Pilliga Push Camp – Declaration of Peaceful Direct Action

The Pilliga Push Camp is committed to protecting the waters of the Great Artesian Basin (GAB) and Murray Darling Basin by educating, uniting and mobilising communities. We shall sustain a Peaceful Direct Action (PDA) campaign to stop the development of Santos's Narrabri Gas Project and the resulting destruction of the Pilliga (Billarrga) forest and its biodiversity, Gamilaraay sacred sites and cultural identity, as well as surrounding farmlands and the rural economy.

The Billarrga is one of very few significant recharge zones for the entire Great Artesian Basin (GAB), which extends over 22% of Australia and maintains base flows to countless wetlands, streams and rivers. This land is an incredibly sacred water sink, where the water cycle enters the largest underground water reservoir in the world, as well as contributes significantly to the head of pressure that helps drive the underground water flows.

This head of pressure created beneath the Billarrga enables the release of water back to the surface in more arid zones in Northern Territory, Queensland, South Australia and NSW, through natural springs and bores. This process also helps hydrate the Murray Darling Basin and contributes significantly to the base flows of the Darling River.

Coal seams act as landscape filters, and the extreme water pressures deep below the ground have locked in hundreds of millions of years of accumulated salts and toxins, including volatile organic compounds, heavy metals and radioactive particles.

To release the gas from the coal seams Santos need to de-water and de-pressurise them, and in the process extract massive and unsustainable amounts of water from our underground reserves. The decrease in water pressure within the coal seams will impact significantly on the head of pressure driving the GAB, as well as release the salts and toxins.

In short, this campaign is about saving Australia's future water security, food security and economic prosperity. 'Water Is Life', and once we destroy the water, there is no longer an economy, community or ecology.

Diagram 1 – Showing size and location of the GAB, outlined in blue and its four sub basins shaded in green, yellow, pink and light blue. As well, the map details how the GAB overlaps the underlying Murray Darling Basin, outlined in red, and the Lake Eyre Basin outlined in gold.

