

**NSW DEPARTMENT OF
PRIMARY INDUSTRIES**

DPI – Mineral Resources Assessment Report:

**Northern Geosciences (Draft) Report on Hydrogeological Investigations
Dooralong and Yarramalong Valleys (January 2005)**

**Submitted to the Minister for Mineral Resources by the Australian Gas
Alliance, 31 January 2005**

GS2005/065

28 March 2005

EXECUTIVE SUMMARY

The Northern Geosciences (Draft) Report on Hydrogeological Investigations Dooralong and Yarramalong Valleys was submitted to the Minister for Mineral Resources by the Australian Gas Alliance on 31 January 2005. The Minister had previously agreed to consider this document prior to making a determination on the Sydney Gas Operations Pty Ltd application for two coal seam methane (CSM) exploration wells (JB9 and JB13) in Petroleum Exploration License PEL5 near Wyong.

Two CSM exploration production test wells (JB1B and JB2A) have previously been approved by DPI-Mineral Resources and completed by Sydney Gas Operations Pty Ltd (Sydney Gas) in the Dooralong Valley.

A proposal by Sydney Gas to drill, fracture stimulate and test two more CSM exploration production test wells (JB9 and JB13) in PEL5 has been received by DPI-Mineral Resources and is currently being assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* prior to determination by the Minister.

No further proposals for CSM exploration beyond JB9 and JB13, or any proposals for production in the Yarramalong or Dooralong Valleys have been received by the government to date. Speculation about any such activities is therefore premature at the current time.

This Assessment Report has been compiled using the technical knowledge and expertise of DPI-Mineral Resources. The report assesses the potential for the currently proposed CSM wells (JB9 & JB13) to result in the environmental impacts presented by Northern Geosciences. The probability of these impacts occurring is summarised as follows:

1. The proposed CSM wells will result in a negligible risk of aquifer cross-contamination
2. The proposed CSM wells will result in a negligible risk of overhead groundwater leakage
3. The proposed CSM wells will result in a negligible risk of inducing changes to water table levels
4. The proposed CSM wells will result in a negligible risk of methane migration to the surface through overlying strata
5. The proposed CSM wells will result in a negligible risk of surface subsidence
6. The proposed CSM wells will result in a negligible risk of pollution of catchment waters
7. The proposed CSM wells will result in a negligible risk of impact to registered bores
8. The proposed CSM wells will result in a negligible risk of impacts to stream flows

9. The proposed CSM wells will result in a negligible risk to groundwater recharge of Tuggerah Lakes.

The Northern Geosciences report does not raise any issues which have not previously been considered by DPI-Mineral Resources. It does not demonstrate that any of these potential impacts are likely to be significant in the context of the current proposal by Sydney Gas for JB9 and JB13.

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BACKGROUND TO THIS ASSESSMENT

The Northern Geosciences (Draft) Report on Hydrogeological Investigations Dooralong and Yarramalong Valleys was submitted to the Minister for Mineral Resources by the Australian Gas Alliance on 31 January 2005. The Minister had previously agreed to consider this document prior to making a determination on the Sydney Gas Operations Pty Ltd application to drill, fracture stimulate and test two coal seam methane exploration wells (JB9 and JB13) in Petroleum Exploration License PEL5 near Wyong.

No information on either Northern Geoscience or the author (Tim Jones) was provided with the report.

CONTENT OF NORTHERN GEOSCIENCES REPORT

The report provides the author's assessment of the climate, geology, physiography, hydrogeology and hydrology of the Dooralong and Yarramalong Valleys, west of Wyong. This is largely a compilation of existing information supplemented with limited field investigations and is generally not disputed.

The report also identifies a number of potential risks and environmental impacts associated with coal seam methane (CSM) exploration and production and makes a number of recommendations. These submissions are the main subject of this DPI-Mineral Resources assessment report.

DPI-MINERAL RESOURCES RESPONSES TO NORTHERN GEOSCIENCES REPORT

NORTHERN GEOSCIENCES SUBMISSION (A):

*"Tim Jones was retained by the Australian Gas Alliance to undertake these hydrogeological investigations and provide an unbiased and independent study on the hydrogeology of the study area and relate the findings to the possible impacts caused through **commercial methane gas production** proposed by Sydney Gas Ltd (SGL)." (pg 5)*

DPI-MR RESPONSE (A):

The potential environmental impacts of an activity cannot be accurately assessed without first defining the nature of that activity.

