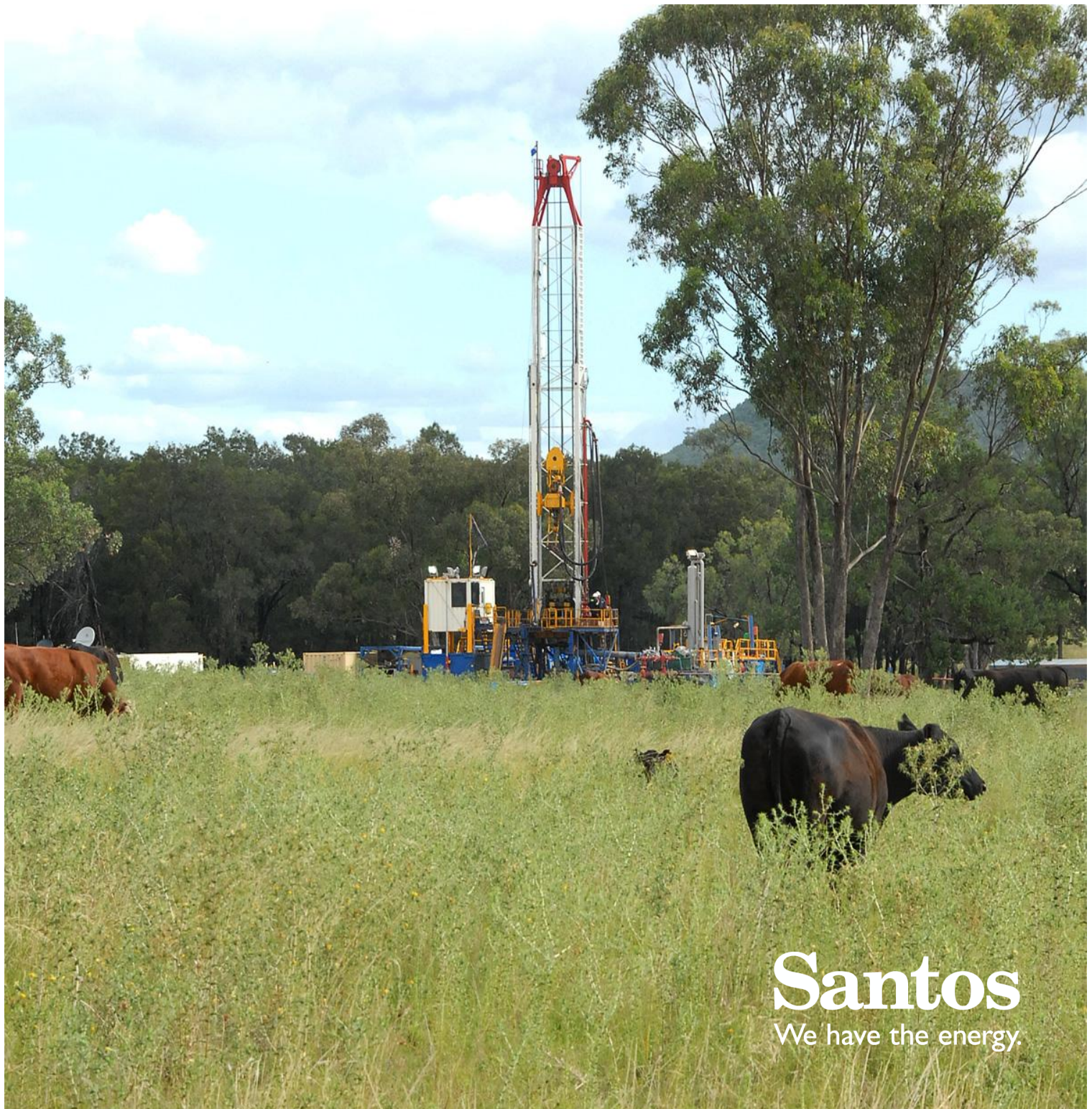


Senate Rural Affairs and Transport References Committee

Inquiry into management of the Murray Darling Basin

– impact of mining coal seam gas

Santos Submission | August 2011



Santos
We have the energy.

Contents

Executive Summary	2
Introduction	5
Who is Santos	5
About Santos	5
Coal Seam Gas	6
The Role of Gas	7
Lowering Greenhouse Gas Emissions in Australia and Asia	7
Gas as an Enabler of Renewable Energy Technologies	8
Santos CSG Operations	8
Queensland	8
New South Wales	10
Growing Local Economies and Delivering Local Benefits	11
Queensland	11
New South Wales	12
CSG and Water	13
Consultation	13
CSG Water	14
Monitoring	15
CSG Water in NSW	17
Case Studies	17
Santos GLNG Project: Water Beneficial Re-Use	17
Roma Managed Aquifer Recharge	18
Fairview Irrigation Pilot	19
Mount Hope Station pilot project	19
Support for Namoi Catchment Water Study	21
Property Rights	22
Co-existing Land Uses	23
Model Drilling Process and Protections	26
Well Safety	26
Drilling	27
Typical Gunnedah Basin CSG Well	28
Hydraulic fracturing	29
Regulation	32
Regulation in Queensland	32
Regulation in NSW	32

Executive Summary

A proudly Australian company, Santos is a leader of the Australian natural gas industry, with more than 50 years of responsible gas exploration and production across the nation, including more than fifteen years of coal seam gas (CSG) operations in Queensland.

Santos' industry leadership stems from decades of respectful relationships with landholders, responsible stewardship of the environment and water resources and enduring, mutually-beneficial partnerships with communities in South Australia, Queensland, Victoria and New South Wales. Constructive relationships are the foundation of our business and contribute to our social licence to operate.

Santos' existing operations show that agriculture and natural gas extraction can coexist successfully. As the global population increases, sustainable and multiple uses of land is the best response to increased domestic and regional demand for food and energy. This is particularly true when both can be provided safely and sustainably from the same land. In fact, Santos' approach to CSG water management results in an increase of the regional food growing productivity, not only during water production, but after the water is no longer available.

Santos' natural gas operations in the Cooper Basin have been safely fuelling industry and homes since 'first gas' was supplied to Adelaide from Moomba in 1969, followed by supply to Sydney in 1976. Santos is confident its record in natural gas exploration and production illustrates the many economic, social and environmental benefits that can be delivered for local communities, and state and national economies.

Coal seam gas is natural gas (predominantly methane) extracted from coal seams. Methane is odourless and colourless. CSG is produced by drilling a well into a coal seam and releasing the gas by pumping out water which, in turn, reduces the pressure in the coal seam (i.e. the pressure down the well) allowing the gas to flow to the surface. As an end-use commodity, it is identical to natural gas and is used for exactly the same purposes.

Coal seam gas extraction represents significant new jobs and investment in regional and rural areas of Queensland and NSW. The Queensland Government has estimated over 4,300 direct and indirect jobs in the Surat Basin region¹. Employment by Santos has grown six-fold in Queensland over the last six years, and today there are over 700 direct, new jobs as a result of Santos' investment. In total, the Santos GLNG project will create 5,000 construction jobs and 1,000 jobs in production. Initial economic impact assessments show that Santos' projects in NSW will create at least 1,000 new, direct jobs there.

Santos invested \$1 billion in Queensland prior to January 2011 (when final investment decision was made) and has since awarded a further \$1 billion worth of contracts to Australian companies. In 2010, Santos invested \$504 million with 1,044 Queensland suppliers. Around half of this investment was spent with suppliers in regional Queensland, including \$22 million in Roma. Similar growth and investment patterns can be expected in NSW as the industry develops there.

FAST FACTS

- ✓ Coal seam gas is natural gas extracted from coal seams.
- ✓ Gas extraction has a proven ability to co-exist with other land uses.
- ✓ Santos uses water from coal seams not suitable for drinking or agriculture then treats it for beneficial re-use in the community.
- ✓ Australia's coal seam gas industry is already delivering billions of dollars of investment and thousands of new jobs.

¹ Department of Employment, Economic Development and Innovation: [Blueprint for Queensland's LNG Industry](#), pg 3

Energy security has long been a major competitive advantage for Australia, and a key to our ongoing economic development and prosperity. Using natural gas to generate electricity can deliver significant reductions in Australia's CO₂ emissions from power generation, whilst ensuring energy security for Australia's economic well being. Natural gas can fuel baseload, shoulder and peak capacity. A proven and established technology, combined cycle gas turbine (CCGT) plants emit less than half the CO₂ emissions of black coal and less than a third the CO₂ emissions of brown coal. Furthermore, CCGT plants use less than one third of the water needed by coal fired baseload generators while generating competitively priced energy.

Exporting gas as LNG also assists to reduce CO₂ emissions in Asia by displacing more polluting fuels, whilst also contributing to the economic development of Australia and the economic growth of Australia's regional and rural communities. A recent Worley Parson's study found that for every tonne of CO₂ emissions associated with the CSG/LNG production and use, up to 4.3 tonnes of emissions are avoided in China when used instead of coal by power generators.²

Importantly, CSG projects represent an opportunity to expand a new, domestic gas supply for Queensland and NSW to fuel industry and homes, and to further develop an export industry for Australia. As production increases, the industry will pay significant royalties, providing strong benefits to the people of Queensland and NSW for the use of this valuable resource. Estimates of royalties to the Queensland Government alone exceed \$6 billion over the 25 year life of the Santos GLNG project. However, the royalty return is far exceeded by the returns to the Australian Government through income tax, which will total \$40 billion over the life of the project.

In addition, gas is a vital enabler of intermittent, renewable energy technologies such as wind and solar. As the energy mix between renewable and fossil fuels changes, natural gas can quickly and reliably maintain energy supply. For example, South Australia has been able to bring on significant wind generation capacity because of the gas fired, peaking generating capacity in that state. Together, gas and wind provide over 70 per cent of South Australia's electricity capacity, giving the state the cleanest power generation mix on mainland Australia.