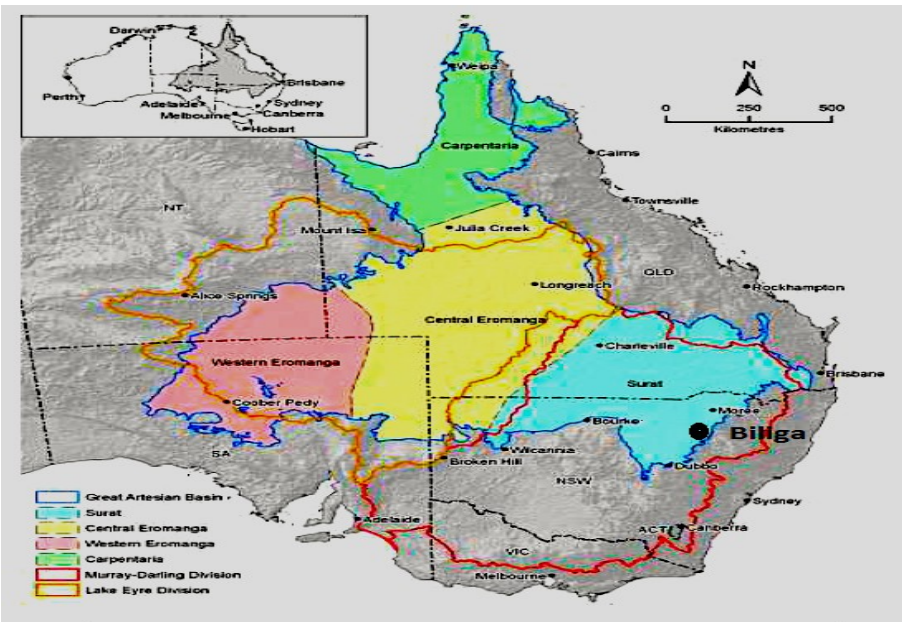


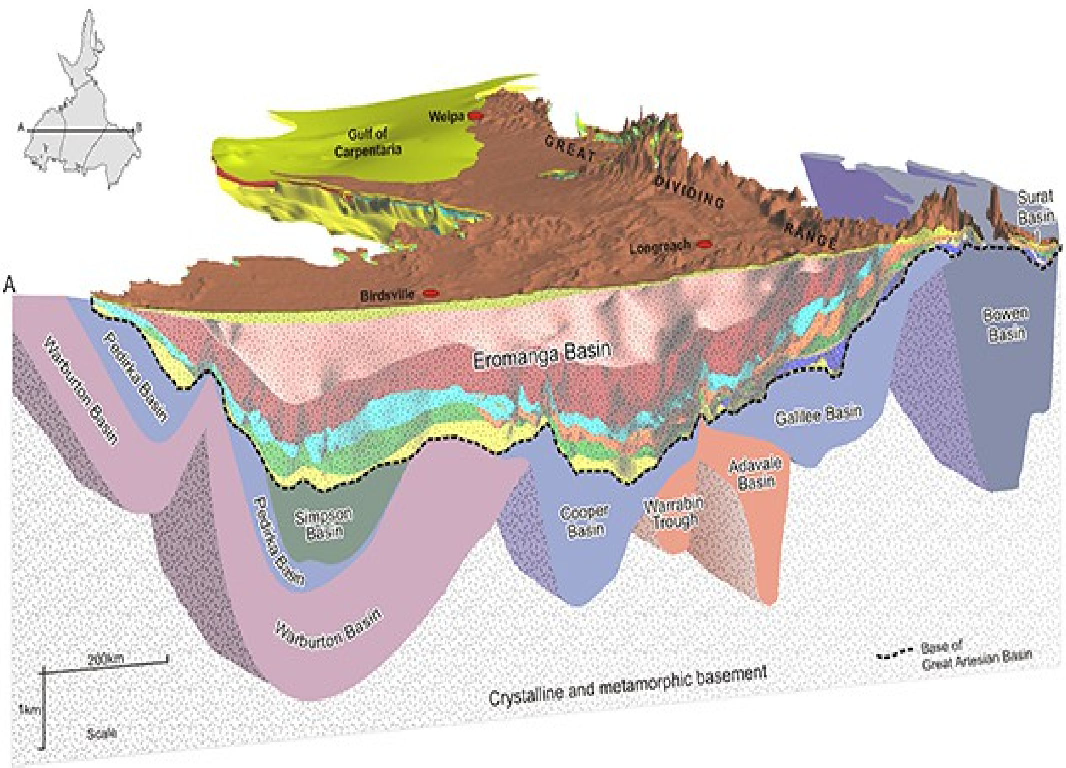
Figure 1: Location of the Great Artesian Basin within Australia

Disclosure 1 – LANDSCAPE HYDROLOGY

The Circulatory System

Over hundreds of millions of years and many different geological events, layers of sediments (sand, silt, clay and organic matter) have been deposited to form the Great Artesian Basin (GAB).

Diagram 2 – GAB *Layering*
Cross section of the GAB showing the layering of sediments that have formed the underground water storage system. The Eromanga Basin and Surat Basin are both part of the GAB and sit above other basins. Further south, beneath the Billarrga, the GAB sits above the Gunnedah/Oxley Basin which is part of the larger Murray Darling Basin.



Deposits of coarse sediments have formed the sandstone arteries of the basin while deposits of fine sediments have formed the siltstone and claystone storage tissues. Cracks, fractures and fault lines throughout the entire geological strata create the network of capillaries.

Deposits of organic matter that have been transformed by biological and geological processes have formed the coal seam kidneys of the aquifer system.

Although the entire geological strata is full of water, easily detectable groundwater flows can only occur within the sandstone and coal seams layers, due to larger pore spaces allowing easy infiltration and percolation.

The clay and silt stones have very small pore spaces and only allow for slow movement of water in and through these layers. However, cracks and fractures within these rocks, as well as sandstone channels deposited by ancient streams and river beds, facilitate the free movement of water throughout the entire layered geological formations.

Supporting information

Great Artesian Basin Recharge Systems and Extent of Petroleum and Gas Leases – Second Edition, March 2015

There is proven downward connection between sub basins of the GAB and many of its underlying petrochemical rich basins.

There is no disconnection within the geological structure of the GAB, nor underlying Basins, water under extreme pressure is free to move within and between all strata layers. The only real difference is the size of the pore spaces within each layer that influences the speed by which water can flow through that medium.

Coal seams can vary in pore space depending on their age, depth under the ground and the pressures exerted upon them, however all coal seams are porous and function as biological/carbon filters. The coal beneath the Billarrga is naturally fractured and because of this it has good permeability, allowing water to easily flow

Many microscopic organisms live within the coal seams and rely on relatively quick movement of water and the transfer of nutrients in and through the coal. This biological process could only exist if the coal seams themselves acted as porous free flowing aquifers.

How is Coal Seam Gas made? (A bit like compost)

Supporting information

Coal Seam Gas water from Maramarua, NewZealand: Characterisation and Comparison to US Analogues, Department of Civil Engineering, University of Canterbury, Christchurch, NEW ZEALAND. Abstract

Coal seam gas is formed through the anaerobic biodegradation of organic matter and by thermogenic processes of high temperature and pressure. Initially, plant detritus is deposited and buried by the deposition of sediments of marine or terrestrial origin. This organic matter is first decomposed by aerobic respiration; however, as the burial process continues and oxygen is depleted, the biodegradation process turns from aerobic respiration to fermentation and methanogenesis.

