has constructed one of 53 ha and 1000 ML capacity with an average depth of 1.7 m; QGC's at Berwyndale is even larger.

Some ponds are unlined whereas some are lined with clays and compacted, say to 98% with 2% or less moisture. Origin reported that it laid down 300 mm of compacted clay, with the compaction process supervised by a qualified geotechnical consultant.

Some evaporation ponds by Santos under the former regulatory regime administered by the Department of Natural Resources and Mines were allegedly not compacted to adequate specifications and are now leaking. Some have inadequate free board and have been overtopped. A contractor claimed that it is widely known in earthmoving circles that two Santos ponds were poorly constructed. Anecdotal evidence suggests that the water level in the unlined evaporation pond at QGC's Wambo Downs South pilot plant is dropping faster than evaporation alone would explain, indicating that water is headed for the Condamine River. The large pond at Berwyndale within 500 m of the Condamine River is reportedly unlined and has not been compacted and expert advice is that it is certain to leak. If these allegations are true, then the statutory regime has failed.

Design, construction, operation, maintenance and decommissioning of evaporation ponds must comply with the EPA Code of Environmental Compliance for Regulated Dams (draft at the date of writing). "Referable dams" (W Act) are a subset of the total number.

There is of course a wide variety of soils at the gas production sites and not all are suitable for evaporation ponds. There is still a lack of understanding in the

relevant circles about precisely how each clay soil type will behave under a potentially heavy salt load. Although usually sodium in a clay increases water holding capacity, in certain circumstances it can decrease. On sloping sites it is more likely that there will be seepage.

Virtually all experts consulted were sceptical that evaporation ponds can in practice be constructed to be sufficiently impervious to prevent leakage into the soils or groundwater. NRW is not confident that technical knowledge is enough to set robust conditions for construction of ponds, even if they are clay lined. Unless there are inspectors on the spot watching that ponds are built to professional design, they will not necessarily be done properly. One small mistake that wouldn't be easily be detected can cause a dam to leak. One engineer said that the chances of being able to construct a secure naturally lined dam on that scale are virtually nil. It just doesn't happen, even if laboratory tests are positive. Dalby Town Council originally relied upon a clay lining for its evaporation ponds, but after observation bores exposed leakage, it is now moving to line with high density polyethylene.

Plastic black clays do not necessarily seal off even if kept continuously wet. They crack because they are unconsolidated. The local black clays in the Dalby area need special techniques by a sheep's foot roller or vibrating flat roller to compact: track rolling with a bulldozer is not sufficient. Compaction is a specialised task: compacting clays in a 115 ha dam to a non-leaky standard is very different from the task of compacting certified road base in constructing traditional roads. However, with a full-scale mining boom in progress, clients must take the contractors that they can find.

Sealing must be near-perfect to be acceptable. Even a very low percentage seepage, over years, will generate sufficient significant escape of salt into the landscape.

Capping and sealing ponds after they have served their purpose is also going to be a challenge. Fifteen years ago, it was common practice to cover polluted tailings with a low-permeability clay. In various climates, these often broke down through cracking and erosion. It is now standard practice to cover a low permeability layer with a porous layer which captures rain and supports vegetation which in turn transpires a good deal of the moisture produced. It is not clear how practicable treatment to this extent will be for ponds of more than a hundred hectares.

The question arises as to who will be accountable for maintenance of a de-commissioned pond in perpetuity. Legally, the landholder will remain

responsible once the petroleum lease is relinquished, but the average landholder would have neither the engineering expertise nor the disposable cash to remediate large ponds if significant defects arise. The gas company will be anxious to depart from the scene as quickly as possible and is likely to restructure its liabilities away rather than accept responsibility. Corporations law requires that companies be concerned pre-eminently for the interests of the shareholders, leaving only the State to accept responsibility for the public interest and remediating any oversights of its departments at the time that the relevant leases were issued. The statutory obligation to make adequate provision for future liabilities may not cover work beyond those conditioned on the leases.

EPA considers the disposal of co-produced water into evaporation ponds as one of the least preferred options.

Finding: It is not possible to construct evaporation ponds with a sufficient degree of confidence that they will not leak unacceptably. After decommissioning, there is no known way of rendering evaporation ponds harmless and the current regime leaves the long-term responsibility with the landholder who most often will not have the capacity to remedy defects. Evaporation ponds are an unsatisfactory method of disposal.

Basin Salinity Management Strategy

Under the Murray Darling Basin Salinity Management Strategy, Queensland is accountable for any approved actions, made after January 2000, that increase stream salinity. Approved actions are those approved, permitted or licensed under a Queensland Act or Regulation. Examples of approved actions that may increase salinity risk include clearing of remnant native vegetation under the *Vegetation Management Act 1999*, discharge of saline waters under the *Environment Protection Policy (Water)*, and development permits under the *Integrated Planning Act 1997* for activities that increase salinity.

If 7,000 ML of water is produced annually, this could result in an additional 15,000 to 50,000 tons of salt in the Condamine catchment per year. Over the life of coal seam gas projects in the catchment, up to 1,500,000 tons of salt could be imported into the catchment, though as the industry expands, this will be an under-estimate. (Of course, traditional bores are having a comparable effect).

As the extraction of coal seam gas is an approved action, the State of Queensland will be accountable for this salt. It is unknown if bonds or royalties earned by the Department of Mines and Energy as a result of developing coal

seam gas at this time (and presumably remitted to the Consolidated Revenue) will offset any penalties imposed on the Department of Natural Resources and Water under the Strategy, or what administrative mechanism will be available to reconcile the accounts.

NRW in November 2006 embarked on a new project to examine the risk of salinity arising from coal seam gas evaporation ponds in the Condamine-Balonne catchment. This project has been launched to enable the Department to satisfy its requirements under the Murray Darling Basin Agreement to run five-year audits of salinity. The project is intended to run till April 2007.

The Condamine Alliance also has an end-of-valley target for salinity on which it is contractually required to report.

Under a separate regulation, if produced water is to be released to an aquatic environment, the Environmental Values and Water Quality Objectives for the aquatic environment must be protected. The EVs and WQOs must be determined and compliance monitored in accordance with the *Queensland Water Quality Guidelines 2006* and the EPA Procedural Guide - *Licensing Discharges to Aquatic Environments*.

Finding: The Queensland Government will be called to account nationally for the total load of salt that leaves its borders in the Murray Darling system.

The Effects of Gas Production on Groundwater-dependent Ecosystems

It is not known whether any groundwater-dependent ecosystems are associated with the Walloon Coal Measures, although this does not mean that they are unimportant.

There are no established methods of dealing with possible effects on these ecosystems although conditions could be placed on the petroleum tenure. This could not easily be done retrospectively.

Beneficial Disposal of Saline Water

The gas-producing companies are concerned that a failure to apply this water to beneficial uses will make them the subject of adverse reaction from the community. Companies would prefer to find beneficial uses rather than constructing and maintaining large areas of evaporation basins. The evidence as to relative costs is contested but it seems that the financial benefit from not constructing evaporation ponds would be a strong, if not complete, offset against the cost of treatment to beneficial standards.

Arguably, more significant than the cost is the loss of reputation in the eyes of the community. Landowners have expressed resentment at the large quantities of water that the companies are allowed to pump out while their own supplies are limited by drought and regulation.

One landholders' consultant argued that the industry is on the way to wasting 100,000 ML of water or as much as NRW has laboured long to save through the entire bore-capping program in the Great Artesian Basin. This figure is conflating one-off extractions with annual sustainable extractions. Savings via the GABSI program are of this magnitude – about 140,000 ML/yr – but are ongoing, and would need to be compared with the annual CSG extractions (at a minimum) – of 7-15,000 ML/yr.

Under the waste hierarchy in the *Environmental Protection (Waste Management) Policy 2000* the disposal of associated water should be handled by one or more of the following methods in order of acceptability:

> Avoidance, reuse, recycling/re-injection, disposal in evaporation ponds, running into the environment without treatment.

The gas producing companies are each making their own enquiries and this will always be necessary, as the waters and the potential beneficial users are site-specific. However, a collective investigation would achieve some economies of scale. NRW Toowoomba has launched such an investigation, to examine the potential beneficial uses of CSG water, what are the impediments and the actions necessary to facilitate them. The project will commence in July 2007 and run for two years.

Finding: Water Management and Use should enquire whether a coordinated multi-lateral approach for funding under the National Water Initiative for the preparation of a region-wide strategy to beneficially use associated water might

be worthwhile.

Disposal to mines

The liquid is reported to be good for washing coal but must be in close proximity for this option to be economically viable. In some cases only coal destined for export is washed. The average mine also requires low quality water for slurry pumps, wash down, flotation and quenching. The Spring Gully Power Station will use associated water and other power projects in the Surat Energy province are also investigating this option.

However, even the proximity of a coal mine is no panacea. Some or all waters can initiate stress corrosion cracking and pitting even of stainless steel. Process waters are often saturated with gypsum and so are prone to scaling (but many of the CSG waters are very low in calcium). Future coal mines may use air-based methods of cleaning coal.

Reverse osmosis

Reverse osmosis is now a mainstream technology. The early technology was not marvellous and there were not enough skilled people around to establish them, but this need not be an obstacle now. Membrane technology does require a sophisticated understanding of the incoming waters in order to design the system to match. In most if not all systems, pre-treatment is required to gain maximum efficiency from the plant and to maximise the life of the membranes. A pilot plant should be operated for six months and any changes in water chemistry tracked. For example, Origin has advised that at Talinga, waters were put through an ion exchange to strip the calcium and barium first. Even though the quantities of these were less than 10 ppm, the treatment allowed the reconfigured plant to produce 87% of its volume of water better than 100 ppm from input water of 5000 ppm. Recovery of 75-80% is now routine.

Reverse osmosis plants can be skid mounted and are scalable upwards. However, without considering capital cost, the running cost can be as high as in the order of $250-300 per megalitre which is out of the range of most agriculture.

It is easier to design a reverse osmosis plant drawing from ponds than from direct feed.

Finding: Reverse osmosis is a mainstream technology that can produce near-pure

water from a wide range of CSG waters. The main obstacles are cost (made worse by the relative cheapness of traditional sources) and the fact that some 20% of the volume remains as an even more concentrated brine requiring disposal. All of the disadvantages of evaporation ponds apply to this residual except that its volume is lower and the ponds can be smaller with less risk.

Production of bicarbonate

The bicarbonate could find a market but profitability is said to be marginal. (However, one company Kokstead is currently investigating this process and has applied for mining leases). Bicarbonate is not the only chemical that could be produced: calcium carbonate, sodium sulphate, sodium carbonate and sodium chloride could all be produced from a reverse osmosis plant: the chemistry is mainstream. Sodium chloride is likely to be the least profitable because of the cheapness of competitive sources. Prices obtained depend heavily on purity.

Agriculture

Given that the main land use in the Surat Basin gas fields is agriculture, it is only to be expected that agriculturalists have turned their eyes to the potential of the water, both for intensive and broad acre commodities, both treated and untreated.