Water is arguably the key input into food production in Australia and is an essential consideration when investigating issues relating to environmental values in the Murray Darling Basin, the location of some of Australia's best farming land. To that end, gas extraction has a proven ability to coexist with other land uses, and Santos is committed to work with, and around, other land uses in a collegiate and constructive manner.

Santos is already successfully implementing programs in Queensland to manage the water it extracts and to protect water aquifers including the Great Artesian Basin. Santos does not draw water from aquifers used by farmers and local towns. Conversely, treated CSG water represents an opportunity for irrigation, stock watering and boosting local groundwater supplies by recharging aquifers.

Santos is proud of its close ties with the communities across Australia in which it has operated for many decades. As a leading oil and gas producer in Australia and Asia, Santos is committed to implementing applicable world's best practices

FAST FACTS

- ✓ Gas can fuel baseload, shoulder and peak generation.
- ✓ Using gas to generate electricity can reduce CO₂ emissions from power generation.
- ✓ Exporting gas as LNG will reduce CO₂ emissions in Asia by displacing more polluting fuels.
- ✓ Gas is an enabler of renewable energy technologies.

FAST FACTS

- ✓ Santos supports clear guidelines on land access.

² Worley Parson, Greenhouse Gas Emissions, Study of Australian CSG to LNG, April 2011, pg 4

The Rural Affairs and Transport References Committee

across our projects, with specific regard to land access, water management, drilling and mutually beneficial engagement with local communities.

In Queensland, Santos has negotiated more than 60 landholder agreements every year for the past five years and the Company remains committed to working cooperatively with landholders in Queensland and NSW. Santos supports the recent *Land Access Code* announced by the Queensland Government which has strengthened the position of landowners. In NSW, Santos has already signed 30 access agreements with landowners.

Detailed regulations and conditions govern all aspects of the industry in Queensland and NSW and Santos agrees the gas sector must operate within well thought through and administered regulations to ensure all participants operate by the same standards, and that these standards are acceptable to all stakeholders. This ensures consistency of approach and accurate measurement of compliance.

Santos looks forward to the opportunity to appear at a hearing of the Rural Affairs and Transport References Committee.

Introduction

Santos is pleased to assist the Senate Rural Affairs and Transport References Committee to examine the economic, social and environmental impacts of mining coal seam gas (CSG) on:

- the sustainability of water aquifers and future water licensing arrangements;
- the property rights and values of landholders;
- the sustainability of prime agricultural land and Australia's food task;
- the social and economic benefits or otherwise for regional towns and the effective management of relationships between mining and other interests; and
- other related matters including health impacts.

This submission is structured to address the terms of reference.

Santos has made similar submissions in the recent past to the Senate Environment, Communications and the Arts Reference Committee inquiry into the impact of mining on the Murray Darling Basin and the Senate Select Committee into Agriculture and Related Industries inquiry into food production.

Who is Santos

About Santos

Santos is an Australian oil and gas exploration and production company with operations in every major Australian petroleum province, as well as interests in Indonesia, Papua New Guinea, Vietnam, India and Tajikistan. Santos is Australia's largest onshore domestic gas producer, supplying sales gas to all mainland Australian states and territories, ethane to Sydney, and oil and other liquids to domestic and international customers. Santos has CSG interests in both Queensland and NSW.

The Cooper Basin oil and gas field in south-west Queensland and north-eastern South Australia, which Santos and its joint venture partners discovered and developed, is one of Australia's largest onshore resources projects. More than \$8 billion has been invested to date in this Basin.

In Australia, Santos has one of the largest exploration portfolios by area of any company and it also has assembled a large, well-situated acreage position in Asia. The Company is also pursuing new joint venture opportunities in Central and South East Asia.

FAST FACTS

- ✓ Australian owned.
- ✓ More than 50 years gas exploration experience.
- ✓ Operations in every major Australian hydrocarbon province.
- ✓ More than 15 years of CSG operations in Queensland.

Santos' market capitalisation makes it one of Australia's top 25 listed companies.

A proudly Australian company, Santos is a leader of the Australian natural gas industry, with more than 50 years of responsible gas exploration and production across the nation, including more than 15 years of coal seam gas (CSG) operations in Queensland.

Santos is strongly committed to the highest standards of environmental performance through its sustainability framework, which guides all new development as well as day-to-day operations. Santos' sustainability plan is built on three key elements:

- understanding stakeholder expectations;
- driving sustainable performance in existing operations; and
- integration of sustainability into the Company's transformational growth strategy.

All of these elements guide Santos' business objectives, in conjunction with the Company's priority on safety.

Safety

A focus on safety is one of Santos' values, which is clearly defined by its vision that 'we all go home without injury or illness'. Santos has developed a culture of safety and believes there is no job so important that it cannot be done safely.

Santos has a company-wide *Environment, Health and Safety Management System* (EHSMS), under which employees and contractors have specific responsibilities for establishing and maintaining a safe working environment that benefits both them and the communities in which Santos operates.

The EHSMS provides a structured framework for effective environmental and safety practice across all of Santos' activities and operations. The system, based on the ISO 14001 and AS 4801 standards, has been designed to ensure consistent standards for all employees and contractors. It incorporates industry best practice and includes 18 management standards and more than 30 hazard standards.

Broader natural gas industry precautions are applied and include strict requirements around such things as clothing, materials and the types of equipment used.

The Company's safety systems, procedures and practices are continually improved through feedback, discussion, hazard analysis and risk management processes, incident/near miss reporting and investigation, auditing and drills.

Every Santos field employee and contractor undergoes comprehensive field inductions before commencing any work on site. Visitors must also undertake a general awareness safety induction before attending site, and the community is informed about how to manage potential hazards associated with Santos' operations.

Santos employs a strict pre-qualification process for contractors, which involves an assessment of their past incident and safety performance and auditing of their EHS management system. If their environmental and safety management systems and performance are not consistent with those of Santos, the Company does not engage them.

As part of Santos' third party verification process, the Company undertakes regular safety audits of well and operational sites. Santos personnel are contractually obligated to report any recordable safety incident or near miss. All incidents and near misses are investigated.

Over the past 5 years Santos has delivered a significant improvement in safety, in both what the Company calls personnel safety and process safety. The total injury rate, comprising injuries requiring medical treatment or resulting in lost, restricted time from work, has fallen by 60% inclusive of all employees and contractors and is approaching leading performance in the oil & gas industry.

FAST FACTS

- ✓ Priority on environmental performance and safety.
- ✓ We all go home without injury or illness.
- ✓ Every Santos field employee and contractor undergoes compulsory field inductions before commencing work onsite.
- ✓ Visitors must undertake a general awareness safety induction before attending a site.

Coal Seam Gas

Coal seam gas is natural gas extracted from coal seams. Typically, CSG consists of 98 per cent methane with less than 2 per cent inert gas and no petroleum liquids. Methane is odourless and colourless. CSG is produced by drilling a well into a coal seam and releasing the gas by pumping out the water which, in turn, reduces the water pressure. As an end-use

FAST FACTS

- ✓ CSG is natural gas.
- ✓ CSG is a low emission alternative to coal.

commodity, it is identical to natural gas and is used for exactly the same purposes, and is a low emission alternative to coal in electricity generation.

The Role of Gas

Lowering Greenhouse Gas Emissions in Australia and Asia

Natural gas is the fuel that will grow Australia's economy, contribute to Australia's energy security and meet the future energy demands of the energy-hungry Asian region.

Using gas to generate electricity can deliver significant reductions in Australia's CO₂ emissions from power generation, whilst ensuring energy security for Australia's economic well being. Gas can fuel baseload, shoulder and peak capacity. A proven and established technology, gas fuelled combined cycle gas turbine (CCGT) plants emit less than half the CO₂ emissions of black coal and less than a third the CO₂ emissions of brown coal, and use less than one third of the water needed by coal fired base load generators, while generating competitively priced energy.

Exporting gas as LNG also assists to reduce Asia/Pacific regional CO₂ emissions by displacing more polluting fuels, whilst also contributing to the economic development of Australia and the economic growth of Australia's regional and rural communities.

Asia Pacific LNG imports account for over 60% of global LNG demand, giving Australian LNG suppliers a natural advantage in terms of geography with considerably shorter shipping distance to these markets. Energy consultants Wood Mackenzie are predicting that demand from LNG-importing countries will continue to grow. Global demand is expected to be over 220 million tonnes this year, growing to around 340 million tonnes by 2020. Demand from Asia Pacific LNG importers is expected to grow from around 140 million tonnes this year to over 220 million tonnes in 2020³. There is a clear opportunity for CSG from Queensland and NSW to fulfil part of this demand.

Within Australia, increasing demand for natural gas is likely to change the market structure in coming years. At present, there are a small number of producers and a small number of large consumers, with relatively low household consumption. In 2007, there were approximately 3.75 million households in Australia using natural gas (ABARE, 2008)⁴.

Australia's gas consumption is projected to rise by 3.4 per cent a year, with total primary demand for natural gas projected to more than double to reach 2575 petajoules by 2029-30 (ABARE 2010)⁵.

Global primary energy demand continues to rise, with Asia a major driver. Between 2007 and 2030, global energy demand is expected to increase by 40 per cent, an annual average rate of increase of 1.5 per cent (International Energy Agency, WEO 2009)⁶. Simultaneously, there is increased pressure to find less carbon-intensive energy solutions in an increasingly carbon-constrained world.

FAST FACTS

- ✓ Gas can deliver energy security to Australia.
- ✓ Gas is the cleanest of the fossil fuel alternatives.
- ✓ The world's largest LNG-importing markets are in geographic proximity to Australia.
- ✓ Exporting LNG to nearby markets will lower greenhouse gas emissions in the Asia/Pacific region.