In this process, acetogenic, hydrolytic and fermentative bacteria produce simple organic compounds that methanogenic bacteria then convert into carbon dioxide and methane, (Kjeldsen et al., 2002)

Can things move through Coal Seams?

University of Wollongong Research Online, February 2010

PARAMETERS AFFECTING COAL SEAM GAS ESCAPE THROUGH FLOOR AND ROOF STRATA

To allow the movement and storage of the methanogenic micro-organism and nutrients the coal seams have to act as a permeable aquifer.

Is this like biochar?

It is the massive surface area of the coal's carbon compounds that facilitate the filtration process. As dissolved particles and gasses pass through the coal seam, they are adsorbed onto the carbon surfaces or absorbed into minute pore spaces and held within the coal. The water is free to keep moving and as it does, excessive amounts of salts and toxins are removed from the water profile, remaining trapped within the coal seam.

Hundreds of millions of years of accumulated salts and toxins, including heavy metals, volatile organic compounds and radioactive particles, have been locked away within the coal. Extreme water pressures that exists deep underground massively increases the storage capacity of these landscape filters.

This company uses coal as a filter, as it's porous

Supporting information

James Cumming and Sons Pty Ltd, C & S Brand Coal and Anthracite Coal as Filter Media.
.
Note: C & S Brand Filter Coal has a history of performance over the last 10 years which substantiates its uniqueness as a filter media for water treatment.

The Heart

In order for water to continue to flow within the porous aquifers, there needs to be a pressure difference going from high water pressure to low water pressure in the direction of flow. This requires the intake areas of the aquifer (recharge zones) to be higher in altitude (creating a head of pressure) than the exit points of the aquifer (natural springs and bores).

Diagram 3 – *Pressure head & recharge zones* ***(is this like water pressure created by a pump?)***
Cross section of GAB showing recharge zones in high country on the Great Dividing Range (top right of diagram) providing the head of water pressure that drives the underground water flows.