Two CSM exploration production test wells (JB1B and JB2A) have previously been approved by DPI-Mineral Resources and completed by Sydney Gas Operations Pty Ltd (Sydney Gas) in the Dooralong Valley.

A proposal by Sydney Gas for two more CSM exploration production test wells (JB9 and JB13) has been received by DPI-Mineral Resources and is currently being assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*.

The government can only assess proposals (and any cumulative impacts) after they are submitted by the proponent. **No further proposals for CSM exploration beyond JB9 and JB13, or any proposals for production in the Yarralong or Dooralong Valleys have been received by the government to date. Speculation about any such activities is therefore premature at the current time.**

NORTHERN GEOSCIENCES SUBMISSION (B):

“Water residing in the coal seams typically has a different chemistry and is of a poor quality to the overlying high quality shallower aquifers. Drilling and dewatering can allow for cross contamination and overhead leakage”
(pg 5)

DPI-MR RESPONSE (B):

DPI-Mineral Resources requires all CSM wells to be lined (cased) top to bottom with an impermeable steel or fiberglass-reinforced plastic casing. The gap between these casings and the surrounding strata is required to be grouted with cement. This fixes the casing into place and provides a seal which isolates the coal seams from other strata, virtually eliminating any potential for leakage or aquifer mixing via the well column. When wells are rehabilitated or abandoned, the well column is required to be permanently sealed by cement grout. The existing and proposed Sydney Gas exploration wells comply with this specification.

No crossing contamination of aquifers or overhead leakage of groundwater from overlying strata has been reported as a result of CSM drilling in NSW.

Potential dewatering impacts are covered in DPI-MR response (C) (below).

NORTHERN GEOSCIENCES SUBMISSION (C):

“dewatering the coal seams will cause overhead leakage through faults or fracture zones and can lower water tables significantly during periods of low flow or drought” (pg 5)

DPI-MR RESPONSE (C):

Coal seams are typically overlain by very low permeability strata (aquifers or seals). These strata are mostly clay and mudstone as a result of the sedimentary environments in which coal precursors were deposited. After installation and grouting, CSM well casings are deliberately perforated only within the vertical interval of the target coal seams prior to fracture stimulation, dewatering and gas flow testing.

In the Yarramalong and Dooralong Valleys, the Narrabeen Group overlies the target Newcastle Coal Measures. The Narrabeen Group is interbedded with numerous claystone beds which act as aquifers (claystone is the major lithology type of the Patonga Claystone and Tuggerah Formation within the Narrabeen Group).

Groundwater data, including that presented by Northern Geosciences, indicates that there are distinct chemical differences between the Newcastle Coal Measures and overlying groundwater flow systems. This strongly implies that there is minimal hydrogeological connection between these systems.

No groundwater issues were encountered during any previous exploration in the Yarramalong and Dooralong Valleys, including numerous coal exploration drill holes and the existing Sydney Gas JB1B and JB2A production test wells. When dewatering, these wells produce less than 2,700L/day of formation water from each targeted coal seam interval. This is consistent with lateral recharge from within the fracture stimulated coal seam intervals. Groundwater leakage from overlying strata is clearly not an issue in these wells.

There is no evidence that dewatering of properly cased CSM wells has resulted in overhead leakage of groundwater or lowering of water tables around the well during CSM exploration or production in NSW. Dewatering is effectively contained within the target coal seam strata in the radius of influence of the well.

The proposed CSM exploration activities in the Dooralong Valley are highly unlikely to impact existing groundwater flow systems above the target Newcastle Coal Measures.

NORTHERN GEOSCIENCES SUBMISSION (D):

“percolation of methane into the overlying formations has the potential to impact on the aquatic ecosystem and riparian vegetation” (pg 5)

DPI-MR RESPONSE (D):

Coal seams are typically overlain by very low permeability strata (aquifers or seals). These strata are mostly clay and mudstone as a result of the sedimentary environments in which coal precursors were deposited. After installation and complete grouting, CSM well casings are deliberately perforated only within the vertical interval of the target coal seams prior to fracture stimulation, dewatering and gas flow testing.