Untreated

It has been estimated that a 10,000 head feedlot might consume 250 ML p.a., which could dispose of the output from one gas field.

However, it is not clear whether the untreated water is suitable for intensive animal industries. One company has claimed that the salts can aid digestion in ruminant animals. Another currently uses their CBM water to supplement the water supply to the feedlot (apparently without a permit). The feedlot is expanding in the next few months and wishes to expand more, to the extent of considering installing a reverse osmosis plant. However, a consultant has alleged anecdotally that one of his clients tried a shandy with an existing clean water supply and the cattle did not thrive. Also, emerging information suggests that the high load of salts can disrupt feedlot effluent management systems.

In any case, confirmation that the (untreated) water is of a composition suitable for animals does not overcome the difficulty that the salts are eventually deposited in the landscape somewhere and add to the salt load.

DPI&F, in its facilitation of intensive animal husbandry and fisheries, processes IPA development applications under the *Environmental Protection Act 1994* and *Fisheries Act 1994* respectively. The onus is on the potential user to demonstrate both that the water is suitable for the intended use and that any effluent water can be appropriately treated and used on site or disposed of in a sustainable manner.

To date DPI&F is aware of one application for a feedlot but not of other specific potential users who may have been consulting with industry. No feedlot yet has a permit for CSG water.

Treated

If the price were right (such as if subsidised by the gas producer), there would be an extensive demand for clean water for crops. Some 25% of Australia's watermelons and rock melons are grown in the Chinchilla district and potential additional users are waiting.

Cotton would support a cost of up to about $300 per megalitre but optimistically this will cover only the operational cost of a reverse osmosis plant (if that) and not the capital cost, which, amortised, would be at least as much again. It seems generally agreed that water can be treated nominally for $1000 per megalitre.

One operator is confident that pasture can be irrigated by using gypsum as a soil amendment and heavy applications of feedlot manure to offset potential increases in soil pH.

Finding: Utilisation of untreated water in intensive animal industries is not a solution. Even if the animals cope with the water, the problems of disposal to land are only deferred. There is a virtually unlimited latent demand for treated water for irrigation, but treated water cannot be produced at a price acceptable to growers.

Aquaculture

A current DPI&F project is examining the potential for growing fish species in coal seam water. Preliminary results show excellent potential for aquaculture in CSG water with simple fortification of the receiving water with agricultural

grade potassium. To date, trials with both barramundi and mulloway show excellent potential. DPI&F together with the Cotton Catchment Communities CRC, Arrow Energy and McVeigh Enterprises will soon begin construction of a commercial sized demonstration site at Kogan for the aquaculture of potential freshwater but mainly marine/euryhaline species.

To confirm the suitability of a water for aquaculture, water quality needs to be tested case by case, because of the variability. Laboratory analyses without field trials are not sufficient. Also, there is a need to track the water chemistry over time.

If a water body is static, evaporation may mean that certain kinds of fish can no longer cope, even if the water is suitable at the outset. However, this can be managed. Operators can calculate changes over time given known evaporation rates in the locality and can choose species accordingly.

Finding: Aquaculture may be a minor beneficiary but suffers from the same objection as other intensive industries: that after use, the operator must still dispose of a saline waste; and concerns about building containment structures that do not leak.

Wildlife habitat

Where salt lakes can be constructed, they may serve as quite valuable wildlife habitat, especially for migratory species. Salinity need not be an obstacle, as a wide range of ephemeral animal prey can be supported by a wide range of salinities and by variable salinities. The disposal ponds at Dalby town's treatment plant are already attracting interesting birds not commonly seen away from coastal mudflats. However, this value can be seen only as a side benefit of disposal into ponds and not as a reason for constructing ponds.

Non-statutory Portfolio Responsibilities may be Neglected

State departments' functions are not all set out in statute. For example, DPI&F has a minimal statutory role in relation to the disposal of water. If the beneficial use or disposal option does not involve a feedlot or aquaculture proposal, DPI&F would have only a non-statutory third-party role at the development application stage and it would not necessarily be asked for its opinion. However, DPI&F has a portfolio responsibility to ensure that agricultural industries are profitable and sustainable, so can be legitimately involved.

The list of NRW's portfolio responsibilities not granted a head of power in statutes is even greater (NRMW 2004). Prior to the separation of the Mines portfolio, the Department's "State interests" (a term originated in IPA but now enjoying currency in the broad sense of portfolio functions) included:

1. Protection of land from degradation and inappropriate use.
2. Protection of catchments and natural waters from degradation and inappropriate use.
3. Protection of native vegetation from degradation and inappropriate use.
4. Protection of the economic values and potential of natural resources.
5. Protection of the social and cultural values of natural resources.
6. Provision of effective recognition, protection and conservation of Aboriginal and Torres Strait Islander cultural heritage.

State Interest 4 included "protection of minerals, petroleum, energy and extractive resources from alienation and inappropriate use". Given that this list was endorsed by the Minister, the status of the element regarding mining and petroleum now that the Mines portfolio is in the charge of a different Minister is unclear.

Finding: DME should refresh a succinct statement of its portfolio functions in the form of a an annotated list of State interests as part of a whole-of-Government analysis currently being coordinated by DLGPSR.

Finding: In the meantime, those elements of NRMW's tabulation of State interests that applied to the Mines section of the former portfolio be extracted out and adopted by the Director-General as a guide to the portfolio's functions.

Finding: Once its State interests are identified, DME review its administration of the coal seam gas industry and specifically review the PAG Act to ensure that the statutory regime is not an obstacle in discharging the full range of its portfolio functions.

Skills and Capacities

Each of the three main regulatory departments requires a corpus of professional and technical skills, a corporate memory about its portfolio and adequate numbers of staff to police its regulatory functions. Not only must a workable statutory regime be established and policed, but also there must be sufficient strategic and professional skills to alter the regime and (as inevitably will happen) some producers and consumers of water get into trouble. Water quality issues are much more difficult to manage after de-commissioning when skilled operatives have left the site. So often, the mining industry has left the State to manage the legacy.

Project funding from the National Water Initiative, even if generous, will not necessarily augment core skills. There must be an ongoing corporate memory and project management and planning skills as well as project funds. The consensus is that the skills are not available in the quantity or locations necessary to reduce the Government's exposure to risk as the CSG industry develops.

Referrals between DME (CHQ and region), NRW (CHQ and two regions) the EPA (CHQ and regions) also need to be regularised. Regional NRW people claim that they are inadequately informed about the companies, their level of development or timelines for development of leases.

Finding: That the three main departments with State Development meet regularly (say monthly, at least initially) to ensure that there is good liaison in overseeing the CSG industry. That these meetings consider whether a protocol or MOU is necessary to cement appropriate referrals into place.

Finding: That EPA and NRW meet to consider whether there should be a partial delegation of powers under the EP Act to designated NRW officers for some of the statutory water-related functions.

PART IV – THE STATUTORY REGIMES

Overview

Under the current arrangements, DME issues a petroleum tenure to a company that can best demonstrate the capacity to exploit the gas; the EPA specifies environmental standards; and the company is at liberty to find beneficial users, subject to securing a water licence. The user must apply for development approval unless exempted. In other words, four different statutory regimes administered by four different public agencies from four separate office locations can be involved. Four sets of policies and guidelines of uneven format underpin the regimes.

The statutory situation is actually more complex than that: there are 1923 Act bores, 2004 Act bores and bores in the process of transition. Also, more than one environmental authority may be required. For example, the Spring Gully Power station required both an environmental authority and development approval under the *Integrated Planning Act 1997* to use associated water, while the gas extraction and construction of evaporation ponds was dealt with under a separate environmental authority that did not require development approval. (A water licence is also required). For another example, if the water is used in intensive livestock industry, there is no clear nexus between the two separate environmental authorities required.

In this section, some specific features of the four main statutory regimes and some less well-known statutory provisions are presented, before moving to questions of how they can be coordinated, or whether they should be.

Petroleum Tenures

There are some 250 petroleum production tenures including oil and about 155 prospecting tenures (not all for CSG). The petroleum regime differs from the mining regime in that production including production of water follows as of right.

The PAG legislation does not provide for comprehensive impact assessment of the kind that is possible under the State Works Act or IPA. There are no

statutory public interest criteria by which the Minister can refuse an application, although the Minister can write his/her own. By departmental practice, it is assumed that development of the gas resource is in the public interest and that environmental considerations can be accommodated simply by conditioning. These assumptions are flawed, as discussed in the final section.

Environmental Authority

The Environmental Protection Agency took responsibility for the environmental assessment of mining in January 2001. The EP Act requires decision-makers to operate under the principles of ecologically sustainable development. The Act has a four phase process to achieve this objective. Phase 1 is to clarify the environmental values, which are to be protected. Phase 2 is the licensing of environmentally relevant activities through setting standards, conditions and indicators. Phase 3 involves the integration of environmental licensing with other natural resource statutory systems and the operational requirements of industry. Phase 4 involves enforcing conditions, evaluation and feedback.

S.13 provides that a waste is any product that is surplus to an activity. S.19 allows an activity to be prescribed as an ERA. As a consequence, associated water is considered to be a waste product. It could be declared to be a beneficial use but EPA will consider such applications on a case by case basis. But as one industry representative has commented, there must be a better way of handling the water than to treat all of it as toxic waste! Regulated wastes are listed in the schedule to the EP Reg. Two relevant ones are “saline effluent” (undefined) and “oil”. The legislation is silent on how much salt is required to make water hazardous.

Applications may be code-assessable if generating less than 4 ha of disturbance. Few if any CSG projects will be captured by the code-provisions, so all water disposal projects are likely to be Level 1 activities or Level 2 non-code compliant (see table in accompanying paper for explanation). The code, currently in draft, will have an appendix detailing specifications for the construction of evaporation ponds.

Environmental harm is unlawful if not authorised. Environmental harm in these circumstances could include adding salt to land or streams prone to salinisation, adding contaminants like salts, fluorine or hydrocarbons to streams, contaminating aquifers through say (leakage of dams), destroying biodiversity, or discharging permanent flow into ephemeral streams. However, there is no statutory way of linking environmental harm to a decision to turn off the gas.

Cause and effect are difficult to separate. The companies' capacity to bid down the price they can offer will be limited by the strength of the conditions that the EPA is prepared to set

Apart from Fairview, disposal to date has been via evaporation pods. This practice is unsatisfactory and unsustainable. No CSG projects have yet been refused on environmental grounds.

The environmental licensing regime is not well structured to refuse unsatisfactory applications for CSG. Partly this is because of its subordinate position in the chain of statutory approvals. Partly it is because of the subordinate position of the EPA portfolio. Partly it is a policy mindset of the staff. Refusal is problematic for street-level delegates unless they are confident of the support of their Minister and, in the case of the high-profile energy industries, the Premier.

Finding: That as part of a more comprehensive submission on the CSG industry, a Cabinet decision should be sought to fortify the capacity of the regulatory authorities to refuse CSG applications that are not in the public interest. At present in Queensland, the regimes granting environment authority and development approvals operate in the expectation that development will be approved and that the assessment is merely intended to place conditions to ameliorate damage rather than to refuse on the basis of environmental harm. (Evidence that this is so can be seen in the lack of power in IPA to prohibit development).