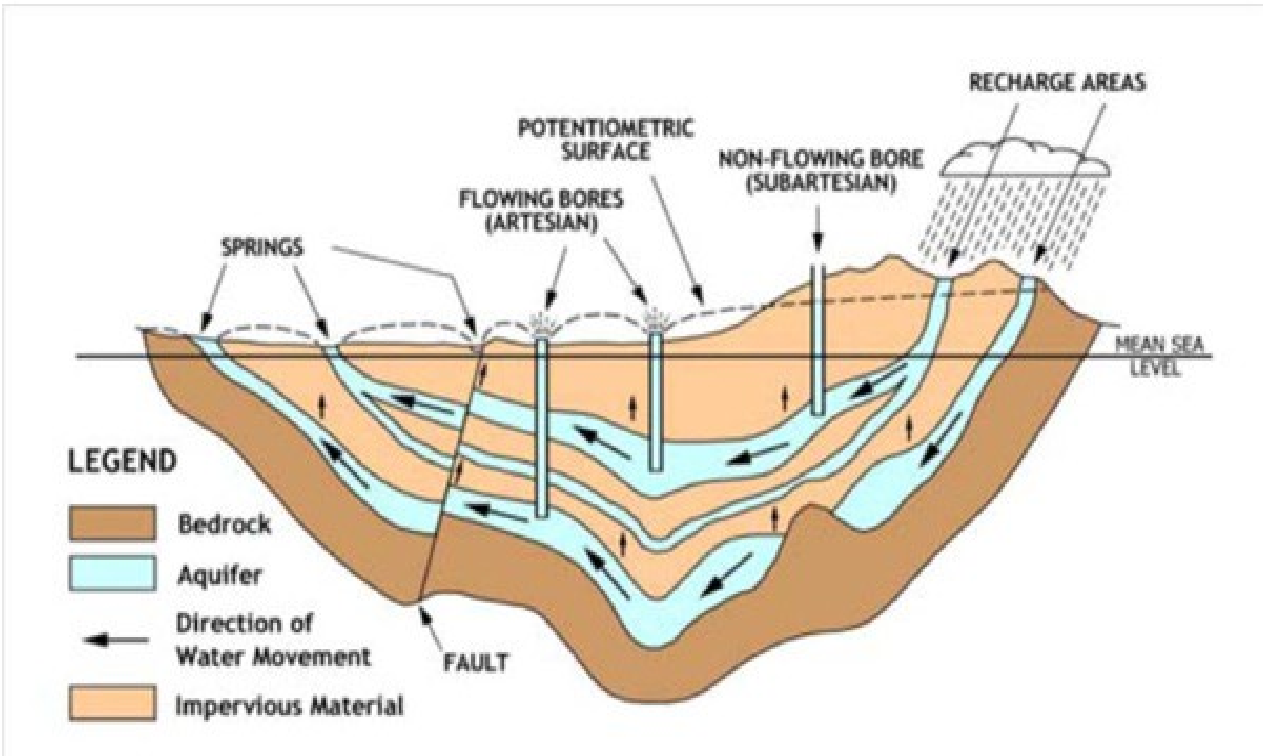
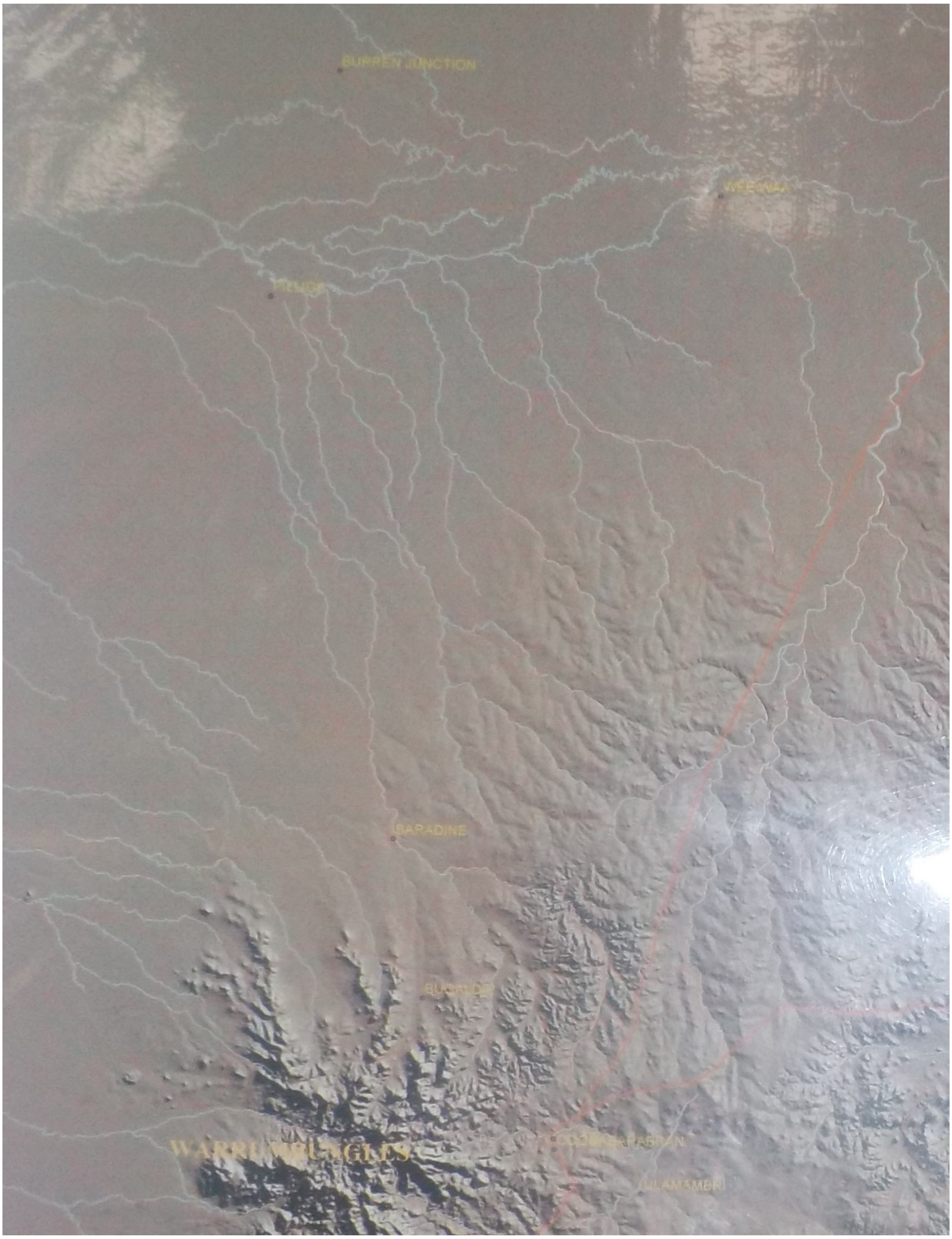


Diagram 4 – *Recharge zones & water flow direction*
This map below shows the GAB in dark blue and elevated recharge zones in light blue, Billarrga is shaded red. Arrows indicate direction of ground water flows.

These raised margins on the GAB were created through massive geological uplift that exposed the ends of the sandstone layers above the ground, forming sections of the Great Dividing Range.