In the Yarralong and Dooralong Valleys, the Narrabeen Group overlies the target Newcastle Coal Measures. The Narrabeen Group is interbedded with numerous claystone beds which act as aquifers (claystone is the major lithology type of the Patonga Claystone and Tuggerah Formation within the Narrabeen Group).

Although these aquifers (or gas seals) trap most of the gas, small amounts still leak through in a gradual and very slow natural process called micro-seepage. This happens anywhere there are source rocks producing hydrocarbons, i.e. coal seams and organic-rich strata.

No methane migration into overlying formations as a result of CSM exploration or production has been reported in NSW, including the existing Sydney Gas JB1B and JB2A production test wells. Note that gas liberated as a result of reduced confining pressure due to coal seam dewatering will migrate to the area of lowest pressure, i.e. through the perforation and into the CSM well. The CSM industry is predicated on the fact that this occurs. Overlying strata is not dewatered and any methane in these strata is undisturbed.

There is some potential for limited methane loss to the surface via old, improperly rehabilitated coal exploration drill holes during CSM exploration. Gas and water were reported to have been discharged from unrehabilitated drill holes adjacent to a well near Gloucester in NSW during the fracture stimulation process. Due to an inability to pressurise the seam, the fracture stimulation process was promptly discontinued, limiting any impacts. The drill holes were subsequently properly sealed before recommencement of CSM production testing. The potential for this type of event to occur is limited by the long standing DPI-Mineral Resources requirement for coal exploration drill holes to be rehabilitated to a standard which eliminates this risk.

The proposed CSM exploration activities are unlikely to increase the potential for methane migration from the target Newcastle Coal Measures to the surface via overlying strata.

NORTHERN GEOSCIENCES SUBMISSION (E):

“land slumping or subsidence following coal shrinkage through gas production” (pg 5)

DPI-MR RESPONSE (E):

Coal does not shrink as a result of current methods of commercial CSM extraction. Methane extracted by these methods is adsorbed on coal cleats and micro-surfaces or held within the coal crystal lattices by hydrostatic pressure. It does not provide structural support to the overlying strata.

Similarly, formation water extracted during dewatering of the target coal seams is predominantly removed from voids or fractures in the targeted intervals and does not provide structural support to the overlying strata.

Over-extraction of water from unconsolidated sediments often results in surface subsidence. This scenario is not applicable to extraction of CSM or formation water from solid rock strata. Similarly, underground extraction of coal or other minerals may result in subsidence, as these materials provide structural support to the overlying strata. Again, this cannot be extrapolated to extraction of CSM or formation water from solid rock strata.

No substantiated reports of land slumping or subsidence have been reported as a result of CSM exploration or production in NSW.

NORTHERN GEOSCIENCES SUBMISSION (F):

“disposal of waters pumped from the production wells, as it is of low quality cannot be allowed to mix with streams or rivers, which form the central coast drinking water catchment” (pg 6)

DPI-MR RESPONSE (F):

The Department of Environment and Conservation (DEC) is responsible for regulating the offsite disposal of formation water produced as a result of CSM

exploration and production activities. DPI-Mineral Resources requires that any formation waters produced as a result of CSM exploration activities are either disposed of on site (by either evaporation or reinjection into the source groundwater system), or transported off site for treatment and disposal at a licensed treatment facility.

Apart from one discharge of saline water by a CSM explorer in the Pilliga (First Source Energy - no longer active in NSW), no water releases have been reported as a result of CSM exploration or production in NSW.

NORTHERN GEOSCIENCES SUBMISSION (G):

"impacts to other registered bores by lowering of water tables within the zone of influence of any production wells, and impacts on stream flows"
(pg 6)

DPI-MR RESPONSE (G):

The target coal measures subject to dewatering as a result of CSM exploration in the Yarramalong and Dooralong Valleys are located at an average depth of more than 400m, well below the depth of any water bores in this area. DPI-Mineral Resources responses B & C detail why CSM wells are unlikely to impact overlying ground and surface water resources.