Water Tenures

The PAG statute privileges the CSG industry as it in effect prevents further non-CSG access to the Walloon Coal Measures – it regards the WCM as fully committed. The pre-eminence of the PAG Act means that the water resource planning regime is not a suitable tool for *regulating* the production of water (though it can help in *planning* – see next para). Rather than centrally controlling *allocation*, the PAG Act sets out a model of making good, based on conditioning, monitoring and compensation. The regime makes a feature of identifying unsatisfied potential users and ensuring that the companies supply them first. However, it does not envisage that a project will be refused on the grounds that it will extract too much water from the measures. By the time that detrimental effects on others' bores are discovered, the project concerned will be well under way. Further, there is no statutory feedback from the water monitoring provisions to the petroleum tenure allocation provisions, so there is

no pathway by which a project can be halted or a new nearby project refused on the grounds of over-commitment of the water in the measures. By definition, the gas industry cannot give rise to over-commitment.

The GAB Water Resource Plan was finalised in March 2006 and is not due to be reviewed for five years. The right of the CSG tenures to water was considered in preparing the GAB Water Resource Plan and should be re-considered when the WRP is reviewed.

Not every water licence attaches to land: most do, but petroleum tenure holders do not have to be landholders. They hold the water licences in order to on-supply. At no stage does the company own the water. S.370 of the W Act requires any owner of water infrastructure with an intention of charging for water to register as a water service provider. Only the gas tenure holder can get a water licence for associated water. But the designers of the regime never intended that the gas company was to be in the business of water services. Proposals to access and use associated water by third parties, when legally recognised by the PAG Act, may not be recognised by the W Act as an entitlement, which may create legacy issues (notably, pressure upon the authorities to allow a substitute supply from other sources once the associated water runs out).

The petroleum legislation imposes no volumetric restriction on use; but a water licence is assessed on criteria related to the volume of water available, not quality. There is no plan to match good water with good soils or profitable water-dependent industries. However, there are provisions to request a land and water management plan if required. (A condition could be set on licences for associated water requiring the CSG operator to not supply water for irrigation unless the irrigator has an approved LWMP. An amendment to the W Act to require any irrigator using associated water to have this LWMP is being considered).

NRW will oblige the company to make water available to the priority group for the cost of supply, on terms reasonable to both parties. The cost of supply could include any pipeline costs or any water treatment costs. If a priority group member wants associated water, they would need to either arrange their own pipeline, or come to an arrangement with the CSG operator about this. The CSG tenure holder simply needs to make the water available as a first option for the priority group member. If the priority group member can't make use of the water because the cost of supply is too high for them, the W Act is not requiring the CSG operator to supply the water anyway. The landholders in the priority group know well that supply always was patchy in quality and quantity and the companies cannot be obliged to overcome these inherent deficiencies. (Incidentally, no priority group has yet been established).

The new regime was designed in consultation with the gas industry though minutes are not available. The legislation recognises that there are two

industries and the gas cannot affect the water regime without compensation.

Industry has also explained that there are several institutional barriers to reuse, one being the absence of a proper mechanism for trading and for recognising the value of putting what may be very clean fresh water into streams.

The machinery of government changes after the September 2006 election create a potential complication with the administration of this regime. The Department of Mines and Energy has carriage of the PAG legislation and is required to lead the coordination of these matters. However, hydrological expertise and portfolio responsible for groundwater resides in the Department of Natural Resources and Water. It is possible that a protocol or work instruction needs to be signed to clarify the reporting relationships within the government, as discussed above.

Several observations uncovered during this analysis are evidence that the regime is not working as planned. A debate over trigger thresholds is reported later as indicative.

Intensity of other extractions

Industry has claimed that the level of scrutiny being applied to the coal seam gas industry is far greater than that over "the 13,500 boreholes" in the district. How intense is the pressure on the Walloons? The following figures are taken from Foster (2005).

There are four management units that cover the Walloon Coal Measures in the Surat Basin: the Surat East 2, Surat North 1, Eastern Downs 1 and Surat 5.

OBJ

Regulating Land *Development*

Development control (via IPA) plays a relatively minor part in the CSG industry. It is mentioned in the accompanying table that explains the statutory regime. Under IPA's performance-based regime, in the absence of adequate baseline

data and statutory thresholds of environmental damage, there is in effect no effective prohibition, no standard against which to assess a project and a large disadvantage suffered by departmental and community stakeholders who rapidly become fatalistic. However, this feature of IPA is being considered in the current whole-of-Government review of IPA.

Regulating Land *Management*

IPA is the primary statute regulating *development*. Mostly, ongoing *management* of agricultural land by routine farming practices escapes regulatory control. However, there are provisions in the W Act for two kinds of regulatory plan relevant to this analysis.

The Minister may prepare a Water Use Plan before water can be used, where there is a risk of land and water degradation as a result of the application of water. Deposition of large quantities of saline waters in the Murray Darling catchments would seem to be an eminently justifiable trigger for a water use plan. It could create a means of dealing with the bigger picture water quality issues such as third party water use. However as one of these plans has never been produced, it's not really clear what the end result would be.

Also, it is not clear what mischief it would be intended to remedy. It will not discover a benign method of treating associated water. It seems to have been set up to allow cumulative impacts from several otherwise unregulated activities to be brought under the influence of a statutory plan. It would cover a group of properties. It could mop up careless land use practices retrospectively and could uncover lateral solutions or head off otherwise unforeseen consequences.

Similar remarks apply to the preparation of land and water management plans prepared by landholders (s.73(1)(d), s.967 W Act). These instruments can regulate the way that associated water is applied to land. An NRMW guideline entitled "Environmental Management for Activities under Petroleum Tenures" is available.

Finding: For every proposed significant addition of associated water – treated or untreated – to land, NRW should invoke the provisions requiring a land and water management plan (single users) or a water use plan (group of users).

Pipelines

Numerous other statutes are also invoked at various stages of a water-related development. One aspect that has come to attention is the regulation of pipelines. There is some confusion over appropriate tenure and permissions for pipelines, as NRW, Main Roads, local government and the Commonwealth can get involved.

One informant was highly critical of one company's actions in clearing native vegetation along the road reserve rather than bury the pipeline in an adjoining cleared grazing property. A local government officer consulted conceded that his council would allow a company to install a pipeline on a road reserve rather than requiring them to occupy cleared or already cleared land inside the paddock. This practice is regressive and not consistent with emerging best practice nationally for the management of roadsides.

The ownership of pipeline infrastructure within the boundaries of a petroleum lease is also an issue. An infrastructure provider or local government would not have the right to own or operate such a pipe without a separate easement. The PAG Act does not by itself authorise or encourage beneficial use so its leases are not easily used for that purpose.

Finding: DME in consultation with the EPA and NRW's vegetation policy unit should develop policy and best practice guidelines to generally prevent installation of pipelines on vegetated road reserves.

Finding: DME should review the PAG legislation with a view to facilitating efficiency in the provision of water infrastructure.

Connections Between the Statutory Regimes

One of the four main elements of the statutory regime, the development approval, does attempt to coordinate a range of considerations from a number of portfolios, and so it limits the involvement of other parties: without it there may be six or seven steps. But none of the other three do so, all confining themselves to the issues set out in their respective legislation.

Pre-eminently in terms of the subject of this paper, the State's petroleum leasing regime is aimed at fostering development of the industry. If there had

been any doubt, the Director-General's message to staff dated 14 December made this plain: "Our focus will always be to promote investment in mining and energy in Queensland." Similarly, the water licensing regime is single-minded, being aimed at controlling flows and not at monitoring quality, ensuring environmental performance or meshing with land use planning. EPA is primarily concerned to prevent water from escaping into the environment where it will do environment harm.

Is this a problem? The question arises as to whether DME should issue any form of petroleum tenure until the disposal and land-use considerations are locked in. There are notionally two optional models for crafting a statutory regime that crosses portfolio boundaries:

- adopt a disaggregated model, each separate step in the chain of statutory approvals being a discrete step. Avoids any cross compliance and the heavy overheads of a coordinated regime; or
- adopt a coordinated model: no company is permitted to launch a gas development until its downstream consequences are settled. This option is in keeping with the principles of ESD and responsible, 'joined up government', but would require statutory reform to ensure that the four main Acts (1994, 1997, 2000, 2004) at a minimum align with each other and at a maximum form a single regime.

"Lack of coordination" is a common refrain from stakeholders inside and outside government who interact with multiple statutory approvals, particularly when more than one is required for a single developmental project. Where multiple permits are required by legislation, all of them are required: the absence of any single mandatory permit is fatal to the application. Industry would like to see a synchronised approach between the regulators and the industry. There is some frustration on industry's part at the fragmented nature of the statutory regimes.

However, there are several sound reasons why a disaggregated regime might be preferable. First, coordination comes at a price. The overheads involved in cross-referrals can add long delays and also tend to reduce the resilience of the overall system. Second, a centralised system is vulnerable to the particular capacities of the peak coordinator. Either applicants and objectors could be disadvantaged, or both alternately, depending on which department facilitates the coordination, how well resourced they are and their policy mindset. A new appointment to a key position could unravel years of otherwise settled policy. Third, the complexity of some projects is so great that they can tax the discretionary skills of public officers. The logic that a system should be divided into separate regimes according to disciplinary or professional specialties is

sound. Fourth, it can suit applicants to deal with only one regime at a time. This allows incremental progress on a development approval, with the strengths and weaknesses of the project becoming more obvious as additional assessments are carried out and each authority expresses its views. A system relying upon a single decision could truncate individual investigations before they are sufficiently mature to yield insights about the project.

Next are presented some reasons why a coordinated or centralised system might be better. First, the complexity of a disaggregated regime to an un-initiated applicant can be daunting. Under a one-stop-shop regime, the cross-referrals are carried out within government and may be largely invisible to an outsider. Second, the government should always present itself as having a coherent approach to development. Governments are sensitive to the criticism that one agency doesn't speak to another. Third, a good deal of time of applicants and authorities can be wasted through duplicated investigations, non-matching application forms, the start-up and wind down costs of bringing separate officers up to familiarity with the case before the reassigned, and in re-packaging information in different formats to suit each authority's regime. Fourth, and perhaps most important, governments should not raise applicants' expectations unnecessarily early in a regulatory process nor oblige them to expend money in unnecessary impact assessments if it intends to refuse the relevant permits later in the process.

How can a government send consistent signals to the industry and other affected parties without aggregating all of the statutory regimes into a single inefficient, omnibus process?

One response could be that the regime is in fact already coordinated: a privilege of the allocation of the gas is that the company controls access to co-produced water. So in effect, the allocation of gas also allocates the water and subsequent approvals can only condition a development at the margins. The EPA hasn't blocked any CSG projects to date. Expressed in this way, the primary defect of the current statutory arrangements become clear: the PAG legislation is not designed to take into account the range of public interest considerations that a comprehensive regime would address.