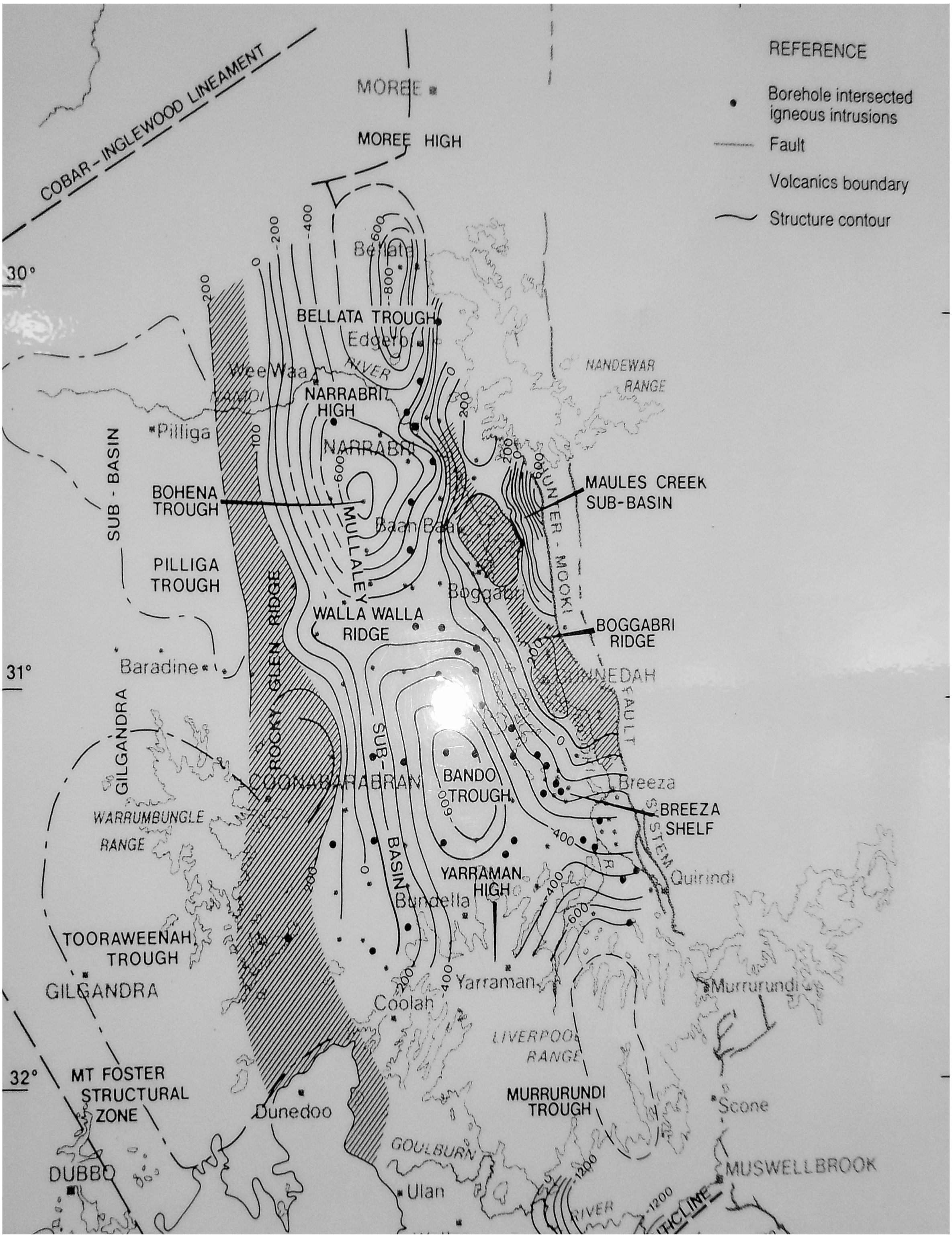
Billarrga is one of very few places where the exposed aquifers have formed highly efficient water sinks.

Diagram 5 – *Billarrga watershed*
Bottom right corner of aerial photo is the Billarrga outcrop that traps and funnels rain water into the ground. Springing from the Billarrga is many streams flowing from middle right to top left of picture, feeding the Namoi River and forming the headwaters of the Darling River. The Darling is one of 3 main rivers that provide irrigation water to our most important agriculture region, the Murray Darling Basin, producing 1 third of our food crops.



Due to the past geological uplift, the underlying rock strata is highly fractured, allowing water to quickly and easily infiltrate into the underlying aquifer system.

Diagram 6 – Billarrga *Water sinks*
Topographical map showing the troughs (hollows that act as water sinks) running parallel within a sub basin (area between Rocky Glen ridge and Boggabri Ridge) within the East Billarrga.