³ Wood Mackenzie, Global LNG Service 2011

⁴ ABARE 2008, Energy in Australia, 2008

⁵ ABARE 2010, Australia Energy Projections to 2029-30

⁶ ABARE 2010, Australia Energy Resource Assessment

A recent Worley Parsons report⁷ compared the greenhouse gas emissions performance of Chinese power generators using Australian LNG derived from CSG with those using imported black coal across the entire life cycle. It found that, for every tonne of CO₂ emitted during production and use of CSG/LNG, up to 4.3 tonnes of emissions would be avoided in China when used instead of coal by generators. It also found that a project exporting 10 million tonnes of LNG a year to China could avoid more than 32 million tonnes of global CO₂ emissions each year. As some 80 percent of Chinese electricity is generated using coal, the global impact of a switch to more CSG/LNG could be significant.

Gas as an Enabler of Renewable Energy Technologies

It is acknowledged that the use of renewable energy sources will produce even fewer carbon emissions however, as the energy mix between renewable and fossil fuels changes, gas becomes a vital enabler of intermittent, renewable energy technologies such as wind and solar. Natural gas can quickly and reliably maintain energy supply, as in South Australia which has been able to bring on significant wind generation capacity, as a result of its existing significant and complimentary gas fuelled generating capacity.

FAST FACTS

- ✓ Gas is a vital enabler of renewable energy technologies.
- ✓ Gas is increasingly competitive with electricity generation from coal.

In this way, gas is critical as a complementary energy source to support the expansion of the renewable energy sector. For example, the Australian Government has recently committed \$464 million towards the Solar Dawn project to be built near Chinchilla in Queensland. At 250MW, it will be the world's largest solar thermal power plant – but it will be gas hybrid. Without the gas boiler back-up system, the plant would not be able to provide reliable, baseload power.

This demonstrates that the expansion of gas supply in Australia is a key part of reducing domestic greenhouse gas emissions, as well as building a cleaner energy future for the Asia Pacific region. As a facilitator of the development of renewable technology, gas has a critical role to play. Gas is increasingly competitive with electricity generation from coal (especially following the introduction of carbon pricing) whereas renewable electricity generation remains three times more expensive. A full, immediate shift to renewable power generation would be impractical on technological grounds and an extremely high cost solution at this time to the challenge of reducing greenhouse gas emissions.

Santos CSG Operations

Queensland

Gas is not new to Queensland, having been discovered there by accident at Roma in 1899. In fact, Queensland lays claim to the first reticulation of natural gas, at Roma, (for street lighting) and Brisbane was Australia's first capital city to have a natural gas distribution network.

Mindful of Queensland's extensive coal reserves, it became apparent almost 40 years ago that these coal reserves had the potential to contain gas. Santos, which has been conducting

FAST FACTS

- ✓ Coal seam gas is not new to Queensland.
- ✓ More than 70% of gas produced in Queensland comes from CSG.

⁷ Worley Parsons, Greenhouse Gas Emissions: Study of Australian CSG to LNG 2011

conventional oil and gas activities in the Surat Basin since the 1960s, began CSG exploration in 1996.

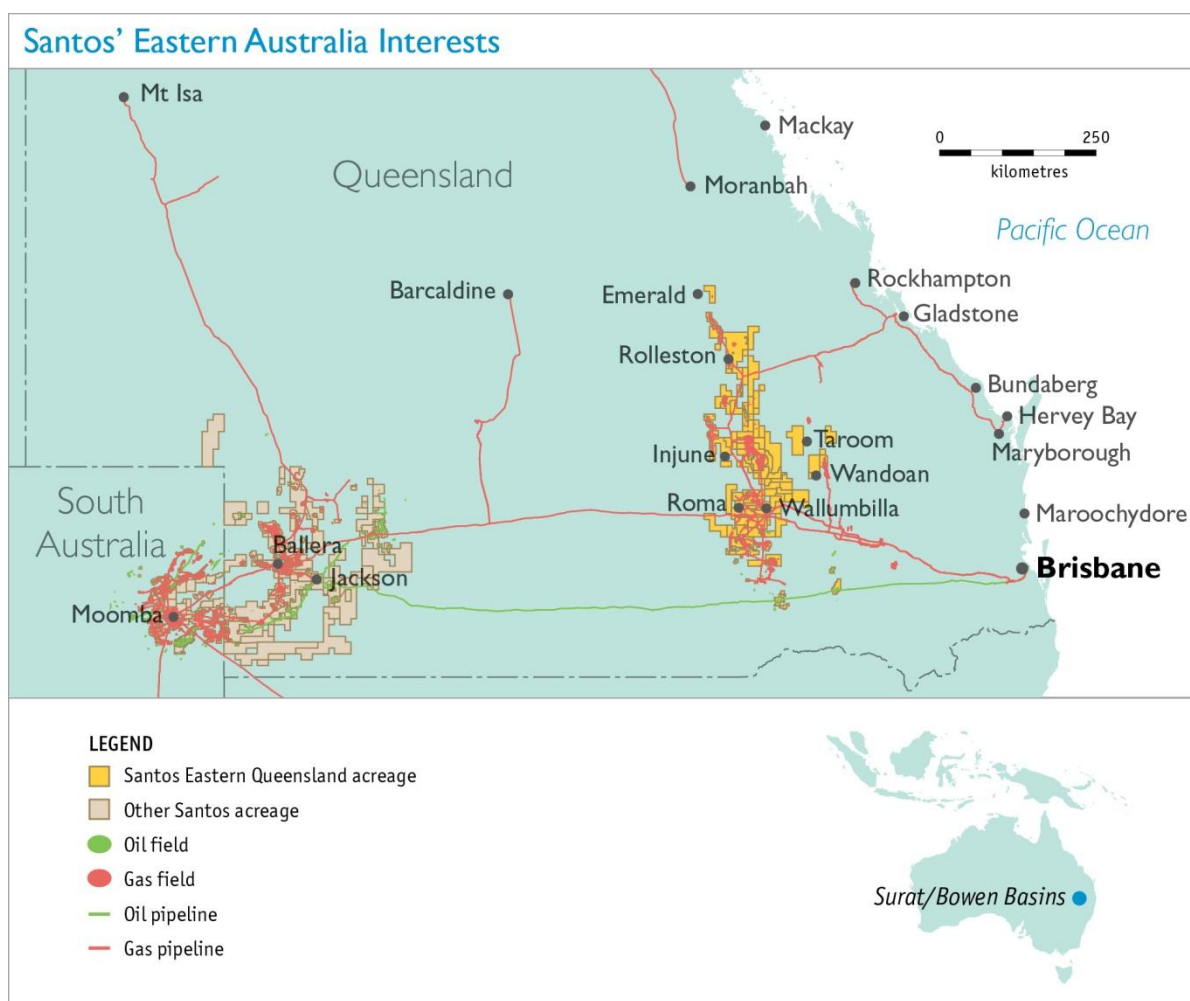
Exploration and gas production activities are currently being undertaken in the Scotia, Roma and Fairview fields. Exploration is also being undertaken in the Arcadia Valley field.

The Roma area was initially developed by Santos as a conventional gas field. However, the gas reserves from the coal seams in the area are now being developed for CSG production.

Santos purchased the Fairview and Arcadia Valley assets in 2005. Since then, Santos has progressed development of the Fairview field and has increased its reserves significantly.

Santos' extensive CSG resources in the Surat/Bowen Basins near Fairview and Injune in Queensland will, in part, supply the Santos GLNG project at Gladstone. The Santos GLNG project, a joint venture of Santos, PETRONAS, Total and KOGAS, will use world-first technology to process CSG into liquefied natural gas (LNG) for export - a cleaner energy source for energy-hungry Asia. It will deliver \$9 billion in average gross, contracted, export revenue per annum for the life of the project. This is a significant economic boost for the domestic economy.

More than 70% of gas production in Queensland comes from CSG.⁸ This production demonstrates that CSG extraction can coexist, and is coexisting, with other land uses and the industry can develop in a way that has a minimal and manageable impact on the environment.



⁸ Department of Employment, Economic Development and Innovation, [Queensland's petroleum - Exploration and development potential](#), February 2011