In confronting this difficult question of governance, it is worth exploring the legal limits of legislation.

The strength of the tenure power

The power of the State in choosing whether and how to dispose of its natural

resource assets through the allocation of tenure (granting property rights) is a much more direct and powerful form of exercising control than the regulatory power of moderating property rights after they have been allocated. This is well explained in departmental guidelines (such as NRMW 2002). By their nature, regulatory controls (in this context, the environmental regulation and development approval) are less powerful, especially when they are expressed in performance terms as is the post-IPA format. This maxim means that the State should allocate gas resources only when it is satisfied that the associated regulatory functions are perfectly capable of mopping up residual public interest concerns.

Finding: That DME re-shape its tenure allocation power and policy to embrace a wider range of the State's public interest responsibilities so that the State's capacity to oversee the CSG industry is not dependent on the weaker regulatory powers.

Cross-compliance

There is a principle well embedded in law that it is not legitimate to use one Act to achieve another Act's purposes. Officers exercising statutory discretion must confine themselves to the scope set out in the legislation which confers their powers.

An officer is obliged to take into account any statements of government policy or even professional best practice of which s/he is aware and which bear upon the issue. These will be given weight according to the level of official authority of the entity that promulgated them. However, officers cannot go on fishing expeditions and are always subject to the precise provisions of the primary governing legislation.

This traditional position however is problematic when a public authority is challenged by a multi-headed complex problem, particularly one that is regulated by more than one statute. The beneficial use of associated water falls under four primary Acts written at different times with different degrees of emphasis on the proclaimed Government policy of "sustainability".

Several negative manifestations of this problem can be identified:

- if DME issues any form of petroleum tenure before the environmental performance and disposal of associated water are locked in, it is abrogating the precautionary principle and is perhaps giving momentum to an activity that is more easily launched than controlled;
- if a condition (say, of an environmental authority) cannot be consummated because the requirements of the another Act cannot be satisfied, the company applicant may well be trapped;
- the capacities of each of the decision-makers to make a prudent decision will inevitably vary and their willingness to heed advice from other specialists will also vary. It becomes possible for an enthusiast armed with single-minded legislation to lead the Government into error.

Bates (2002) has written: "In the absence of clear statutory guidance as to priority, the courts favour an interpretation which treats each piece of legislation as laying down simply other another layer of control. There is a strong presumption that the legislature does not intend to contradict itself, so the courts will favour an interpretation that does not lead to conflict but allows legislation to operate in parallel."

Why is it important that parallel statutes be consistent and enable departments to act within a broad whole-of-government framework? The reason is the complexity of society and the complexity of the biophysical environment: in other words, the number of factors that can 'go wrong'. The legally precise approach of dividing statutory functions into discrete portfolios for administrative convenience traps the State into inability to adopt a holistic approach to the management of natural systems that are holistic. In other words, an enthusiastic operator can innocently or intentionally drive an environmental wrecking ball through the gaps in a disaggregated statutory regime.

The same issue of cross-compliance arises in the relationship between regulatory development approval and volumetric water allocation for, say, intensive animal husbandry. In this case, a nexus can be created under IPA s.3.2.1(5) by the requirement that a regulation may prescribe that the assessment manager may not proceed to assess an application unless it is accompanied by evidence that a water allocation or equivalent is in place. At the date of writing, no such regulation has been promulgated. In any case, the COAG-inspired advent of trading in water that is disconnected from specific parcels of land has made this provision highly problematic. While in principle an assessment manager could require as a condition that the owner of the development must keep a water allocation on foot (and DPI&F has imposed such a condition on previous permits), and such a condition would run with the

land, major capital-intensive developments such as feedlots are not conducive to stop-start regulation of this kind. It is understood that DPI&F no longer applies conditions of this kind, for legal reasons of cross-compliance.

There is the one and only one adequate solution to the risk of invalidly using one piece of legislation to regulate functions lying in a different regime: that is to amend the primary legislation to create a head of power to allow the missing functions to be factored into decision-making. (See also the proposal to establish "special criteria", explained elsewhere in this paper).

Finding: That DME amend the PAG Act to create a head of power that will allow considerations of water management to be factored into PAG decision-making. The normal method of doing this is to establish some public interest criteria at the beginning of the Act. Such a move may well be opposed by industry but modern governance demands no less.

Cumulative impacts

There is no effective mechanism in place to assess the cumulative impacts of the existing and planned scale of development on natural resources at the landscape scale. Each project is considered on its individual merits.

The extent of the eventual impacts from what could become a dramatic change in land use over a substantial area is unknown, as are the implications for existing programs and projects underway or proposed. While individual projects are regulated, the expanding footprint of gas production in the region constitutes a significant land use in its own right.

Cumulative impacts are notoriously difficult to avoid. Not the least of the challenges is to set thresholds objectively. The process of setting thresholds (targets) for *water quality* is now quite well advanced, through the medium of the Condamine Alliance and other regional NRM bodies funded by the State and Commonwealth Governments. The process of setting thresholds (environmental flows) for *volumetric extractions* is quite well advanced, through the medium of water resource planning, but the coal seam gas industry escapes both. In principle, punitive impact could be identified during an impact assessment process, but no such process is set out in the PAG Act and the industry escapes impact assessment through the State Works Act or IPA.

PART VI – FREE-MARKET OR CENTRAL PLANNING?

Coordinated Production and Disposal

Industry personality Richard Cottee observed at the September Chinchilla Forum that "Capitalism creates this chaos much more than carefully planned economic development … but the chaos is more productive and I would prefer to live in this chaos that has created the nation." The quotation, while charming, misreads history, economics and public policy. Australia's daunting distances were developed not through free-wheeling capitalism (more true of the USA) but on the back of State-provided infrastructure. It wasn't until State legislation prised the best land out of the squatters and re-allocated it to small holders that agriculture, for example, flourished. It was State-sponsored railways that extended settlement throughout coastal Australia and State-sponsored water supplies that gave birth to irrigated agriculture.

It is important to keep the relative strengths of entrepreneurial capitalism and State facilitation in clear focus. It is the energy of entrepreneurial companies which will develop the gas industry but it is coordination by the State that will consolidate the growth, will achieve efficiencies of scale in providing infrastructure and will rein in the natural tendency of free-market capitalism to leave a trail of wrecked environments and disrupted private property rights in its wake as it moves on to the next entrepreneurial challenge.

Also, it is not true that chaotic capitalism is the most "efficient" system. Certainly, other aspects being equal, competitive markets will tend to reduce the prices of goods for *consumers*, but can cause inefficient use of *resources*, waste of sunk *public and private investment* and neglect of what economists call *externalities*: goods and services not traded in identifiable markets.

> As this analysis has proceeded, the evidence has grown that this industry is being developed faster than the capabilities of the authorities to moderate the potential downsides. To mention just one aspect: carbon sequestration depends (where depleted oil and gas fields are not available) primarily upon injecting carbon dioxide into deep, saline, stable aquifers (to maintain pressures). The CSG industry is currently dissipating deep, saline, stable aquifers.

Each company may well be able to manage its own patch, but each company's efforts will not be adequate to manage the interplay of effects once many new

fields are added and flood vulnerability, roadworks, possible new dams, changes in the grain industry and climate change considerations are superimposed.

There are three main options for coordinating production of gas and water and disposal of water:

- a “hands off” or “let the market sort out disposal” model;
- a “ centrally coordinated” model under which the State directs production to pre-determined locations, coordinates disposal and ensures that all appropriate statutory approvals are obtained; or
- an “intermediate” or “networked” model.

It is difficult at present to know how serious are the negative consequences of adopting the pro-market approach, because the statutory regimes are not working as they were intended. At a minimum, to ensure that the pro-market option does not betray the public interest, the regime changes mentioned elsewhere (pre-lease evaluation, impact reporting, dissemination of information) must be made.

Beyond that, the analysis leads this author to conclude that an intermediate or network model is best. The reason for rejecting the hands-off approach is that there are no obvious satisfactory solution for the disposal of associated water. It is irresponsible for the State to foster an industry with (in general) no known feasible pathway for managing the downstream consequences.

The networked model would assign roles as follows:

- DME as tenure allocator is responsible for overseeing and refining the statutory regimes and for evaluating specific project applications in a multi-disciplinary public interest context;
- DME or NRW at DME expense develops a centre of technical and professional expertise in the management of associated water;
- SunWater coordinates disposal projects (putting producers and consumers in touch with each other and building the necessary infrastructure) and in drafting submissions for public subsidies where justifiable (explained in the next section);

- DME and NRW are both responsible for wholesaling data and DME for negotiating a single-portal access to web-based information, perhaps hosted by the Condamine Alliance or the Australian Coal Seem Gas Council;
- State Development facilitates projects in an orderly manner, by matching development of gas with public infrastructure and with SunWater's strategic plans for water infrastructure.

Finding: That DME adopt a networked model for overseeing the CSG industry, building formal relationships with NRW, State Development, SunWater and a web-page host.

Coordinating a network of water infrastructure (especially pipelines)

It is not clear whether coordinated collection, treatment and reticulation through a pipeline grid, which would bring continuity of supply, is practicable, given the distances between fields. Without a coordinator, the companies are unlikely to collaborate to install joint pipelines and treatment plants where this is feasible. There are advantages in centralising facilities: for example, Dalby Town Council prefers to have its desalination plant along with its other water infrastructure in the one place, not scattered over the field. SunWater is actively promoting its credentials as a facilitator of joint schemes. However, it would expect a commercial return and commercial viability has not yet been demonstrated for any scheme.

SunWater is a government-owned corporation, with the Minister for Natural Resources and Water and the Treasurer being the shareholders. It is required to operate commercially and is not subject to routine public interest directions from the Ministers. SunWater (which has a mandate to aggregate users) could be directed jointly by the shareholding Ministers to take on a scheme as a community service obligation, but to preserve the integrity of SunWater's corporate status, this would require a transparent subsidy from the State.

SunWater has a strong capability as an engineering services provider, a planning consultant, a construction body or an operational manager of facilities. Inquiries indicate that SunWater would be quite keen to operate in this field on a fee-for-service basis, or on a build-and-operate basis, or as a manager/contractor. SunWater is already agent for six coal mines and to service additional gas companies would be routine.

An alternative would be to set up a water board under the Water Act. Local

governments would approach the Minister and could then assemble water, build pipelines, build a treatment plant and take on debt. However, even a group of local governments would probably require specialist engineering consultancies and/or would likely contract SunWater to manage a scheme.

Although this problem won't be solved by markets, there is one benefit in leaving any scheme to SunWater: that it will certainly take a hard-headed approach to any schemes and under current policy settings will not be vulnerable to pork-barrelling. SunWater will keep any subsidies transparent whereas a local board is more vulnerable to local special factors. Expressed in other words, farmers have little capacity to pay and will lobby incessantly for favours. SunWater has a greater capacity to ride out these forces.

Finding: It is unclear whether the central coordination of a network of pipelines and treatment facilities is practicable or even desirable; to operate such a network and even to advise on its appropriateness is a specialist task; SunWater is the best placed body to consider such a scheme.