Billarrga Recharge - How important is it?

Supporting information

Great Artesian Basin Recharge System and Extent of Petroleum and Gas Leases – Second edition, March 2015

Only 0.2% of the GAB has effective recharge of 30 – 79 mm/yr.

In NSW, the main occurrences of recharge greater than 30mm/yr is in the east Pilliga between Coonabarabran and Narrabri

When Billarrga receives rainfall, much of the water is transferred into the ground and fills the ends of the raised sandstone arteries. This recharge does not just facilitate the filling of the GAB it also contributes significantly to creating the head of pressure that is required to drive the underground water flows.

Like a heartbeat, Billarrga pumps the blood of the earth throughout its underground journey, to be filtered and returned to the surface, sustaining life all over this continent.

'This Land Is Sacred'

Disclosure 2 – IMPACTS of CSG on LANDSCAPE HYDROLOGY

Pushing us beyond the brink!

Both biological (decomposition) and geological (pressure and heat) processes are involved in the formation of coal. Natural gas production (predominately methane) is a by-product of both these processes. It is this gas stored deep below the Billarrga, trapped within the coal seam aquifers, that Santos want to mine.

The process by which Santos will tap the gas requires enormous and unsustainable amounts of water to be extracted from the ground water resources beneath the Billarrga, in order to de-pressurise the coal seam.

How much produced water does one Coal Seam Gas well average per day?

Supporting Information:

Gas Today, Australia, May 2009

According to Origin Energy Senior Engineer Water Management, Robert Caine, by-product water on an individual well can vary between 0.1 mega-litres per day (ML/d) and 0.8 (ML/d)
(that = 100,000L to 800,000L per day).

Waterlines Report, Australian Government - National Water Commission, 2011

The actual production rates and times within and between coal measures vary considerably. From their CSG production experience in the Surat Basin, Queensland Gas Company Pty Ltd (QGC) indicated that initial water quantities extracted from a well ranged from 0.4ML/d (400,000L/d) to 0.8 ML/day (800,000L/d) before decreasing to about 0.1 ML/day (100,000L/d) over a period of six months to a few years (Environmental Resources Management 2009).

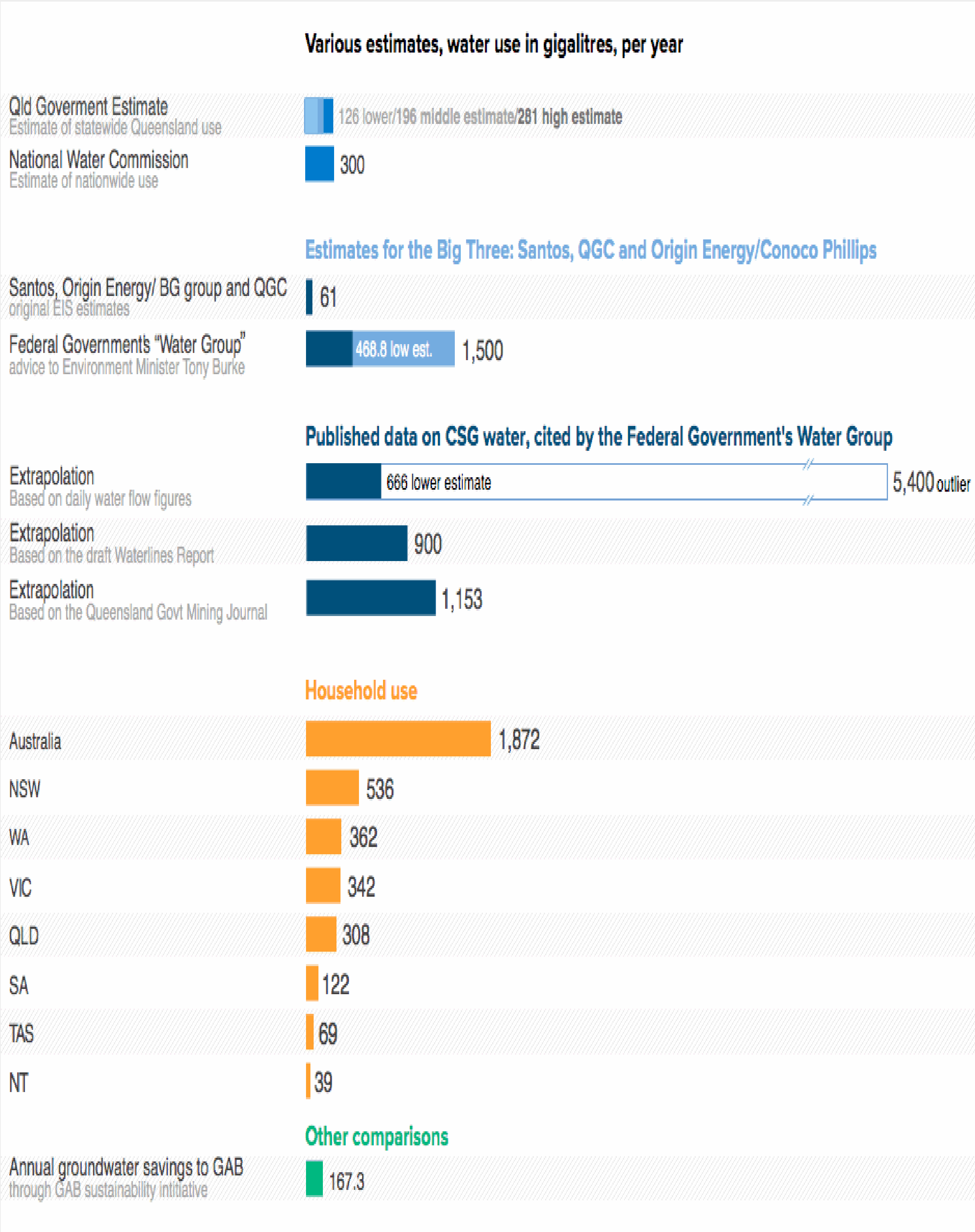
Diagram 7 - See bar graphs on following page for extrapolation figures from published data on Coal Seam Gas (CSG), cited by the Federal Government's Water Group. This information, supported by the figures above, was included in the data used in this report to estimate the average annual water use per CSG well in the Surat Basin. The Narrabri Gas Project is located in the south eastern part of the Surat Basin.