New South Wales

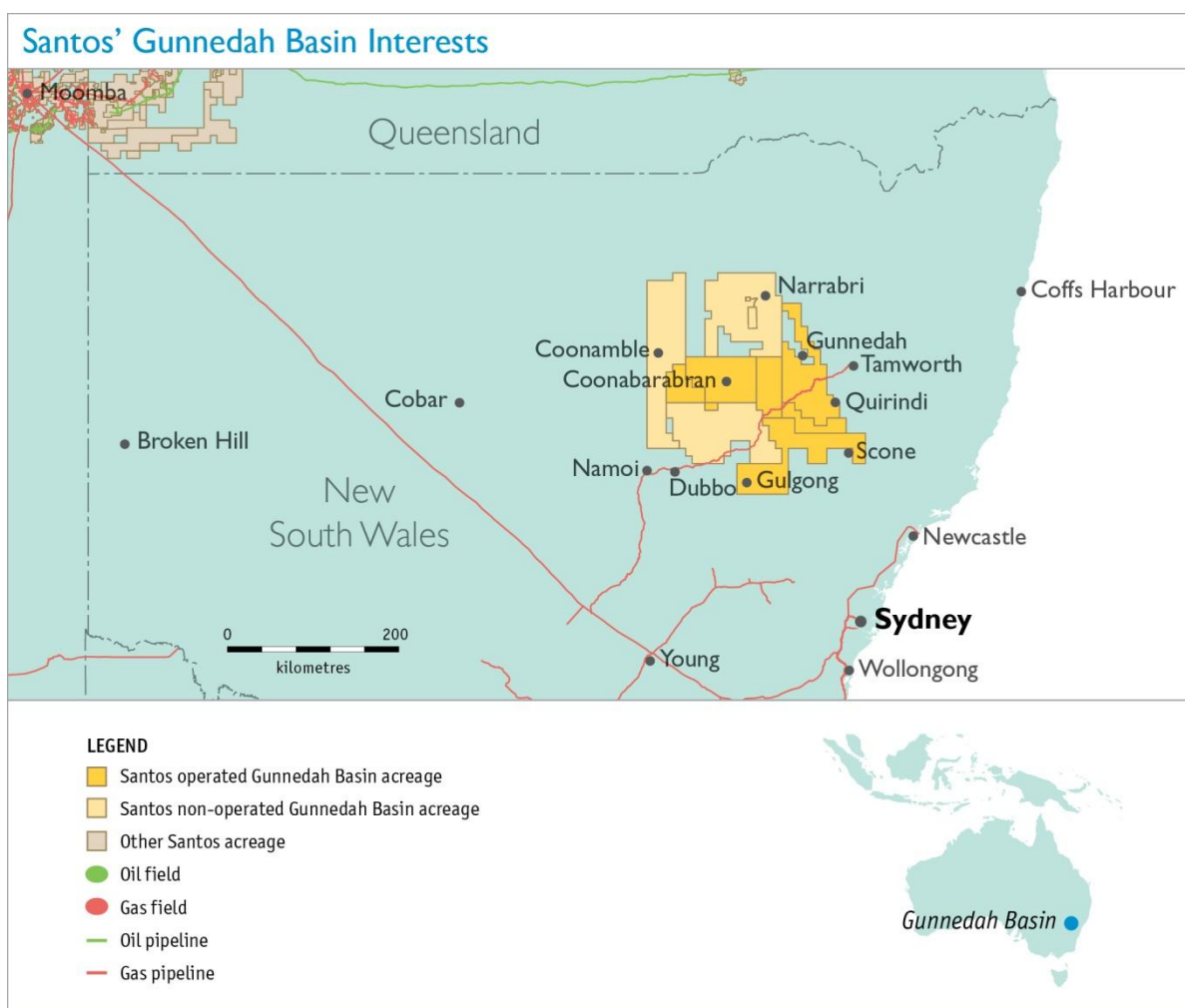
The Gunnedah Basin covers the districts of Gunnedah, Coonabarabran, Scone, Quirindi, Narrabri and Boggabri in north western New South Wales.

Exploration companies have been searching for CSG in the Gunnedah Basin since the 1990s.

Santos first acquired interests in the Gunnedah Basin in 2007 and in 2009 acquired a 20% holding in Eastern Star Gas (ESG) and a 35% equity interest in various exploration permits operated by ESG.

FAST FACTS

- ✓ Santos first acquired interests in the Gunnedah Basin in 2007.
- ✓ Santos has a fully operational office in Gunnedah.



Santos announced on 18 July, 2011, that it had reached binding agreements to give effect to:

- the acquisition of 100% of the outstanding ordinary shares in Eastern Star Gas Limited (ESG); and
- the subsequent sale of a 20% working level interest in ESG's permits in the Gunnedah Basin, northern New South Wales, to TRUenergy Holdings Pty Ltd (TRUenergy)

Pursuant to these transactions, Santos will assume operatorship and own 80% of ESG's coal seam gas (CSG) permits, with TRUenergy owning the remaining 20%.

In addition to the permits held by ESG, Santos' other Gunnedah Basin assets (for which it is already operator) include:

- 25% of PELs 1 and 12 (Santos can increase its interest to 65% via farm-in);
- 15% of PEL 456 (Santos can increase its interest to 50% via farm-in); and
- 100% of PELs 450, 452 and 462.

Assumption of operatorship, and majority interest in the various CSG permits, will allow Santos to undertake co-ordinated development of its Gunnedah Basin acreage.

Santos has a commitment to open and transparent consultation with the communities that the Company works in. Since beginning exploration in the Gunnedah Basin in 2008, Santos has held more than 30 community information sessions and has met with a large number of community groups. Santos distributes a quarterly newsletter to over 4,000 landowners in its exploration area. Santos regularly conducts site visits to its operations and takes a prominent attendance at the Aguiup Field Days each year. Santos has established a fully-operating office in Gunnedah.

Growing Local Economies and Delivering Local Benefits

The development of the CSG/LNG industry represents an enormous economic opportunity for Australia, in terms of economic benefits for rural and regional communities, lowering greenhouse gas emissions in Australia and Asia and export revenue.

Queensland

The Queensland Government has described the development of the CSG industry as a once in a generation opportunity for a generation of employment. The Government's modelling indicates that a medium size industry of 28mtpa would generate over 18,000 jobs in Queensland⁹. It would also increase gross state product by over \$3.2 billion (one per cent), generate private sector investment of over \$40 billion and provide royalty returns of over \$850 million per annum¹⁰.

The recent Queensland State Budget explicitly nominated the development of the CSG/LNG industry as underpinning a predicted 27 per cent increase in business investment in 2011-12. This increase will boost state economic growth from zero in 2010-11 (due mainly to natural disasters) to over five per cent next financial year, driving unemployment below five per cent and helping to create 140,000 new jobs.

These jobs are already being delivered. There has been a six-fold increase in direct, Santos employment in Queensland in the last six years, driven by the development of the Company's CSG reserves and the Santos GLNG project. In 2009-10, Santos delivered the equivalent of one new job each and every day. This six-fold increase does not include the hundreds of jobs created by the Company's contractors and sub-contractors. In total, the Santos GLNG project will create 5,000 jobs in construction, in addition to 1,000 permanent jobs in production.

FAST FACTS

- ✓ Santos GLNG project will create 5,000 jobs in construction, in addition to 1,000 permanent jobs in production.
- ✓ Santos GLNG project will generate \$40 billion in federal income tax over the life of the project.
- ✓ Santos spent \$22 million in the Roma region in 2010.

⁹ Queensland Government, Blueprint for Queensland's LNG Industry p.3

¹⁰ Queensland Government, Blueprint for Queensland's LNG Industry p.3

The Rural Affairs and Transport References Committee

The project will also create direct economic benefits for Queenslanders. The most direct contribution will be through royalties. Queensland royalties will be approximately \$180 million per annum, meaning the Santos GLNG project will pay some \$6 billion in royalties over the life of the project.

This is the equivalent of \$500,000 per day – enough to build a primary school every 50 days, or a high school every 100 days. But, by far the largest gain will be for the citizens of Australia, through income taxation. It is estimated that \$40 billion will be collected in income taxation over the life of the Santos GLNG project, an enormous boost to Commonwealth revenues.

These financial returns to government and the community are in addition to the direct, local, economic stimulus provided by CSG/LNG projects. Already, Santos has invested \$1 billion with Australian suppliers, and signed future contracts worth another \$1 billion. In 2010, this included \$504 million with 1,044 Queensland suppliers. Around half of this investment was spent with suppliers in regional Queensland, including \$22 million in the Roma region where the fields are located.

At the local level in Queensland, Santos is active in contributing to the new infrastructure needed in the communities in which the Company operates. For example, Santos has already committed:

- \$1 million for the Gladstone Hospital, including \$700,000 to upgrade the high dependency unit and \$300,000 for medical education;
- \$2.65 million for the Gladstone Airport instrument landing system (ILS);
- \$800,000 for community housing support through Gladstone Council;
- \$250,000 for the Gladstone Rotary Club bus service for patients needing treatment in Rockhampton; and
- \$4 million investment into the Roma community to upgrade the airport terminal, improve health services and increase housing support.

Santos is committed to delivering direct, economic benefits for the communities in which it operates, as well as growing the Australian economy overall.

New South Wales

The CSG industry also has the potential to bring significant economic benefits to the NSW economy, particularly in rural and regional areas. Santos will work cooperatively and constructively with individual landholders, local communities, local government/s and the State Government to ensure the economic and environmental benefits of gas are realised in a timely and efficient manner as NSW moves to a low carbon economy. The Gunnedah Basin gives NSW the opportunity to go from being a net importer of gas to becoming self-sufficient and then, potentially, an exporter of gas.

First, there is the potential to develop an indigenous, domestic gas source for the state to fuel households, industry and electricity generation. Presently, nearly all of NSW's gas is supplied from the Cooper Basin and the Bass Strait.

Secondly, natural gas can help New South Wales in the move to a low carbon economy. Using natural gas to generate electricity is a key strategy that can deliver significant reductions in CO₂ emissions from power generation.

Thirdly, as Santos' record in Queensland demonstrates, a NSW CSG industry will undoubtedly create local employment opportunities as well as significant opportunities for local suppliers.

FAST FACTS

- ✓ The CSG industry has the potential to create an indigenous gas source for NSW
- ✓ As Santos' record in Queensland demonstrates, a NSW CSG industry will create local employment opportunities.
- ✓ Santos will work with the local community to manage the demand on infrastructure such as schools, roads, hospitals, recreation facilities and accommodation.

Fourthly, Santos will continue to work with communities to manage the demand large resources projects like CSG place on local infrastructure such as:

- Schools;
- Accommodation;
- Roads;
- Hospitals;
- Community recreation facilities such as sporting facilities and libraries; &
- Airports.

In NSW, mindful that Santos is in the exploration phase of its work, the Company is progressing its commitments. However, Santos has already committed \$100,000 towards video conferencing equipment for the new Gunnedah Rural Health Centre that is under construction and due for completion by mid-2012.

Santos understands that a social licence to operate, characterised by mutually-beneficial outcomes, is based on open and honest communications and ongoing consultations with landowners, community groups and community leaders. Santos is committed to delivering direct, economic benefits for the communities in which it operates.

Since arriving in the Gunnedah Basin, Santos has committed to being available to farmers and communities to answer questions and address concerns raised. There has been active engagement through information sessions, briefings and updates including, but not limited to:

- Agquip annually (1,500+ inquiries per annum);
- 30 community briefings;
- Presentations to a range of community groups;
- Participating in Namoi Water Study; and
- Conducting regular engagement with landholders, local government, state MPs, federal MPs and other stakeholders.