Matching Supply and Demand

SunWater has run a supply model and surveyed demand for a scheme in the Chinchilla district. The models showed that they could supply 2000 ML per annum at $1000 per ML, double the price the users were prepared to pay. The affordable price is capped by cheap water elsewhere and also by limit on demand for produce. Melons would support at a maximum of about $500 per megalitre. Cotton would not spend $2-300 per ML at present but that might change. Indeed, pumping costs at present for some bores feeding cotton can run as high as $90 per ML (diesel fuel) and growers in the district are prepared to pay $150 for temporary transfers. If a grower has some existing water to shandy, the cost can be brought down considerably.

Chinchilla Shire Council is using only 50% of their allocation from the weir (managed by SunWater) and are not using their allocation from the GAB, so are unlikely to want to pay more for gas water

The feasibility of purifying the water depends very much on the alternative supplies available in that locality. Where there is an adequate allocation (even if the quality is patchy), enthusiasm for paying for CSG water will be weak. Although townies have a much greater capacity to pay (for them "Water costs what it costs"), in general they are already being more-or-less adequately

supplied. Dalby is different, sitting on a shallow aquifer that is failing. This explains Dalby's eagerness to sign a contract with Arrow, one that will substantially meet their future demands. Even here, however, the pathway chosen has been subsidies from central government rather than a charge to users. (Interestingly, Dalby Town Council is placing money into a sinking fund so that at the end of 15 years, it will have a kitty to cover the presumed increased cost of an alternative supply).

As pressure builds upon gas producers and governments to not waste this resource, pressure will be applied for governments to subsidise the price. At present the policy environment is signalling that water is worthless. There are two ledgers, one showing profit and loss for gas production; and this is disconnected from the production of water which is simply regarded as a byproduct.

People are accustomed to inexpensive water and market forces will limit the willingness of irrigators and other investors to pay the cost of treatment: by comparison there are other enterprises in which they can invest. Without federal funding, the desalination plant at Dalby could not have been progressed, but if the water were not being used, the community would be demanding to know why not.

Considering just the cost of treatment and not the benefit of removing the salt, there is no obvious reason to justify giving priority to CSG associated water over all the other water conservation and water development projects that are now on the State and national public agendas. CSG associated water projects may not offer any more value for money than numerous other identifiable projects. And a decision to depart from a value-for-money criterion needs to be justified, not assumed.

If this principle means that CSG associated water projects will rarely warrant public subsidies, then the State and the industry have only three options:

- to build the cost of treatment into the cost of the gas (a practice that would be justifiable in terms of mainstream economics); and/or
- to regard treatment as not generally viable and therefore to conclude that there is no general satisfactory disposal option.

Finding: That there are plenty of potential beneficial uses and beneficial users of purified associated water but not at a price for which purified water can be

produced. The gap is probably of the order of $700 per megalitre.

Finding: That DME commission a consultancy in consultation with the Queensland Water Commission and the National Water Initiative to develop a benchmark assessment of value for money presented by CSG associated water projects. Such a benchmark would simplify subsequent assessments and may avoid wasting everyone's time with the lodgement of hopeless applications. It may also help to indicate the quantum of the gap that governments may be prepared to contemplate when funding projects and this would indicate the basic amount that local sources must fund.

Finding: That DME prepare a Cabinet submission exploring the prospect of establishing a trust fund to deposit the royalties from the sale of gas and to fund public benefit water projects, as a more efficient method of funding than project-by-project applications. (This would not be necessary if the gas market is adjusted to allow the necessary investment to be debited by companies against profits).

PART VII - INFORMATION

Throughout the course of this analysis, stakeholders have impressed upon the author, more than any other concern, the absence of reliable information on which they can base their own assessments. Landholders and the regional NRM body (the Condamine Alliance) want assurance that the Department is monitoring the impact of CSG operations – on volumes from existing bore water supplies, on leakage from evaporation ponds to shallow aquifers and on the environment.

To ensure that appropriate information is placed in the hands of those who need it, several steps are necessary: setting of standards, capture, management and dissemination of data. Before dealing with those in turn, it will be helpful at the outset to distinguish between *foundation* and *project* data.

Foundation data is that necessary to understand Queensland's landscapes and ecosystems. By its nature, and also for economies of scale and fiscal efficiency, it requires long-term dedicated monitoring programs and will not necessarily be directly linked to specific projects or investment programs and may not have an immediate client. This data needs to be centrally coordinated and publicly accessible.

Ideally, the State would set out to collect this data systematically over a period of years as funds allow, but in practice, the data sets can and are built up by taking advantage of others' capture projects – such as the logs that licensed drillers must submit for every bore they put down – as opportunities arise.

Project data includes data collected by gas producers with specific operational or compliance objectives in mind. Depending on its durability and confidentiality, project data may not all be centrally coordinated or publicly accessible, although public access is strongly preferred except for the minimum that is commercial in confidence.

It is a well established rule of thumb within NRW that project proponents should be responsible for the collection of such data as is necessary to obtain statutory approvals for their projects and to monitor their effects on the environment and the property rights of others. The impact reporting regime within the CSG industry has been crafted in accordance with that principle.

Finding: The reporting regime ('impact reports') for CSG may well enable the companies and the departments to identify the effects of specific projects, but they are no substitute for systematic capture of regional-scale foundation data. The State needs to invest in collection of data that goes beyond what can reasonably be asked of individual companies.

Standards of Data

Information to monitor the effects of the CSG industry is needed about:

- distribution of current operating bores, approved bores and exploration wells;
- composition of waters and trends;
- life expectancy of individual bores and bore fields;
- practicability of re-injection;
- soil conditions at every evaporation pond disposal site.

NRW requires not only impact reports but also water production reports. This information will help to ascertain the provenance of the water, its origin and how fast it will deplete. All water taken must be identifiable. Each company has some flexibility to decide which tests they will run to satisfy these objectives.

NRW on its part will keep records of the other users relying on each aquifer. Additionally, Queensland is having to embrace national water accounting and the coal seam gas industry will not be able to escape this additional responsibility.

It is particularly necessary to know original baseline conditions. However, the legislation doesn't require companies to report baseline conditions immediately, only twelve months afterwards when the site has already been altered.

The legislation was not written around shell companies and short-life start-ups. Difficulties could arise with long-term record-keeping if there is a high turnover or structural instability among the subject companies.

As soon as someone's bore goes dry neighbours will point to the nearest coal seam gas company and blame them. The smartest thing that the gas producers can do is to put down monitoring bores to demonstrate their innocence. Companies must prove their case of harmlessness. In ten or twenty years' time, good baseline data now may allow them to demonstrate this. As one informant said, "Whatever it costs them, it's cheap". A company representative opined that collecting the data may not require much work beyond what they must do for their own purposes: "as aquifers are their life blood".

Origin's monitoring at Spring Gully is presented as a typical monitoring program. There is a string of observation bores 5-10 m deep around the perimeter of the evaporation pond. There is another set 30-50 m deep into the Hutton Sandstone, the most shallow broad scale aquifer in that locality. (Incidentally, this monitoring program has not been accepted by NRW, as it has not been put to NRW in an underground water impact report).

In discussion, one of the companies claimed that it is difficult to separate the effects of their de-watering from the effects of drought and also that farmers on their part are reluctant to release their own data. These observations underscore the importance of conducting systematic monitoring.

Finding: Regular audits of companies' record-keeping, both in their CHQ and field depots, should be run by DME.

Format of data

Data should be presented in a format that interested parties can understand, can be easily disseminated and is comparable with other companies' formats, not buried within an Annual Report or a return submitted for other purposes.

It has been suggested that the four or five different information requirements (for petroleum tenure, environmental authority, water licence, IDAS, the assessment that DME conducts before allowing a company to relinquish) could be collapsed into a single report, in some form of environmental management system. This could make the reporting requirements less onerous (and a review of the legislation with this end in mind is underway, in consultation with APPEA). Industry was a party to the crafting of the reporting regime but that is not an argument that it is satisfactory.

Finding: A review of the reporting requirements be progressed on a whole-of-Government basis with a view to a simplified but comprehensive environmental

management system for each field. (This would be prepared post-ATP by the applicant(s) but is different from the pre-ATP capability evaluation proposed in the final section of this analysis).

Capture of Project Data for Compliance Purposes

As explained above, as a condition of their petroleum tenures, companies are required to undertake impact assessment reporting and monitoring. Once the statutory impact report is accepted by DME, it becomes the point of truth as to whether the drawdown has damaged another person's capacity to access water from a bore.

Conditions could be enforced either as a condition of the water licence (in regard to the on-supply of the associated water) or of the petroleum lease (e.g. via a management plan). The credibility of the water management provisions of the petroleum legislation is based upon the impact reports.

During this analysis, a misunderstanding about the status of impact reporting was revealed. Some industry representatives argued that reporting other than that included in the Annual Reports was required only if evidence of damage appeared. Companies needed a 'trigger threshold' only if a problem arose with their operations and not as a routine. By this reading of s.253 the wording "A petroleum tenure holder **may** ask…" means that the action is optional; and if a company has good reason for believing that its operations won't cause any significant reduction in performance of existing bores, it doesn't need to ask for a trigger threshold.

However, the intention of the legislation was that the trigger threshold is essential so that the preparation of an impact report may commence. The impact reports should be stand-alone documents establishing baseline data and confirming proactively that the extraction operation is proceeding without adverse consequences on the aquifers. The words "**may** apply" were included because, once a trigger threshold has been set for an aquifer, there is no need for another tenure holder to apply for a trigger threshold in the same aquifer: the newcomer can just use the threshold that had already been set. For this reason it would be inappropriate for the legislation to specify "must apply".

Tenure holders, and not the Government, have the responsibility for making good their impacts. The trigger thresholds are intended to allow the Government to help tenure holders in defining and limiting the extent of these impacts and

to clarify in advance what their "make good" obligations are likely to be. It would be quite difficult for the Government to accept water impact and related reports unless the trigger thresholds have been set.

If tenure holders wait until their neighbours are complaining about problems with their bores, then they do not understand the nature of the problem. The "make good" situation set out in the petroleum legislation is based on similar conditions that have been operating effectively for mine water licences issued under the Water Act for many years. In these cases the impacts on water levels and bore owners are identified well in advance. Impact estimates are reviewed periodically based on monitoring data that can then potentially improve these estimates (via a groundwater flow model if necessary). As potentially affected neighbours are identified (in advance of an actual impact) the tenure holder can start to negotiate a means of making good, so that the bore owner never needs to complain about their bore running dry. If the tenure holder follows the requirements for impact reporting then they will always know in advance the extent of this "make good" obligation, and can plan for it accordingly.

The absence of requests to the Department to establish trigger thresholds is evidence that the impact reports have not been prepared as the legislation intended. An audit in October 2006 revealed that not one company had submitted an impact report as required. Further, in the absence of knowledge of current effects, no one is monitoring the cumulative impacts. Industry commented that honouring their obligations in this regard was a one-on-one issue for each company in turn. This is surely not the case. That there can be such a fundamental misunderstanding over a provision drafted jointly by industry and the State is extraordinary.