Note *- Did not include the figures based on daily water flow as they were worked out on maximum flow rate and minimum flow rate, not on average flow rates across the life of the well.*

Note *- Graphs on following page also show comparison rates of house hold water use for each state in Australia.*

Supporting Information:

ABC News - web page
Coal Sean Gas by the numbers - Coal Seam Gas & Water



Updated, 4 Apr 2012

How much water per year can one CSG well extract from the Narrabri Gas project?

A single Coal Seam Gas well in the Surat Basin can extract between 400,000 litres of water and 800,000 litres of water per day, **over a period of six months to a few years,** during the initial phase of de-pressurising the coal seam aquifer. Once the coal has been de-watered and de-pressurised the gas can flow from the coal seam into the extraction pipes.

For an average production life of 15 years, each well in the Narrabri Gas Project has the potential to extract an average of approximately 150,000 litres of water per day from the coal seam. Due to water continually re-entering from pressurised aquifers above, water extraction is required for the life of the well.

This means that over the life of every CSG well, an average of approximately 55,000,000 litres (55 Ml) per year would be removed from the ground water resources beneath the Billarrga.

Coal Seams & Aquifers are interconnected!

Supporting information

The Australian – News, September 24, 2011

Monash University-based hydrologist Gavin Mudd told The Australian.

"Even if the [impermeable] clay layers are not cracked or broken by fracturing activities you still have full pressure in the aquifer but zero pressure in the coal seam.

"Water will always return to the coal seam, it's just a matter of how long it takes," Mudd.

On this point the CSG industry appears to concur that, 'The interconnectivity of coal seams and aquifers remains the biggest concern to operations'.

Statements made by Santos, buried deep in an expansive environmental impact report regarding the Gladstone LNG project in Queensland, highlight those concerns.