During 2010, Santos exchanged over 600 phone calls, emails and letters with stakeholders and distributed over 20,000 newsletters. Santos ran eight community information sessions in five towns. The team conducted over 50 property visits for groundwater monitoring and visited 75 water bores. Santos also held numerous briefings with local representatives and presented to Gunnedah, Gilgandra, Liverpool Plains, Narrabri and Warrumbungles Shire Councils.

CSG and Water

Consultation

Santos recognises that water is one of the most important issues associated with the development of the CSG industry, both in terms of the perceived impact of CSG production on the quantity and quality of water available for other uses. Santos is implementing a comprehensive water management strategy in Queensland and is well progressed in developing its water strategy for NSW. These strategies will address both CSG water management as well as potential impacts on soil and regional water resources. The strategies focus on developing long-term solutions that, as a priority, benefit local communities and the environment.

FAST FACTS

- ✓ Santos modelling and independent reviews by state and federal regulators confirms that the impact on groundwater will be minimal and manageable.

In Queensland, all of Santos’ modelling, as well independent reviews by experts and state and federal regulators, confirms that the impact will be minimal and manageable. Moreover, Santos believes through the beneficial reuse of CSG water, it can actually provide a new water resource for rural communities and agricultural industries and be used to provide a permanent improvement in the farm productivity of the land on which it operates.

CSG Water

CSG water is contained within underground coal seams. This water is pumped from the coal seams as part of the gas extraction process. The quality of CSG water is brackish, with its salinity limiting its use. Water from Santos-operated gas fields typically contains between 1,500 and 3,000 parts per million (ppm) of total dissolved solids (TDS). In comparison, Roma tap water contains on average 800 ppm and seawater 35,000 ppm of total dissolved solids (as the table below shows).

It is only after treatment, which costs up to \$2,500/ML, that it can be beneficially reused. In this way, the industry is turning a waste product into a water resource for the community. Treated CSG water represents an opportunity for irrigation, stock watering, boosting local supplies and recharging aquifers (see case studies below).

Santos recognises that its extraction will have a minimal and manageable impact on groundwater reserves. The Company currently estimates that it will produce 6.7 GL per annum on an average basis across the GLNG development area. Of this, about 2.5 GL per annum will be produced in the Surat Basin.

Water Source	TDS (parts per million)	
Rainwater	15 – 22 ppm	RAINWATER
Desalinated water	180 ppm	
Brisbane tap water	240 ppm	
Average groundwater bore in Fairview Qld	300 ppm (average)	
Roma tap water	800 ppm (average)	
Amended CSG water	1,800 ppm	
Average CSG water	1,500 – 3,000 ppm	
Livestock and watering	5,000 ppm	SEAWATER
Saltwater swimming pool	6,000 ppm	
Seawater	35,000 ppm	

Monitoring

Santos' modelling has been undertaken on a conservative basis, but the Company recognises that modelling needs to be confirmed by comprehensive monitoring to provide assurance and an early warning if unexpected impacts occur. Santos is investing in one of the most significant groundwater monitoring programs in Australia. This includes installation of more than 40 new groundwater bores, installation of automated monitoring facilities on more than 40 existing farm bores, installation of several deep multi-level pressure sensors, and conversion of conventional oil and gas wells to deep basement groundwater monitoring locations. A baseline inventory of more than 350 bores in the Roma, Fairview and Arcadia Valley regions, has been completed already, accompanied by an extensive sampling program. This information is openly available via a public web-based portal to landholders and any other interested community stakeholders.

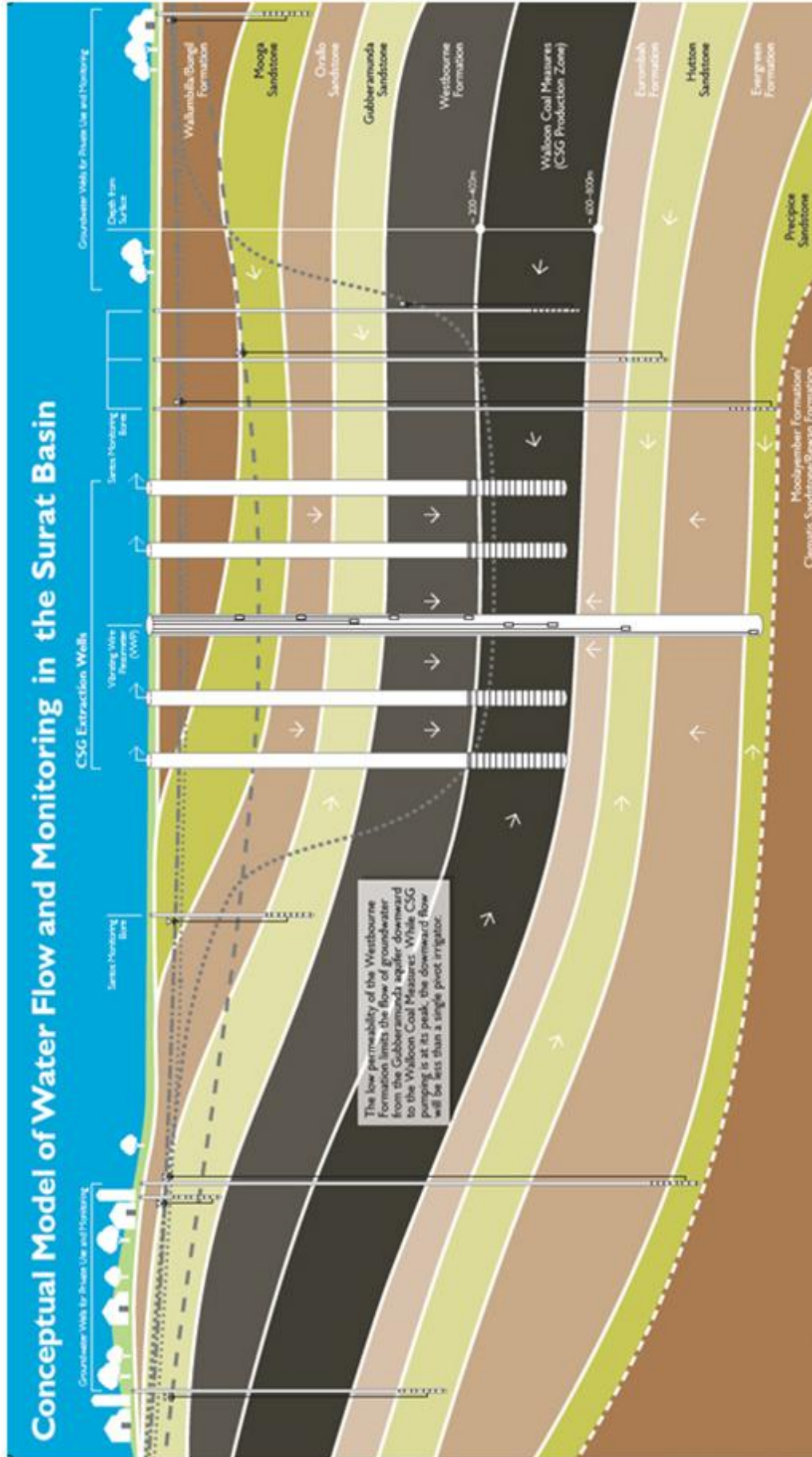
Through this extensive monitoring program, Santos will be aware of groundwater changes several years in advance of their first appearance in local aquifers, and will therefore take appropriate groundwater management action to 'make good' on potential future adverse impacts. In the event that any activity undertaken by Santos does result in an adverse impact on local aquifers, Santos would immediately review and implement appropriate 'make good' actions, including modifying or ceasing CSG water production in the associated local area.

FAST FACTS

- ✓ Santos is implementing one of the most significant groundwater monitoring programs in Australia.
- ✓ Through this program, Santos will be aware of groundwater changes and take appropriate action accordingly.

'Make good' arrangements are negotiated with individual landholders to meet their particular needs. Santos is drafting a 'make good' agreement document for discussion with local landholders.

The below illustration demonstrates the state-of-the-art monitoring system being installed by Santos in our fields.



CSG Water in NSW

In NSW, the Gunnedah project is only at a very early exploration phase and reuse options have not yet been finalised. However, early studies show the potential for reuse of treated water via re-pressurising currently depleted areas of the shallow aquifer system is a real possibility, and something Santos would like to pursue. In effect, this puts currently unusable and inaccessible water into the currently used, and somewhat depleted, groundwater system.

In NSW, initial hydrological investigations indicate the Santos Gunnedah project is currently likely to extract CSG water at an average extraction rate of approximately 3.5 GL per annum, and a maximum rate of 5GL per annum. The Murray Darling Basin Commission (MDBC) has estimated the current total extraction from the Namoi Catchment (rivers and shallow groundwater) to be approximately 540 GL per annum. The CSG water, while produced from within the geographic footprint of the Namoi catchment, would be produced from deep coal seams, unused for any purpose, and removed from the shallow groundwater system by 300 – 800 metres of very low permeability aquitard.

Santos will treat 100 per cent of its CSG water (*see case studies below*), which will enable reuse of approximately eighty percent, through activities such as shallow aquifer recharge which brings benefits to the whole community. Reusing 80 per cent means that the net extraction of water by Santos in Gunnedah is likely to be between 0.7 and 1.4 GL per annum.

In Queensland, Santos is currently trialling its treated CSG water to enhance the historically depleted aquifer that Roma depends on for water supply. The remaining twenty per cent will generally either be injected back into a deep aquifer with salty groundwater, or treated and disposed of according to relevant state guidelines.

Case Studies

Santos GLNG Project: Water Beneficial Re-Use

Ground water models developed by Santos predict that town water supply bores will not be impacted as a result of CSG activities in the Roma, Fairview or Arcadia Valley fields.