It is suggested that it would be best for the companies to band together to engage consultants who will model whole gas fields using groundwater / hydrological / geological / stratigraphic / biological parameters. This task may not be as onerous as one might first expect, as not all fields are going to be equally problematic. NRW should be invited to sit on the reference panel for the consultants.

Finding: The impact reporting regime is not based on the assumption that the Government will step in and tell the petroleum tenure holder what they need to do to make good, after bore owners have made complaints. DME regional staff must make this plain to each company and publish such explanatory materials as are necessary to ensure that all staff and companies are aware of the regime.

There should be a regular (say monthly) meeting between DME (CHQ and region)

and NRW (CHQ and region) until the misalignment of interpretations over impact reporting is overcome and effective new protocols are in place.

Management of Data

There are three stand-alone databases: royalties, QDEX and Merlin (tenures). Annual reports are remitted to QDEX (Queensland Digital Exploration Database. There is an interactive map outside the firewall. DME does not seem to have a central map showing the location of all gas approvals or EPA approvals in a district. One can obtain maps of bore locations from NRW, but it helps to know the number of the particular bore.

The companies are coy about releasing some of their technical information beyond their statutory requirements. There seems to be no formal mechanism in place for relevant information to be injected into a broader, comprehensive water quality monitoring regime, such as that required to assess progress towards overall water quality targets at the catchment scale. It is not known whether arrangements are in place with EPA for monitoring data to be provided to DME/NRW so that there is one single point of truth for all groundwater data. Procedures seem to be required to refer incoming reports to water specialists in DME or NRW for evaluation. It is not clear how NRW regions can access data or information on company reports.

Finding: That NRW and DME each appoint a " Data Coordinator for Coal Seam Gas" to assemble through one portal the information available within their departments. The DME person would also have the task of assembling information sourced from the gas producers and pressing them to release information not yet in the public domain. (It is possible that these roles can be taken up by current officers without additional funding. If facilitative seed funding is required, it should come from the DME portfolio. A sum of $50,000 should be sufficient to scope the problem, assemble the data that is currently available and identify the size of the gaps).

These officers would also have a role of coordinating new data capture projects and soliciting funds for data collection which lies beyond the scope of each company's individual responsibility.

These officers would also negotiate a data sharing agreement between the parties to overcome intellectual property considerations.

Dissemination of Project Data

There seems to be general agreement that such information as does exist about this industry, whether adequate or deficient, is not readily accessible and this is antagonising other stakeholders. The advent of the Internet should make it easy to establish one-portal access to information about any industry, especially one that is likely to generate sensitivities in the community. At present, it is difficult enough for people inside government to obtain copies of various permits and to find out information about the aquifers. The companies should be encouraged to place as much information as possible in the public domain and the State departments should be able to establish an index to their own public data sets. A common portal would be beneficial to the State departments for their internal purposes as well as external stakeholders.

The companies would have more credibility if they published regular results from their networks of observation bores. One company observed that they would be prepared to make public their data on quality and quantity from the monitoring bores, so long as their competitors were obliged to do similarly.

The industry agrees that there is a need for better education and information and, especially, for stronger dialogue with catchment groups. Industry considers that a general website could be helpful. If established, it should deal with all aspects of the coal seam gas industry and not just the water.

A central portal could include links to the following:

- public leaflets and educational materials;
- each department's databases such as MERLIN, QDEX and NRW's groundwater data base; (these could be indexed into a single "CSG approvals" page);
- selected web pages of each department;
- regional NRM bodies and community organisations such as Chinchilla Development;
- web sites of ACSGC and APPEA;
- each company's ASX reports;
- local governments;
- specialist, government and learned documents such as the Ministerial

Council's *Strategic Framework for Water Management in Mining;*

A central FAQ facility could be set up if funding and protocol issues could be overcome.

Finding: The two Data Coordinators should negotiate as to who will undertake the role of disseminating or retailing information. They should facilitate the supply of information to the host of a new web page.

Finding: A web page indexing information about this industry is required. This "Coal seam gas" page could be hosted by the Australian Coal Seam Gas Council, the Condamine Alliance, the University of Southern Queensland or the Australian Centre for Sustainable Catchments.

Finding: A new web page indexing development approvals is also required as a satellite to the main CSG industry web page. This should be developed by DME. NRW's "Approvals" http://www.nrw.qld.gov.au/planning/approvals/index.html

Web page is a good start in this direction and this needs to be extended across State Government. This could be done through a Smart State project.

PART VIII – SOME CONCLUSIONS IN PERSPECTIVE

The economic benefits to the region, the State and the nation from the development of the coal seam gas industry in the Surat Basin to date and into the foreseeable future are undeniable. It is no longer an emerging industry but a critical component of Queensland's energy supply. Power stations, pipeline owners, gas producers and gas users are becoming enmeshed in a web of path dependencies. This growing momentum makes it vital that the State be confident that the industry can develop without unintended consequences and without leaving a legacy of unfunded liabilities for future generations. Governments of the future will own the liability for impacts that arise or that remain after other accountable parties have left the scene. Whether there is significant existing damage is not relevant.

As with any start-up industry based upon extraction of raw materials, the industry will attract or is already partly buoyed along by energetic entrepreneurs. This phase will fade as the industry matures and as some of the low-overhead start-ups are consolidated into more established enterprises.

Generally, however, the desire of the gas producing companies to be good local citizens and to leave their communities in a better condition is not disputed. While the corporate and ethical reputation of companies is variable, this author has no doubt that overall the industry's concern not to waste water, not to sterilise ground and not to jeopardise their social licence to operate is genuine. An Origin spokesman said that the company's emerging position now is that it won't develop a field without being able to facilitate a beneficial use for the water. However, in a competitive gas market, this policy could threaten the company if its competitors refuse or fail to internalise their costs in this way.

There is an attitude of 'technological optimism' among the 'can-do' people who populate the industry, a confidence that the engineers and geologists (and markets) will solve whatever disposal or environmental problems arise. It is this, rather than any ethical carelessness, that explains why the industry is powering ahead to sign long-term contracts for gas while long-term solutions to disposal of water are not yet cemented in place. However, the optimism is potentially misplaced as it is quite likely that for many fields no solutions that are both financially viable and environmentally benign exist.

It is quite possible that the CSG industry is inflicting and will inflict less damage on the landscapes of the Surat Basin than is currently being caused by agriculture. The gas companies however face the two-pronged challenge in that, first, their impact is additional to what is already stressing local aquifers and

local river systems; and second that the effects of agriculture are fairly well understood and a "part of the furniture".

Holistic Government Responsibility

This paper has been written from a whole-of Government perspective. The Government as a whole must be holistic, even if specific agencies have constrained responsibilities. The public service must look at the total water balance in a catchment, the loads of salt in the landscape, the stress on rivers from all sources and the ripple socio-economic and environmental consequences. The companies are not just tapping coal seams with water as a by-product, they are altering Queenslanders' heritage of natural resources in irreversible ways.

It is not appropriate for the State Government to launch an industry and then run the risk that in five or 10 years' time, a serious and/or irreversible problem has been caused. The duty of the public service is to protect the public interest, not the interests of the industry as such. This requires public officers to take all reasonable steps to predict consequences and to put remedial steps in place at the outset. The precautionary principle obliges us to do that, as does suitable language in the Water Act and the EPA Act, to mention only two of the relevant statutes. It is invalid to assume that the promotion of this industry in its current form is automatically in the public interest.

The State Government must be confident that the risk is being accepted by some entity capable of managing the risk (the precautionary principle). It may well be true, as some have noted, that volumes are relatively small and any beneficial reuse will be local and close to the site of production. Infrastructure requirements may well be modest and pipework may well be funded by the users. But this analysis has uncovered no satisfactory method of benign disposal, whether on a small scale or a large.

The preferred method of giving these long-term and holistic aspects sufficient weight is to direct that the public service run a multi-disciplinary, multi-departmental and multi-resource evaluation of every proposed development in advance. This responsibility should lie upon the DME portfolio. It cannot be delegated to industry, a process which is adopted currently for impact assessment generally and is a major reason for the general dissatisfaction with impact assessment. Furthermore, it should be signed off by an officer who is not the delegate of the Minister making the eventual decision whether to grant an ATP or lease. A suitable model for such a procedure is in s.16 of the *Land Act 1994* which is mandatory before the State moves to allocate its land resource. DME should dedicate experienced officers to this role.

The critical stage at which this multi-dimensional evaluation should be run is before the issue of an ATP. Once a prospector has invested funds, it is problematic to refuse a lease on grounds unrelated to the conduct of the prospecting program.

The Minister's discretion to set out "special criteria" against which applications will be evaluated does not seem to be fettered by the PAG Act. Such criteria could include environmental and socio-economic criteria and, specifically, could include a requirement for tenderers to submit details of how they intend to dispose of associated water. Of course, the special criteria should be made transparent in the tender documents. No statutory criteria are set down for evaluating tenders other than procedural matters (s.39ff PAG) and *capability criteria* (s.43,49 PAG) and again, so long as natural justice is observed, the Minister's discretion is relatively unfettered. Also, the Minister could issue statutory policy guidelines as per s.43(1)(a).

By informal current practice, tenders are assessed primarily on how much exploration activity the bidder is prepared to undertake to prove up the resource, as evidenced in particular by how much money the bidder will spend. At present, there is no evaluation of land use and no environmental or hydrological criteria. This practice is not compatible with the satisfaction of the State Government's five advertised priorities, with the achievement of a range of Government policies other than the promotion of the CSG industry and with the protection of the public interest in the land and waters of the regions in which the industry is developing.

Finding: The current practice of not considering public interest criteria other than the promotion of the industry during evaluation of tenders to prospect is a matter of informal practice, is contrary to a range of Government policies and has no support in statute.

This practice has the potential to create anger in the community and to mire the State Government into authorising developments that it later finds to be unacceptable but irreversible except by payment of large quantums of compensation.

A more thoughtful pre-evaluation would not necessarily slow the rate at which gas projects are brought on line. Indeed, it could well simplify the issue of other permits such as environmental authorities, water licences and development approvals – and impact assessments where they are required.

A simple example of a "special criterion" (though not water-related) would be that tenderers should calculate the greenhouse footprint of their project and detail how long they intend to flare or vent unwanted gas. Such a consideration is likely to loom large in the Government's horizon during the next five years but without a test of this kind set out in the tender documents, the State the would be discarding the tenure allocation power to minimise greenhouse gases and would be obliged to rely upon a carbon trading scheme which does not yet exist or obliged to compensate companies for not releasing greenhouse gases that their lease entitles them to waste.

Summary and Main Findings

Challenges facing any program of benign disposal (including beneficial use) include:

- quality: most associated water requires treatment for most beneficial uses;
- reliability: by its nature the production of water is unsustainable;
- cost: both treatment and distribution are expensive;
- geographical spread: the four main companies have numbers of separate developments scattered over hundreds of kilometres.

Expressed optimistically, the best solution will be project specific, depending on location, access to water infrastructure and developmental infrastructure, water quality, and the needs and priorities of stakeholders.