Groundwater quality within the Newcastle Coal Measures is not suitable for potable uses and is therefore unlikely to ever be targeted by a water bore.

No impacts on registered bores or stream flows have been reported as a result of CSM exploration or production in NSW.

NORTHERN GEOSCIENCES SUBMISSION (H):

"very little information on groundwater conditions in the Wyong catchment" (pg 6)

DPI-MR RESPONSE (H):

DPI-Mineral Resources has sufficient information to assess the likely impacts of the two CSM exploration wells currently proposed by Sydney Gas in the

Dooralong Valley. Additional information is likely to be required in support of future proposals.

NORTHERN GEOSCIENCES SUBMISSION (I):

“At the time of this investigation the Jilliby 2A well was operating and dewatering the underlying coal seam at an approximate rate of 100,000 litres per week” (pg 8)

DPI-MR RESPONSE (I):

During the period of the Northern Geosciences investigations, Jilliby 2A was dewatering at a rate of approximately 56,000 litres per week.

NORTHERN GEOSCIENCES SUBMISSION (J):

“The basic findings were that the dewatering of the coal seam at the scale proposed by Sydney Gas Ltd in the study area will adversely impact on the local and regional groundwater regime.” (pg 13)

DPI-MR RESPONSE (J):

The current proposal is for two CSM exploration wells only. These findings are of limited relevance given the scale of the proposal and are at odds with CSM industry and regulator experience in NSW as detailed in DPI-Mineral Resources responses (A), (B), (C), (F) and (G).

NORTHERN GEOSCIENCES SUBMISSION (K):

“The deeper aquifer system is interpreted to provide important base-flow to the shallower overlying aquifer, a significant environmental flow to deep rooted vegetation and recharge mechanism for the downstream lakes district, the most important being Tuggerah Lakes.” (pg 14)

DPI-MR RESPONSE (K):

There is unlikely to be any real potential for mixing of near-surface aquifers with the deeper coal seam aquifers of the Dooralong and Yarramalong Valleys. The Northern Geosciences report acknowledges that the targeted coal seam aquifers contain poor quality water. Recharge to surface aquifers is therefore undesirable and contradicts the intent of this statement.

See Northern Geosciences submission (B) and (F) and DPI-MR responses (C), (F) and (G).

NORTHERN GEOSCIENCES SUBMISSION (L):

“There is a significant case to be made for the occurrence and connection between shallow zones and deeper aquifers.” (pg 15)

DPI-MR RESPONSE (L):

There is unlikely to be any real potential for connection between near-surface aquifers and the deeper coal seam aquifers of the Dooralong and Yarramalong Valleys. See DPI-MR responses (C), (F), (G) and (K).

NORTHERN GEOSCIENCES SUBMISSION (M):

“SGL remove off-site approximately 100,000 litres a week.....the volume extracted equates to approximately 5.2 ML/y....” (pg 25). [refers to JB2A].

DPI-MR RESPONSE (M):

During the period of the Northern Geosciences investigations, JB2A was dewatering at a rate of approximately 56,000L/wk or 2.9 ML/yr. JB1B produces approximately 17,000L/wk. Neither of these wells have been subjected to constant dewatering.

Note that JB2A is perforated within three coal seam intervals. JB1B and the proposed JB9 and JB13 wells target only one coal seam each. Therefore, the stabilised water production rate for each of the proposed wells can reasonably be expected to be in the region of 18,000L/wk or less than 1ML/yr of formation water per well.

Note that water extraction rates are substantially higher in the initial stages of dewatering due to recovery of water injected during the fracture stimulation process.

NORTHERN GEOSCIENCES SUBMISSION (N):

“SGL has announced at their 2004 AGM it proposes 200 wells for the area, which calculates to an equivalent volume dewatered from the proposed operation at 1040 ML/y.” (pg 25)

DPI-MR RESPONSE (N):

The current proposal is for two CSM exploration wells only. See DPI-MR response (A).