Santos has a comprehensive water strategy in place for our GLNG joint venture project in Queensland. It addresses 100 per cent of the CSG water, as well as the project's impacts on soil and regional water resources. The strategy focuses on developing long-term solutions that benefit both local communities and the environment more broadly.

Desalination

CSG water that contains high levels of salt is treated using reverse osmosis technology. This technology separates the salts and organic compounds to produce desalinated water.

Managing Brine

Santos is currently treating CSG water via desalination and generating brine at the Pony Hills Water Treatment Plant in Fairview. The brine from this plant is subsequently re-injected into the Timbury Hills Formation in accordance with the Queensland Government's preferred approach to brine management. As Santos' CSG

FAST FACTS

- ✓ Santos' Gunnedah project is likely to extract CSG water at an average extraction rate of approx 3.5 GL per annum.
- ✓ CSG water is generally extracted from unused, salty deep water sources surrounding coal seams; not currently used shallow aquifers in the local area.
- ✓ Santos will treat 100% of its CSG water.

The Rural Affairs and Transport References Committee

fields are further developed and expanded over time, additional brine management options or up-scaling of current options will be required.

Amendment

Water with low to moderate concentrations of salt can be balanced via an amendment process. This process involves balancing the chemical make up to produce water that is suitable for irrigation. The suitability of amended water for a given purpose is determined by the water quality and is regulated by Department of Environment and Resource Management (DERM).

Santos is investigating a range of sustainable uses for treated CSG water that protects the local environment and benefits local communities. This includes using desalinated water, amended water and a combination of both to meet national standards and regulations.

The following chart summarises how Santos will manage its CSG water in Queensland.

Water Treatment Processes				
All the water Santos produces is treated by following two processes:				
1. Desalination <i>Using the process of reverse osmosis to separate salt from water.</i>		2. Amendment <i>Altering the balance of the water.</i>		
The treatment process used depends on the quality of the water and its intended use.				
Monitoring Program				
Groundwater		Surface water		Soil
Great Artesian Basin	Local Bores	Springs	Creeks	
Santos monitors all its gas fields and water treatment facilities using sophisticated tools that allow remote data collection 24 hours a day. Santos has also completed a baseline inventory of 350 bores in the Roma, Fairview and Arcadia Valley regions.				
Pilot Projects				
Fairview Irrigation Project		Roma Managed Aquifer Recharge Project		Mt Hope Station Irrigation Project
Beneficial Uses of Treated CSG Water				
Managed Aquifer Recharge	Dust suppression	Landholder use	Industry	Irrigation

Roma Managed Aquifer Recharge

The Roma Managed Aquifer Recharge project being undertaken by Santos is the first of its kind in Queensland. It will use treated CSG water to increase Roma's town water supply. The Gubberamunda sandstone aquifer which currently supplies Roma's water supply is depleted from years of urban, industrial and stock water usage.

The town currently draws 3.5 megalitres of water a day, averaged over the year. As part of Santos' beneficial water reuse Managed Aquifer Recharge Project, the Company will be injecting treated CSG water into the aquifer. Initially, Santos is looking to inject around 10 megalitres of treated CSG water per day into the aquifer, and this may increase in the future.

The Rural Affairs and Transport References Committee

Modelling indicates that, at the period of maximum groundwater impact, the vertical drainage from CSG activities, from Gubberamunda, will be minimal at 0.04 megalitres per day. That means, overall, the aquifer will be replenished with a net recharge of virtually the full 10 megalitres of treated CSG water per day

This is the equivalent of supplying more than 50 years worth of water consumption to the town.

Fairview Irrigation Pilot

Santos is establishing Australia's first large-scale treated CSG water irrigation project at its Fairview and Springwater stations, near Injune.

The project involves drip-irrigating 240 hectares of legume forage crops, mainly leucaena and locally adapted native tree species (initially Chinchilla white gum) with treated water. Around two million trees will be planted (over one million trees have been planted to date) or the equivalent of 2,000 hectares of forest plantation. This will produce enough high-quality forage for 1,500 head of cattle and potential for either saw logs or 40,000 tonnes of carbon absorbed from the atmosphere each year.

The pilot has created 50 jobs and research opportunities.

Mount Hope Station pilot project

This partnership with the private landowners of Mount Hope Station will highlight how CSG water can actually help increase food production for farmers. Treated CSG water will be used to grow leucaena and other forage crops.

Farm productivity could be expected to increase 25 fold during CSG water production, and a legacy productivity improvement of 5 fold could be expected to remain once the water production has ceased.

In fact, cattle on unimproved land sit at one beast per five hectares, but when fed on leucaena it can improve to up to five beasts per hectare. And, after irrigation has occurred to the leucaena and the cattle continue to feed on the crops, it is one beast per hectare.

That is, the landholder will experience an increase in agricultural productivity while CSG operations are underway, and CSG will leave a legacy of an increase even after water supply has ended. This is a concrete example that demonstrates CSG and agriculture coexist and actually increase agricultural productivity.

Santos hopes to use this as a model for other farmers the Company works with.

The Rural Affairs and Transport References Committee

Below: Forage oats being watered with desalinated CSG water for stock feed at Springwater in Fairview CSG fields Queensland



Below: Chinchilla white gum plantation



Below: Leucaena crop – some of the 600 head of cattle grazing last year with average weight gains of approx 1.2kgs per day



Support for Namoi Catchment Water Study

Santos' business planning in Queensland and NSW is based on a belief that food security, water security and energy security are inextricably linked, and that this link will become more pronounced in the future.

Santos believes that the Namoi Catchment Water Study (NCWS) will create a valuable asset for agribusiness and resource operators to use when planning in future.

For this reason, Santos has committed more than \$500,000 to the NCWS, and Santos will share information gathered during the exploration and appraisal program with the study.

Currently, Santos is undertaking a comprehensive groundwater sampling regime in the Gunnedah Basin using existing, privately owned agricultural bores within two kilometres of exploration core holes or pilots. Santos is also drilling Shallow Aquifer Monitoring Bores at its pilot testing sites. These bores use quartz pressure gauges that have the capacity to pick up the smallest changes in water pressure. This will enable Santos to capture and analyse a significant amount of baseline data outlining changes in pressure in the shallow aquifers before turning on the pumps in the pilot test. This calibration data will be vital to the NCWS as it will provide real time monitoring of the water pressure movements of both the shallow aquifers and also the much deeper coal seams.

Collection of the groundwater monitoring data will help to:

- characterise existing groundwater systems;
- identify levels and quality of bore water within the region;
- enable maps and trend plots to be developed; and
- identify which areas would benefit from treated water.

The water samples are collected and independently analysed.

Property Rights

Santos understands that landholder access is one of the most important issues to address and get right on an ongoing basis as the gas industry grows. Clearly, landholders have legitimate concerns about how gas exploration and production will impact upon their existing land use, operations and property valuations. Creating respectful, mutually beneficial partnerships is a key priority for Santos. Santos approaches landholders respectfully and in the spirit of a genuine negotiation, rather than with demands or a pre-determined outcome.

Below: Pilot well site at Kahlua - 25 kms north west of Gunnedah, NSW



Santos understands and acts to get the basics right by managing simple, but significant, issues such as closing property gates and preventing the spread of weeds. Santos is proud of the record of negotiating more than sixty landholder agreements in Queensland every year for the past five years. In NSW, Santos has already signed thirty access agreements with landowners.

Recent changes to Queensland legislation further strengthen the landholder access regime and ensure that landholders' rights are protected, while allowing for gas exploration and production. Companies are now required to comply with a Land Access Code that sets requirements in relation to communication, consultation and behaviour when entering private property. In particular, landholders must be provided with 10 days notice of a range of activities, associated with gas extraction. Santos welcomes the introduction of the Land Access Code and supports it.

The changes also provide for gas companies to fund reasonable, independent legal and professional advice for landholders in access negotiations, and compensation needs to be agreed prior

FAST FACTS

- ✓ Creating respectful, mutually beneficial partnerships is a key priority for Santos.
- ✓ Santos acts to get the basics right, such as closing property gates and preventing the spread of weeds.
- ✓ Santos welcomes the introduction of the Land Access Code in Queensland and supports it.

to significant activities being undertaken. The Queensland Government has released a factsheet for landowners, template agreements and provided funding to peak agricultural group AgForce to provide landholders with information and support.

Santos' compensation arrangements include two key elements: an initial payment covering the first 12 months of operations, plus any in-kind compensation (such as upgrading a road or restoring a fence), and an ongoing annual payment. Amounts of compensation vary depending on the extent of infrastructure on a property. The methodology Santos uses to calculate compensation adequately and fairly addresses the compensatable effects prescribed by the relevant legislation. As the following table indicates, the compensation payments are consistent with particular levels of activity.

	Initial	Annual (indexed by CPI)
Significant: 40 wells, campsites, water management pond, flowlines, road access	\$260,000 + in-kind works	\$100,000
Mid range: six wells, campsite, communication tower, flowlines	\$44,000 + in-kind works	\$14,000
Minimal: one well	\$5,000 + in-kind works	\$1,500

Santos believes these levels provide fair compensation for landholders, linked to the level of disturbance on their property.

The current landholder agreement used by Santos includes a standard confidentiality clause. While landholders have not raised concerns with this clause during negotiations, Santos is aware that there is a public concern about potential for the clause to limit a landholder's ability to discuss their compensation arrangement. In response to this concern, whilst the confidentiality clause will remain standard practice, if, at any time a landholder wishes to waive the confidentiality clause, Santos will be willing do so. Santos believes this is a fair outcome for landholders.

Co-existing Land Uses

Santos' existing operations show that agriculture and natural gas extraction can coexist successfully. As the global population increases, sustainable and multiple uses of land is the best response to increased domestic, regional and global demand for food and energy. This is particularly true when both can be provided safely and sustainably from the same land.