Expressed pessimistically, no general pathway for overcoming these challenges has been discovered by this analysis, either at a local scale or at a Basin-wide scale. In other words, there is no satisfactory technical or economically viable general solution.

Finding: That the interdepartmental steering committee overseeing the preparation of this Issues Paper continue to meet, regularly on a monthly basis at first, until strategic plans for each most affected district are in place.

Finding: That a summary of this issues paper be presented to the Australian Coal Seam Gas Council and be subject for **managed** *ongoing discussion there.*

Finding: There is no satisfactory general solution for benign disposal of associated water. Evaporation ponds are unsatisfactory from all perspectives. Re-injection is not practicable or less not proven on most fields. Application of untreated water by other industries does not dispose of the salts. Desalination (purification) is technically feasible but would require economic support and in any case still leaves a residual brine.

Finding: That the State Government progress the preparation of three different kinds of strategic plan for disposal of associated water:

- *the industry development plan currently being prepared for the Department of State Development. Contact should be made with State Development to ensure that its plan serves the broader purposes of the State government as well as industry facilitation;*
- *a Surat Basin-wide non-spatial strategy for the benign disposal of associated water, coordinated by DME in consultation with industry and other departments, using this report as a starting point but incorporating more in-depth technical engineering input about options such as re-injection; (this could be followed by a Bowen Basin-wide strategy);*
- *spatial strategic plans for each district, perhaps crystallised in the form of a Water Use Plan .*

Finding: That the Director-General as a matter of priority instruct that all future tender documents for authorities to prospect for CSG include "special criteria" of a public interest nature. These would include criteria aimed at securing the best possible proposal for benign use of associated water, at evaluating the most appropriate use of the gas/water resource being targeted, at assessing the impact on other natural resources and at demonstrating how the proposal meshes with other State Government policies.

Finding: That the Director-General concurrently instruct that each tender process be supported by a report from the chief executive's delegate (not the Minister's delegate) on each application or each tendered field in terms of the special interest criteria.

Finding: That the PAG Reg be amended to set out "standard special criteria"

generally along the above lines so that these become unambiguous and mandatory.

This evaluation need not bog projects down in unnecessary caution. A certain amount of uncertainty as to eventual beneficial uses can, arguably, be accepted when assessing a new project. The precautionary principle is not absolute. Rather the purpose is to oblige DME to accept responsibility for the downstream consequences of each project that it is launching.

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Policy and Resource Strategy

Department of Mines and Energy

30 December 2006

APPENDIX

COAL SEAM GAS CO-PRODUCED WATER

STATUTORY REGIMES

Explanation

This chart maps the statutory processes that apply to the development of a new coal seam gas field with associated water. It does not cover safety matters or transitional matters or tenures under the 1923 legislation or the mining legislation. Some entries will be superseded by forthcoming amendments to the petroleum and gas legislation.

TABLE 1: NEW STANDARD PROJECT

OBJ

OBJ

OBJ

OBJ

Ends Version of 30 Dec. 2006

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Management Unit	Number of Bores	Estimated Stock & Domestic Use (ML/Yr)	Licensed Non-Stock & Domestic Entitlement (ML/Yr)
Eastern Downs 1 (Walloon Coal Measures)	1,522	15,182	9,139
Surat East 2 (Walloon Coal Measures)	249	2,570	1,162
Surat North 1 (Walloon Coal Measures as well as all Injune Creek Group)	309	3,039	22
Surat 5 (Walloon Coal Measures as well as all Injune Creek Group)	184	4,425	44
Total for Walloon units	**2264**	**25,216**	**10,367**
GAB bores in the Surat, Surat East, Surat North and Eastern Downs	7,969		
Condamine alluvium	Many more		
Toowoomba basalt	Many more		

Present Criteria	**Step in Statutory Process**	**Comments, including scope for the amendment**	
AUTHORITY TO PROSPECT Discretions in decision-making are extensively delegated to the Regional Manager Mines, South East Region			
	Geological Survey conducts public good (pre-competitive) investigations and discovers some prospectivity▼		

A sensitive area could be excluded. The Minister could sequence areas to maximise efficiency There are restrictions on advertising tenders over coal or oil shale leases (PAG)	Minister advertises a potential exploration area for competitive bids (s.35, PAG)	As this is resource allocation, it is at the Minister's sole discretion whether to proceed

No statutory criteria are set down for evaluating tenders other than procedural matters (s.39ff PAG) and *capability criteria* (s.43,49 PAG). Minister could issue statutory policy guidelines as per s.43(1)(a). Minister can determine the conditions of a tender. By informal policy, tenders are assessed primarily on how much exploration activity the bidder is prepared to undertake to prove up the resource, as evidenced in particular by how much money the bidder will spend. There is no ESD criterion. There is no evaluation of land use. Tenderers are asked to submit an exploration *work program* as per s.48 PAG etc Native title is a primary Consideration.The ATP is not dependent on land tenure, although the Minister may choose to exclude certain sensitive or public interest tenures. Restricted areas (as under MRA) generally not applicable.RPP not required (W. Reg.; PAG, anomaly with PA to be remedied by C'mas W Reg.)Special provisions apply to reduce conflict with coal miners (s.304ff PAG)	Competitive bids evaluated	

	Company awarded ATP Authorises activities such as reconnaissance, drilling, light clearing and seismic surveys, commonly less intensive ***Conditions*:** ➢ s.20 PAG ➢ exploration Work Program, ➢ s.65 PAG relinquishment conditions ➢ must obtain EA (s.41(2)(b) PAG) (successful tenderer will be advised that a requirement for issue of ATP is to obtain EA plus security) ➢ security may be payable (s.488 PAG) ➢ must submit water monitoring report, concurrently with annual report (s.266,552); also provisions for review reports ➢ must collect information to underpin the 'make good' obligation (s.187,190ff PAG) ➢ must make good the supply of water to specified bores or compensate (s.244,250ff, etc PAG).Must lodge an underground water impact report within one year plus 20 days after first testing (s.256 PAG). This must include an underground water flow model and proposed monitoring program. There can be exemptions.There are provisions for decommissioning (s.292ff PAG, s.50 & sched.3 PAG reg) and compensation (s.531ff PAG)	MinisterMinister may require the ATP holder to give the State a security s.487ff PAGOnus is on the ATP holder to advise the date
EWP is on the register and can be made publicly available upon application EA required under both EP Act and PAG Guidelines on the quantum of a PAG bond are in s.150 PAG Reg Annual report need not be published		

An ATP holder may be issued a data acquisition authority (this fact is in the public domain) but there are no requirements to make the collected information public (s.176ff PAG). See regulation for details of confidentiality period. A regulation may prescribe reports or samples that must be kept. May include advanced interpretations. Must be lodged with the State within six months (s.547,548, 553 PAG). Then available publicly s.550 PAG The State can publish submitted information after the confidentiality period (s.51, 52 PAG Reg) Flaring or venting permitted if company decides it is not feasible s.72 PAG		

ENVIRONMENTAL AUTHORITY		
ATPs, pipeline licences and production tenures are all deemed to be petroleum activities.EA may cover several ERAs such as regulated waste storage and regulated waste disposal. All would be assessed at the same time.Only a holder of or applicant for petroleum tenure may applyChapter 4A EP Act in particular refers. Included 1 January 2005		

Tenure-neutral except protected areas. Native title is not a consideration because tenure is not been granted A series of guidelines and fact sheets is available, listed in Guideline *Petroleum Industry Regulatory Framework*	Company submits application with work program	Exempt from IPA under Sch. 9 of IPA
Codes under EP Act. None yet promulgated, all applicants non-code compliant. However, EPA is using the draft code as a template when compiling conditions (it is expected that a code will be promulgated during 2007)Any site with significant disturbance such as an evaporation pond more than 4 ha cannot be code-compliantEPA has a draft Operational Policy	If code compliant, application is self-assessed	

Saline effluent is a regulated waste, level 1. If the petroleum lease holder producers even small amounts of water over a salinity threshold (not specified in statute but specified in Appendix B. of the draft Code of Environmental Compliance), level 1 assessment is necessary, but if there is no water, may be at level 2	If not code compliant, must be assessed	Activities can be Level 1 or Level 2, prescribed in schedule 1 of the EP Reg under s.20(1) EP Act. Level 1 ERAs are medium to high risk of causing serious environmental harm. Level 2 ERAs are not otherwise prescribed as level 1 and are considered to have a low risk of causing serious environmental harm. An EA for a level 2 petroleum activity can be either a code compliant authority or a non-code compliant, site-specific authority

s.113 EP Act sets out criteria for decision e.g. must consider the standard criteria, the first of which is ecologically sustainable development. Guideline *Preparing an Environmental Management Plan (EM Plan) for Level 1 Petroleum Activities* Design, construction and inspection of regulated dams must be undertaken by a suitably qualified and experienced person. Engineering standards are not codified. New code on regulated dams is being drafted. (Needs RIS)	Application for a level 1 activity must include an EMP which specifies disposal options.Purpose of the EMP is to suggest commitments that can become conditions of the EA	
Guideline *Environmental Impact Assessment Process for Petroleum Projects* explains when EIS is necessary	EIS may be required	Could be run under State Works Act, EPA Act or EPBC Act.EPA will advise whether the project is likely to have a significant impact on a matter of national environmental significance, in which case an application under EPBC Act is required.

	If a new level 1 activity, must be publicly notified	
	Application is assessed	
	EA issued	In principle, EPA could specify “no discharge off site”

Policy to determine amount of bond for level 2 activities is set out in Appendix C of the draft code of environmental compliance. See also guideline *Financial Assurance for Petroleum Activities*	Financial assurance payable	

MANAGEMENT OF EXPLORATION AND EXTRACTION		

s.46 LProGuidelines by chief executive s.15 LProAlso s.555 PAG	Land protection measures followed, including wash down for parthenium	
s.319 EP Act	Must not do environmental harm	A company holding an EA has an obligation to report environmental harm. Also, EPA can discover from routine inspections or third-party reports

Aboriginal Cultural Heritage Act 2003 and guidelines	Must protect cultural heritage	
A regulation may prescribe requirements (s.281 PAG)	Driller must comply with regulation	
	Company applies to do production testing	Minister. EPA does not limit production wells/activity unless there is a need to increase the amount of bond

	Company may need to apply for development approval for ancillary operations which fall within the definition of operational works	
PETROLEUM LEASE		
	The Minister may call tenders (s.127 PAG)	
	Company holding ATP applies for PL; has a prima facie statutory right to proceed to production	

Assessed against PAG and regulations, see s.121, s.131 PAGNo technical guidelines yet approved (drafts exist) but industry codes would be taken into accountDevelopment Plan to be submitted with application (s.136ff PAG). Guidelines could specify content of a Development Plan (drafts exist)Criteria for evaluating Development Plan s.141ff. The intent is that the development plan will maximise the effective recovery of the resource and the return to the State. Environmental issues, ESD, land-use issues generally not a consideration. Too late for fundamental issues – make or break considerations must be applied at ATP stageLimits of the area, company knowledge are relevant (s.118 PAG): Act is focused on development capabilityOverlap with coal tenures – ensure that both resources are recoverable (Ch.3 PAG)The lease is not dependent on land tenure, although the Minister may choose to exclude certain sensitive or public interest tenures. Restricted areas (as under MRA) generally not applicable. (See s.26,27 PAG)	Evaluated	Minister