NORTHERN GEOSCIENCES SUBMISSION (O):

“A simple calculation is to multiply the tanker movements of water per well a week, (approximately 3 x 30,000 litre tankers) by the number of proposed wells (200) = 600. Multiply that by 52 weeks a year = 4,200 tanker movements.” (pg 25)

DPI-MR RESPONSE (O):

Using the author’s assumptions:

100,000L water per well per week = 3 tankers (at 30,000L each)

Multiply by number of wells = 3 x 200 = 600

Multiply by number of weeks = 600 x 52 = 31,200 tanker movements per year

This is clearly a considerable impact and would be considered as part of the EIS which would be required by any such production proposal. However, given the scale of the current proposal, such a calculation is clearly pure conjecture (see DPI-MR response (A)).

The current (and only) proposal is for two CSM exploration (production test) wells (JB9 & JB13) with the cumulative impact of two existing wells (JB1B and JB2A) to be considered:

JB1B = 17,000L/wk

JB2A = 56,000L/wk

JB9 (predicted) = 18,000L/wk

JB13 (predicted) = 18,000L/wk

Total predicted formation water = 109,000L/wk

Number of tankers (at 30,000L each) = $109,000L/30,000 = 3.6/wk$

Multiply by number of weeks = $4 \times 52 = 187$ tankers per year

Four tanker movements a week is not a major impact and will cause minimal additional risks to public safety.

NORTHERN GEOSCIENCES SUBMISSION (P):

"The final recommendations to be drawn from this report is that strong scientific fact exists that coal seam methane production in the Yarramalong and Dooralong Valleys, at the scale being proposed by Sydney Gas Ltd, will result in an unacceptable level of social, economic and environmental impact" (pg 27)

DPI-MR RESPONSE (P):

CSM production in the Dooralong and Yarramalong Valleys is not being proposed by Sydney Gas at this time. This recommendation is therefore premature and unsubstantiated (see DPI-Mineral Resources response (A)).

A full and comprehensive environmental impact statement will be required as part of any future proposal for CSM production.

NORTHERN GEOSCIENCES SUBMISSION (Q):

“A halt to all exploration and/or mining is recommended and no further licences issued in the valleys to allow for a full and comprehensive environmental impact study that incorporates a geological, hydrogeological and geophysical investigation to expand on this study” (pg 27)

DPI-MR RESPONSE (Q):

This report presents no justifiable grounds on which a cessation of CSM exploration is warranted. Existing assessments and approval processes are adequate for the nature and scale of the current and proposed (2 exploration wells) activities. A full and comprehensive environmental impact statement will be required as part of any future proposal for CSM production. See also DPI-Mineral Resources response (A).

NORTHERN GEOSCIENCES SUBMISSION (R):

“A key requirement of such a study would be long-term water monitoring of between four to ten years to collect an appropriate level of time series groundwater data prior to any further mining license assessment by government.” (pg 27)

DPI-MR RESPONSE (R):

The relevant NSW Government approval authority will ensure that an appropriate level of assessment of any potential impacts is undertaken, commensurate to the scale of any proposed activities (see DPI-Mineral Resources response (A)).

NORTHERN GEOSCIENCES SUBMISSION (S):

“An assessment should be made into the ability of the existing road and bridge infrastructure to cope with the estimated tanker movements in the study area and the associated risk to public safety.” (pg 27)

DPI-MR RESPONSE (S):

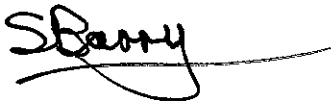
The relevant NSW Government approval authority will ensure that an appropriate level of monitoring is undertaken, commensurate to the scale of any proposed activities (see also DPI-Mineral Resources responses (A) and (O)).

CONCLUSION

The Northern Geosciences (Draft) Report on Hydrogeological Investigations Dooralong and Yarramalong Valleys relates to the potential impacts of coal seam methane (CSM) exploration currently proposed by Sydney Gas Operations Pty Ltd in PEL5 near Wyong.

The report also speculates on future CSM production activities in the Dooralong and Yarramalong Valleys. Sydney Gas has not yet submitted any formal proposals to the NSW government for CSM production in the area covered by PEL5. Consideration of aspects of the report which relate to production is therefore irrelevant at the current time.

The report identifies a number of risks and environmental impacts which may potentially result from CSM exploration activities. These risks have previously been considered by DPI-Mineral Resources and, in terms of the current Sydney Gas proposal, are not substantiated in view of current industry practices and regulatory experience.



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