The surface footprint of CSG extraction is generally relatively small and temporary in nature. The exception to this is access roads and occasional infrastructure such as treatment and compressor stations, and centralised water treatment facilities.

During their construction phase, wells are normally of an area of 1 ha or less for approximately one year, and then decrease to approximately 25m by 25 m, or 0.07 ha for their productive life of approximately twenty years. At the end of their productive life, they are plugged with cement and rehabilitated, in accordance with Government approvals, guidelines and regulations with effectively no surface impact remaining.

Surface well facilities on Santos projects are generally spaced at one every 200 to 300 ha of surface. Every reasonable attempt is made to ensure that surface facilities are generally located in areas that are not visible from public roads, or homesteads, and away from the more intensively used areas of the property.

Santos' pipelines will be buried typically between 0.75m to 1.2 metres below the ground depending on the surface land use requirements. The period of lost agricultural production is generally a year or less. The width of pipeline corridors during construction depends on the diameter of the pipeline, but can range from approximately 8m for gathering lines to 30m for major gas trunklines.

Santos minimises the impact on existing land use by locating (where practicable) pipelines and roads along fence lines and property boundaries. Furthermore, every effort is made to minimise road impact by using existing roads.

Below: Pilot well site at Brawboy, near Gunnedah, NSW.



FAST FACTS

- ✓ The surface footprint of CSG extraction is generally relatively small and temporary in nature.
- ✓ Surface well facilities are generally spaced at one every 200 to 300 ha of surface.
- ✓ Every reasonable attempt is made to ensure that surface facilities are located in areas not visible from roads or homesteads.
- ✓ Santos minimises the impact on existing land use by locating (where practicable) pipelines and roads along fence lines and property boundaries

The Rural Affairs and Transport References Committee

Below: the same site as above during rehabilitation.



Below: The same corehole 6 months later.



Model Drilling Process and Protections

Well Safety

Santos has stringent safety standards and practices in place at every level of its operations that meet, and in some cases exceed, regulatory requirements. Ongoing maintenance and assessment of equipment and gas wells enables Santos to identify and mitigate safety risks.

All Santos equipment is designed, engineered, installed and maintained to ensure robust performance and compliance with industry standards and regulatory requirements. Santos continually monitors gas fields via operator inspections and telemetry to ensure the integrity of its facilities.

All completed wells have American Petroleum Institute (API)-certified wellheads installed and have been pressure tested by an independent third party.

Santos manages CSG well safety in accordance with a series of safety management standards to ensure safe operation. This ensures rigorous standards are enforced for:

- design, construction, commissioning, operations, maintenance and decommissioning
- environment, health and safety
- ignition control
- structural and mechanical integrity
- training and competency
- emergency preparedness
- incident and non-conformance investigation, corrective and preventative action.

FAST FACT

- ✓ Santos has emergency response plans in place for every aspect of operations.

Thorough planning and testing regimes – such as pressure and integrity testing – mean Santos understands the properties of each individual gas well and the risk of incidents is very low. Risks associated with gas well management are well understood and are minimised as part of operations.

Production variables at wellhead facilities such as pressure, temperature and flow rate are monitored. Deviations outside the normal operating envelope result in a physical inspection of the wellhead. In the unlikely event of a loss of containment of gas from wellhead facilities and equipment, the well is shut-in to repair the leak.

Santos has emergency response plans in place for every aspect of operations, including gas well management. These detailed plans outline actions, roles and responsibilities for emergency response to help ensure safety of people and protection of environment and property.

Gas is sometimes vented from a well. Flares may be used to burn gas from wells to dispose of it in a safe and controlled manner. This gas is flared for operational or safety reasons and is part of a normal procedure approved by environmental authorities.

Well sites and gas production facilities are secured and hazards are clearly signed.

Drilling

Santos uses proven drilling techniques to extract gas from Queensland's world class coal seam CSG resource in the Surat and Bowen Basins for the GLNG Project. The same techniques will be used in the Gunnedah Basin. Santos' 50-plus years of expertise in gas well drilling gives it the competence to implement these techniques.

The CSG zones being targeted by Santos are 500-1,200 metres below the surface – well beyond stock or domestic bores. Wells, typically between 100 millimetres and 300 millimetres in diameter, are drilled and are lined with steel casing which is cemented to the side of the hole, to isolate any aquifers that are intersected and also for well integrity reasons.

Many of the processes used for drilling gas wells are similar to those used for domestic and irrigation bores.

The CSG wells Santos constructs are:

- Constructed to deliver gas;
- Constructed to reduce the risk to people, the environment and equipment;
- Designed to isolate water and hydrocarbon formations, contain drilling fluids and support pressure containment equipment; and
- Monitored and pressure tested in-situ.

Santos uses surface casing to isolate any useable aquifers, and generally uses multiple casing string designs. All well designs are written by engineers, and reviewed and approved by senior engineers, and are based on the Santos Drilling Operations Manual, which reflects many years of drilling experience. Santos complies with API standards of well construction which are non-mandatory, but best practice nonetheless.

It is in Santos' best interest to maintain isolation from all aquifers and permeable formations. The CSG business production model is based around removing water from the coal and then producing gas. If water is allowed to flow into the coal seam, production will be compromised and would not be economic. Similarly, if gas was allowed to flow up into an aquifer (or any other formation) the economic resource would be lost, so again, Santos is diligent about ensuring the resource is intact. To produce gas from the well for its full 20 to 40 year life, the gas must be contained and the well designs are driven by this requirement.

All of Santos' wells have steel-casing that is cemented with oil field grade cement, which is then pressure tested to ensure its integrity.

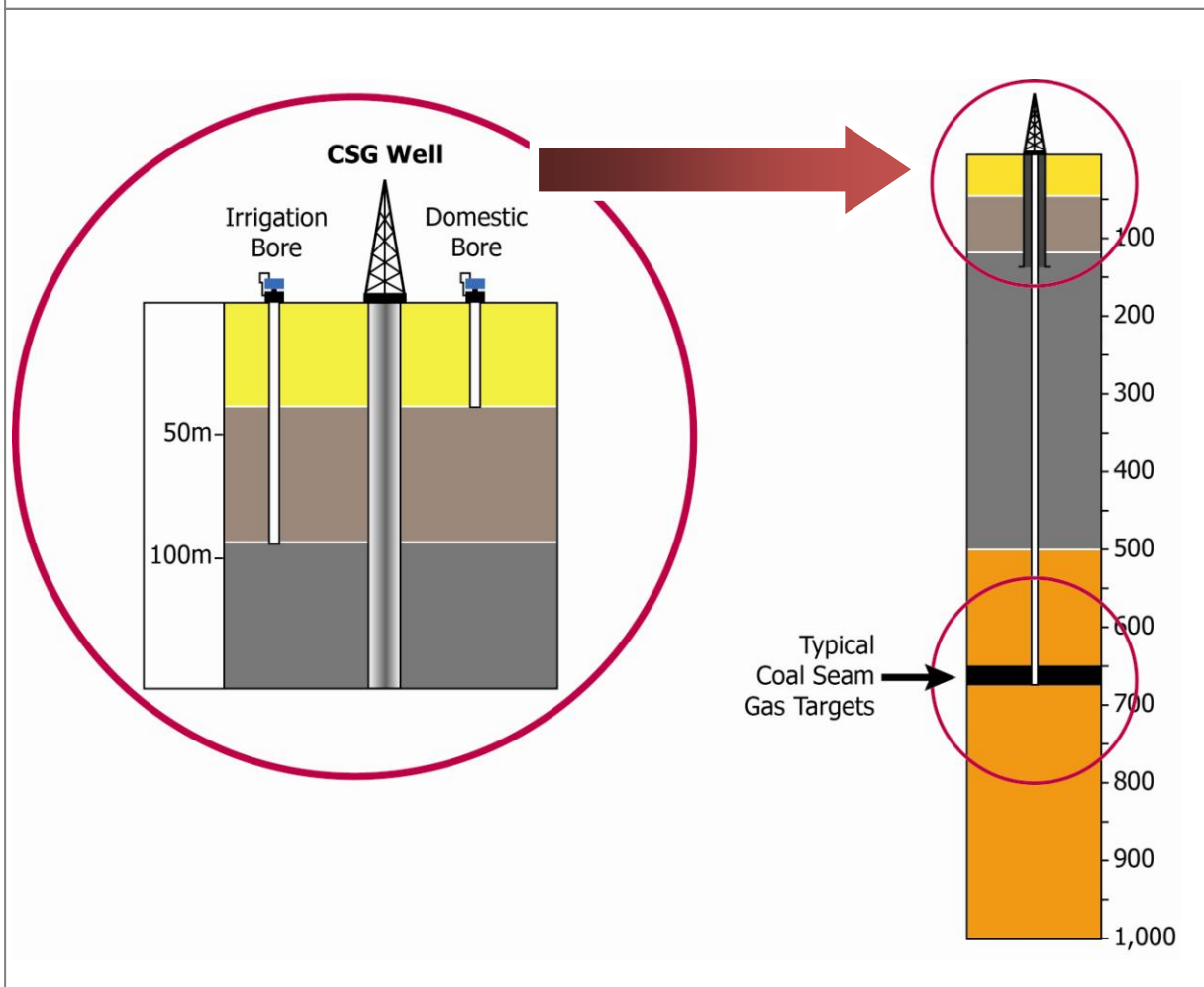
Santos is focussed on minimising the impact on the environment and has made many improvements to this end. For example, many of the CSG well designs use directional drilling to drill several wells from a single pad. Whilst the pad used is slightly larger, there are far fewer pads required. This reduces the total cleared area and allows the pads to be placed to minimise impact and therefore the environmental footprint of the CSG operations.

Santos requires all drilling contractors to comply with the Company's policies and procedures, monitoring performance regularly.