DP defined in s.24 PAG. Not entered on QDEX. Obtainable under FOIAnnual report can be made available when the confidentiality condition expires (s.51 PAG reg)EA required under both EP Act and PAGGuidelines on the quantum of a PAG bond are in s150 PAG RegAn ATP holder may be issued a data acquisition authority (this fact is in the public domain) but there are no requirements to make the collected information public (s.176ff PAG). See regulation for details of confidentiality period.Bores are considered unduly affected if drawdown exceeds a 'trigger threshold' (s.246 PAG). The chief executive may fix a trigger threshold (s.251-4 PAG)Flaring or venting permitted if company decides it is not feasible s.151 PAGA regulation may specify requirements for an underground water flow model (s.257 PAG)A regulation may prescribe reports or samples that must be kept. May include advanced interpretations. Must be lodged with the State within six months (s.547,548,553 PAG). Then available publicly s.550 PAGThe State can publish submitted information after the confidentiality period (s.51, 52 PAG Reg)	Company awarded PL Allows associated activities and pipelines in the area of the lease (s.109-12 PAG) ***Conditions*:** ➢ s.20, 150ff PAG ➢ Development Plan ➢ must submit water monitoring report, concurrently with annual report (s.266,552); also provisions for review reports ➢ must obtain EA (s.121(1)(f) PAG) (applicant to take initiative) ➢ security may be payable (s.488 PAG) ➢ must collect information to underpin the 'make good' obligation (s.187,190ff PAG) ➢ must make good the supply of water to specified bores or compensate (s.244,250ff, etc PAG).Must lodge an underground water impact report within one year plus 20 days after first testing (ATP or PL) or the date of first lodging a royalty return (PL) whichever is earlier (s.256 PAG). This must include an underground water flow model and proposed monitoring programA pre-closure report must identify bores that may be unduly affected by extraction (s.261,2 PAG)There are provisions for decommissioning prior to relinquishment (s.292ff PAG, s.50 & sched.3 PAG reg) and compensation (s.531ff PAG)	MinisterMinister may require the ATP holder to give the State a security – s.487ff PAGOnus is on the lease holder to advise the date. Mines tenure administration is not routinely advised of the date of first royalty

ENVIRONMENTAL AUTHORITY		
ATPs, pipeline licences and production tenures are all deemed to be petroleum activities.EA may cover several ERAs such as regulated waste storage and regulated waste disposal. All would be assessed at the same time.		
See above	Company submits application with work programSame process is applied as for the ATP; same EA number; additional conditions may be applied or additional uses specified	See above

Repeat process as for EA for ATP above

	EA issued	
MANAGEMENT OF EXPLORATION AND EXTRACTION *See similar title above*		

WATER ALLOCATION		

Company has right to take associated water and water for the authorised tenure activity and stock and domestic on this PL land or adjacent land in same ownership (s.185-9 PAG; Ch.2 Pt.6 WA by exception). The following explains the intent of the legislation: Tenure holders, and not the government, have the responsibility for making good their impacts. The trigger thresholds are designed so that the government can help the tenure holders in defining and so limiting these impacts. The intention is to enable them to clarify in advance what their “make good” obligations are likely to be. Although the legislation has not made it compulsory to apply for these thresholds, it would be difficult for NRW to accept water impact reports unless the trigger thresholds have been set. Once a trigger threshold has been set for an aquifer, there is no need for another tenure holder to apply for a trigger threshold in the same aquifer. They just use the threshold that had already been set. This is why the legislation states that tenure holders “may” not “must” apply. If the tenure holder follows the requirements for impact reporting then they will always know in advance the extent of this “make good” obligation, and can plan for it accordingly.		

	The petroleum tenure holder (and only them) can apply for an associated water licence (s.206 WA)	S.38 WA in principle allows a *water resource plan* to be launched, presumably if there is an aquifer- or district-wide concern about the volumes extracted. (A water resource plan can include groundwater). However, associated water is not water in an aquifer. It has already been taken from the aquifer. A water licence for associated water is in many respects an authority to re-use or on-supply water, which is quite different from most licences to take water. So associated water lies outside water resource planning process by policy intent.

s.210 WA: sets out what may be considered when deciding an application. Includes: • 1 strategies and policies for the sustainable management of water in the area (includes effects on third parties and ecosystems by drawdowns); • 2 sustainable resource management strategies and policies for the catchment, including any relevant coastal zone and regional aquifer systems; • 3 *the public interest*.Water quality and end land use not considerationsMust be satisfied that priority has been offered to people on a waiting list (defined in s.203 WA) s.206A WAFurther information may be required s.207 WA.	Application evaluated	Chief executive, delegated to NRW RegionCondition could be placed on the licence requiring that water can only be supplied for irrigation when the irrigator has an approved land and water management plan. This is not explicitly set out in legislation, would rely on general powers of CE to set conditions on licences.Other likely conditions might be that CE is informed of volumes supplied to which other parties, and for what purposes.Monitoring of water salinity might also be required.

		It would be possible to create a jurisdiction under s.59ff WA by a *water use plan*, if concerned about the impacts of the use on the land. No such areas have yet been promulgated. A Water Use Plan s.73(1)(d) WA; s.967 WA could specify that a LWMP is required. Deposition of large quantities of saline waters in the MDB catchments would seem to be a justifiable trigger for a water use plan. It could create a means of dealing with the bigger picture water quality issues such as third party water use. However as one of these plans has not been produced, it's not clear what the end result would be. Minister prepares a Water Use Plan, GIC approves, becomes stat. instrument (like a planning scheme) Not delegated

For associated water licence is not attached to land – s213(e)(vi)Conditions may include monitoring and may cap the price that a gas company charges (limitation on charges applies only to water supplied to the priority group)Chief Executive may require the holder of a water entitlement (incl. WL) to collect and supply informationChief executive approves guidelines for LWMPs (s.72 WA)Criteria for approving LWMP s.76 WA	WL issued Conditions s.214 WA Prepare LWMP if required Development permit not required for the bores that extract the water: they do not have a primary purpose of taking water, i.e. they are not water bores. Development may be required for development by a third party off the PL. S.967 WA not relevant **unless** there is other development not associated with the PL that also includes ops work to take or interfere with water, such as works that take overland flow in a WRP area that regulates overland flow.	Chief executive (s.211 WA) Delegated to regional Water officers LWMP could be required before supply of water to any irrigation (under general powers to condition licences) The tenure holder would also need to be registered as a water service provider if they had the intent of charging for the water they intend supplying to others. (s.370 WA)

	WL ends when the petroleum tenure ends	
DEVELOPMENT APPROVAL – INTENSITY ANIMAL HUSBANDRY		
The case of an application for an intensive animal industry is considered here. Other kinds of development may or may not require development approval, depending on IPA , the planning scheme, the EP Act and certain other legislation		

	Landholder applies for development approval	If applicant is not the landholder, they need resource entitlement for the *land* as per Sch.10 IPA Reg.Applicant needs WL or comparable evidence that the chief executive of NRW agrees – see s.967(3,4) WA and s.3.2.1(5) of IPA - but only if the application includes operational works that take or interfere with water regulated under the WA. If using associated water then only the overland flow aspect could trigger need for consent of chief executive as no Development Permit required for supply of associated water. Where consent required it needs to be written consent – a copy of an entitlement is not sufficient for s967(3)WL holder need not be the landholderIf a proposal is to capture overland flow under a WRP, a DA is required for the activity before DA for the works that capture the water

	Precise pathway depends upon whether the proposal is: ➢ material change of use or operational works or reconfiguration of a lot; ➢ an ERA ➢ code assessable or impact assessable ➢ and how it is treated in the planning scheme	For aquaculture, EPA is assessment manager For feedlots and piggeries, DPI&F is a concurrence agency or occasionally the assessment manager (in most cases the local authority will be the assessment manager) EPA has delegated to officers of DPI&F authority for all matters relating to cattle feedlots and piggeries DPI&F's main concern is that the applicants (potential water users) fulfil their obligations under the *Environmental Protection Act 1994* or *Fisheries Act 1994*. Where they source water for these activities is up to them. DPI&F informs them that they need legal access to water for the activity however the onus is on them to ensure that water is legally able to be used. It is also the potential user's responsibility to ensure the water is of adequate quality for the desired application. Apart from its legislative responsibilities DPI&F are also interested in providing advice to producers on crops/pastures that can utilise this water effectively, and appropriate application rates. But the persons using this water are responsible for testing quality prior to application.

s.966 WA sets out criteria where the chief executive is Assessment Manager or referral agencyA regulation may establish a code for assessing development for which the chief executive NRW is Assessment Manager or a referral agency (s.1014 WA)	Application is referredApplication is advertised	Referral agencies become involvedThird parties become involved
Legal access to water is not a condition of permits for intensive livestock projects (DPI&F policy)	Application is evaluated	
	Concurrently, DPI&F evaluates, as cattle feedlots and piggeries are ERAs	EPA nowadays issues a Registration Certificate, not an EA for animal husbandry ERAs and all require a DAThe RC accompanies the DA(EA is now the document only for petroleum and gas activities)
	Gas coy may need to apply for amendment to its PL EA. which may have required on-site treatment. This may require dialogue between the gas coy and the development project proponent.	

DEVELOPMENT APPROVAL – TOWN SUPPLY		
The special case of water supply for urban potable purposes to a local government is considered here.		
	Consider whether the proposal is best handled as a stand-alone development, or a group or networked system	SunWater may coordinate a number of potential sources of water or a number of potential users.A Water Authority may be created by regulation under s.548ff WA to coordinate a number of potential sources of water or a number of potential users.

	Buyer of the water applies for DA	The Council may be assessment manager even if it is the beneficiary. EPA will be concurrence agency as municipal water supply is an ERA and as regulated waste treatment is an ERA Water Industry Regulation has a strategic role.
	State Development may declare it a Significant State Project, then it will coordinate	
	Application is referredApplication is advertised	Referral agencies become involvedVegetation approval may be requiredThird parties become involved

	Holder of the EA associated with the PL applies for an amendment to that EA	
	Buyer of the water applies to DLGP for a government subsidy if required	Water Industry Regulation will approve engineering design if any government funds are required.
	A Registration Certificate under the EP Act is issued if proposal is acceptable	
	DA is issued	
	All normal statutory requirements on project managers such as LPro apply	
PIPELINE LICENCES **PETROLEUM FACILITY LICENCES**		

Chapter 4 PAG	The owner of land or rights over land may apply for a pipeline licence or a petroleum facility licence *Detailed steps are not explained here*	The Minister may grant a pipeline licence or a petroleum facility licence
	There are provisions for decommissioning prior to relinquishment (s.559ff PAG)	