FAST FACTS

- ✓ The CSG zones targeted by Santos are 500 to 1,200 metres below the surface – well beyond stock or domestic bores.
- ✓ Wells are lined with steel casing that is cemented to the side of the hole, to isolate any aquifers that are intersected.
- ✓ It is in Santos' best interest to maintain isolation from all aquifers and permeable formations – if water is allowed to flow in the coal seam, production will be compromised.
- ✓ To produce gas from the well for its full 20 to 40 year life, the gas must be contained and the well designs are driven by this requirement

Typical Gunnedah Basin CSG Well



Below: Four well pad in Pickanjinie in Fairview Field, Queensland



Below: Single well in Scotia field, Queensland



Hydraulic fracturing

Hydraulic fracturing is a process used in circumstances where gas is tightly held in dense coal seams. When used, its advantage is that it substantially enhances the productivity of a gas well and, as a result, reduces the number of wells that would otherwise be required.

Hydraulic fracturing is not an explosive or high impact process. It involves pumping a specifically blended fluid, charged with proppants such as sand, down a well at sufficient pressure to force small passageways into the coal seam. The proppants keep the passageways open once the pressure is released and serve to improve the efficiency of the well.

Materials used in the fracturing process include around 99% water and sand, as well as about 1% of a range of chemicals in minute, diluted quantities, which assist in carrying and dispersing the sand in the coal seam. The chemicals are not specific to the CSG industry and have many common uses such as in swimming pools, toothpaste, baked goods, ice cream, food additives, detergents and soap.

As part of the process, the sand remains in the coal seam while the vast majority of the liquid, including chemicals, is recovered to ensure it does not impede the gas flow.

Santos has decades of experience using this technology in the Cooper Basin and in south-west Queensland.

FAST FACTS

- ✓ Hydraulic fracturing is safe and has been used in the industry for more than 60 years.
- ✓ Fracturing enhances the productivity of a gas well.
- ✓ In a properly constructed well, fracturing cannot cause groundwater to leak into the coal seam as only the specific coal seam is fractured.
- ✓ Fewer gas wells are required when hydraulic fracturing is used, thereby decreasing the overall footprint.

The Rural Affairs and Transport References Committee

The chemicals utilised in this process, in the quantities used, are safe. However, Santos continually reviews all chemicals used in its activities, with a view to replacing or substituting if necessary.

The risk of water contamination is minimal because Santos applies high standards and best practice in our drilling techniques and tools. Legislation also requires the CSG industry to isolate aquifers and coal seams. If for some reason there is inadequate isolation, then the problem would be repaired prior to fracturing or the fracturing process would not proceed.

All chemicals used for hydraulic fracturing are handled in accordance with the appropriate legislation and have a minimal impact on the environment.

In a properly constructed well, hydraulic fracturing cannot cause groundwater to leak into the coal seam as only the specific coal seam itself is fractured. The fracture is not able to grow up to the shallow aquifers or to the surface.

The Rural Affairs and Transport References Committee

Below: Chemicals used by Santos in fracturing are included in the table below:

Components	Purpose	Common Uses
Ethylene glycol monobutyl ether	Mutual solvent	Cleaning products, cosmetics, liquid soaps
Tetrakis (hydroxymethyl) phosphonium sulfate	Biocide	Water treatment
Oxyalkylated alcohol	Reduce fluid surface tension	Scouring agent for textiles
Ethylene glycol	Prevents scaling	Antifreeze, household cleansers, de-icing, caulk
Tetramethyl ammonium chloride	Reduce clay swelling	Type of salt
Crystalline silica (cristobalite)	Proppant	Sand and gravel
Crystalline silica (quartz)	Proppant	Sand and gravel
Hemicellulase enzyme	Reduce viscosity of guar gum gel	Commercial food processing of coffee
Methanol	Reduce fluid surface tension	Windscreen washer fluid, wastewater treatment, alternative fuel blends
Boric oxide	Crosslinker to increase viscosity	Used to produce high strength alloys, glasses, ceramics, detergents
Potassium carbonate	pH buffer	Soap, wine, glass, dyes, water softener
Sodium persulfate	Reduce viscosity of guar gum gel	Bleach in hair treatments, detergents
Petroleum distillate	Guar liquefier	Baby oil, make-up remover
Sodium acetate	pH buffer	Provides the primary flavouring in salt and vinegar potato chips
Guar gum	Thickens fluid to carry sand	Thickener in cosmetics, baked goods, ice cream, toothpaste and sauces
2-methyl-2h-isothiazol-3-one	Biocide	Preservative in cosmetics, shampoo detergents, dishwashing liquids
5-chloro-2-methyl-2h-isothiazolol-3-one	Biocide	Preservative in cosmetics, shampoo detergents, dishwashing liquids
Acetic Acid	Solvent	Additive in the food industry, descaling agent
Boric Acid	Gelling Agent	Antiseptic, insecticides, flame retardant
Diammonium peroxidisulphate	Breaker	Hair bleach
Diatomaceous earth, calcined	Filler	Tooth paste, hydroponics
Ethanol	non-ionic surfactant	Fuel, alcoholic beverages
Hydrochloric Acid (Muriatic Acid)	pH buffer	Multi purpose chemical reagent, food additive, swimming pool maintenance
Magnesium chloride	Salt	Food industry, anti icer on roads, aquariums
Magnesium nitrate	Salt	Agriculture as a fertilizer, ceramics
Magnesium silicate hydrate (talc)	Filler, stabiliser	Talcum powder, paints, food additive
Non-crystalline silica	Filler, stabiliser	Opal jewellery
Sodium Carbonate (Soda Ash)	pH buffer	Water softener, swimming pools, food additive
Sodium Hydroxide (caustic soda)	pH buffer	Cleaning agent, food preparation

Regulation

Detailed regulations and conditions govern all aspects of the CSG industry in Queensland and New South Wales. The industry must be governed by well thought-through and administered regulations to ensure all participants operate by the same standards, which are acceptable to all stakeholders, including the industry.

Regulation in Queensland

In Queensland, the bulk of Santos' activities are regulated under the *Petroleum and Gas (Production and Safety) Act 2004* and the *Environmental Protection Act 1994*. However, in recognition of the scale and scope of the Santos GLNG project, it was declared a "significant project for which an EIS is required" by the Coordinator-General under the *State Development and Public Works Organisation Act 1971*.

This declaration requires proponents to undertake a detailed assessment of environmental impacts and extensive community consultation for consideration by the Queensland Coordinator-General. Santos GLNG lodged its comprehensive 13,500 page environmental impact statement (EIS) in March 2009, after almost 18 months of investigations by environmental and other specialists.

The EIS investigated likely impacts and benefits of the project on: jobs and people in regional communities, rural industries and business, the environment, safety of the community, emergency services, local health, transport and housing.

The process had a strong focus on community input, with more than 2,700 people registering as project stakeholders. About 900 attended information sessions and several thousand called the project freecall line, emailed the project team or visited the Santos GLNG website.

Once the EIS was lodged, it was released for public review and written submissions were invited. The study received 48 submissions by the closing date.

On 28 May 2010, after almost two and a half years of extensive investigation, scientific assessment, consultation and review by regulators, Santos GLNG became Australia's first major coal seam gas to LNG project to receive its environmental approval from the Queensland Coordinator-General.

The Coordinator-General's report includes 900 environmental and social conditions. The subsequent Commonwealth Government approval under the *Environmental Protection and Biodiversity Conservation Act 1999* included a further 300 conditions – meaning the Santos GLNG project is being developed with 1,200 conditions governing the operations and minimising impacts on the environment and communities.

Regulation in NSW

The Petroleum Act guides petroleum operations in relation to environment, safety, Native Title, royalties, compensation and other issues. It is administered by the Office of Energy and Resources (OER) within the Department for Trade and Investment, Regional Infrastructure and Services (DTIRIS).

Petroleum production activities require environmental assessment under the *Environmental Planning and Assessment Act (NSW) 1979* (the EP&A Act) before a permit is granted. The EP&A Act ensures that all petroleum activities are appropriately assessed by the relevant governmental agencies. The EP&A Act has

FAST FACTS

- ✓ Because of its scale, the Santos GLNG project required an EIS.
- ✓ Santos conducted 18-months of investigations before lodging the EIS in March 2009.
- ✓ The process had a strong focus on community input, with more than 2,700 people registering as project stakeholders.
- ✓ On 28th May, 2010, after almost two and a half years of extensive investigation, scientific assessment, consultation and review, Santos GLNG became Australia's first major coal seam gas to LNG project to receive its EIS approval from the Queensland Coordinator-General.

The Rural Affairs and Transport References Committee

various approval streams which may be relevant to petroleum activities in NSW. The scope, extent and location of proposed petroleum activities will inform which approval stream is applicable.

Environmental planning instruments relevant to petroleum activities include the State Environmental Planning Policy (*Major Projects*) 2005 and *State Environmental Planning Policy (Mining Petroleum and Extractive Industries) 2007*.

“AS ONE OF AUSTRALIA’S LARGEST DOMESTIC GAS PRODUCERS, SANTOS HAS A 50-YEAR TRACK RECORD OF WORKING WITH LOCAL LANDHOLDERS AND CONTRIBUTING TO COMMUNITIES. OVER THE PAST 15 YEARS WE’VE TAKEN THE SAME APPROACH TO EXPLORING QUEENSLAND’S MULTI-BILLION DOLLAR COAL SEAM GAS RESOURCES. AS WE DEVELOP THAT BUSINESS AND EXPLORE NEW OPPORTUNITIES IN NEW SOUTH WALES, SANTOS IS COMMITTED TO HELPING LOCAL COMMUNITIES BENEFIT FROM THEIR NATURAL GAS RESOURCES SAFELY AND SUSTAINABLY, WHILE MAINTAINING THEIR VITAL ROLE AS FOOD PRODUCERS.”