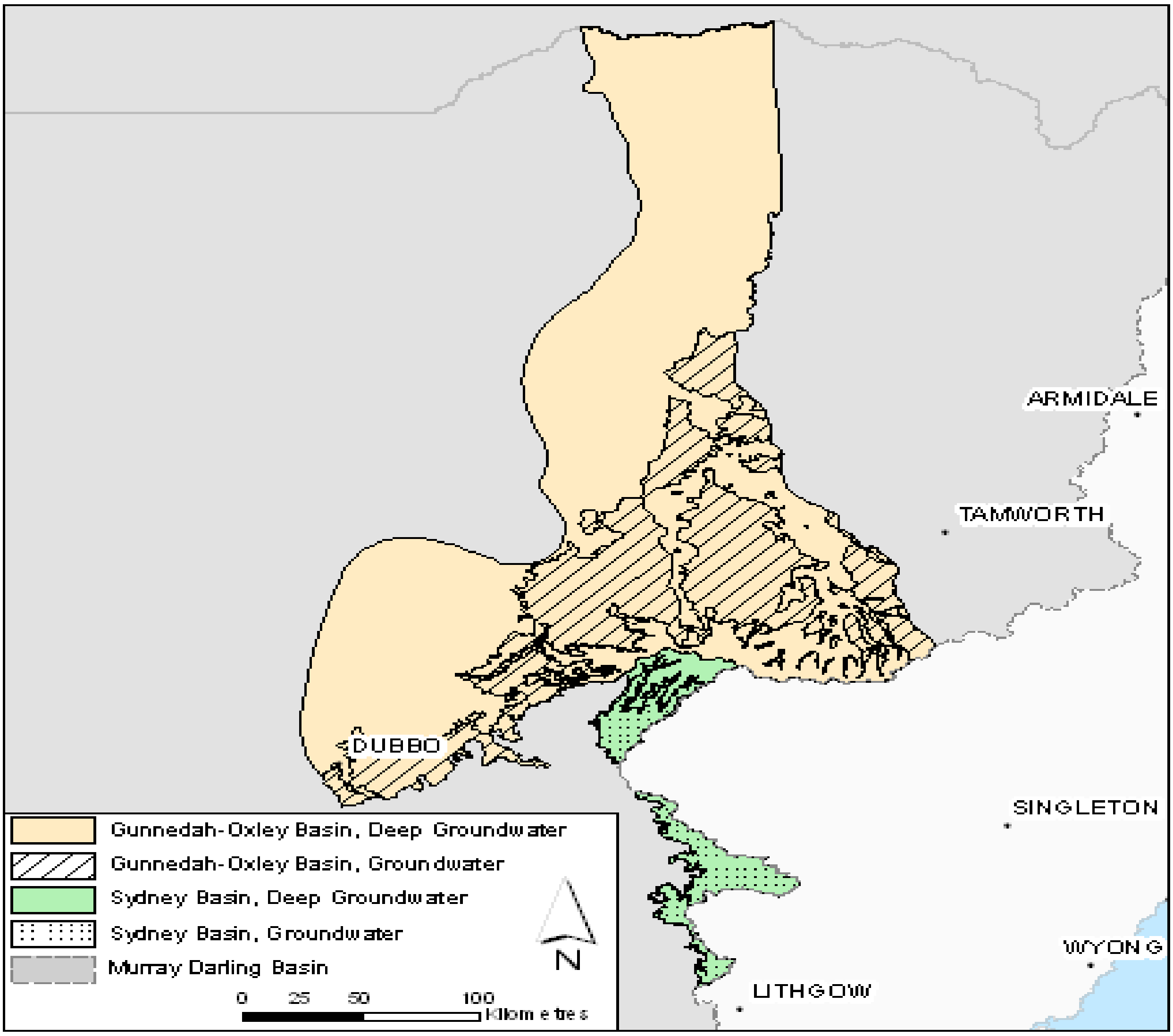
"In all fields there is a potential for water to move vertically from aquifers above and below the well field into the coal seams as a result of the huge pressure differential caused by the draw down of groundwater heads.

How much water would Santos take per year if they went into full production?

Initially Santos plan to drill 850 CSG wells in the Billarrga Forrest and surrounding farmland, **with plans for thousands more in the region**. If they were to get to full production with the initial 850 wells, they would be extracting an estimated average of 46,750,000,000 litres (46,750 ML) of water per year.

114,500 ML of water is the total sustainable extraction limit from the Eastern Porous Rock Water Resources Management Plan for the Murry Darling Basin, that covers 4,262,200 hectares. Santos believes they can take approximately 41% of these communities available water allocations from within the Gunnedah/Oxley Basin water resource.

Diagram 8 – Map showing area within NSW covered by Eastern Porous Rock Water Resources Management Area. Part of the Murray Darling Basin Management Area.



Below is the estimated figure by Santos for their annual water take for the life of the Narrabri Gas Project. This amount of ***2 GL per year (2,000 ML/y) has been declared*** to the Department of Primary Industries – Water (formerly the NSW Office of Water), and will be all the water access licences Santos will have to acquire.

Supporting information

NSW State Government
Department of Primary Industries, Water (Web page)
(Script 3) – Gunnedah Basin – Part 2

Santos estimates that over the life of the Narrabri coal seam gas project the average volume extracted annually will be 2 GL.

What is the truth?

This figure contrasts markedly with publicly available information from reliable sources that were used to estimate an average of 46,750 ML per year.

Probably the most disturbing thing of all is that the extra 44,750 ML of water per year that is not being declared by Santos is also not being disputed by the Department of Primary Industries. - Water.

Just like the dissolved solids (salts), gas molecules can be trapped within the coal seam and be held there in huge volumes due to the extreme water pressures. Santos must reduce the water pressure in order to get the gas to flow from the coal seam. As they pump out the water, the gas escapes it's bonds and is free to flow through the coal and into their extraction pipes.

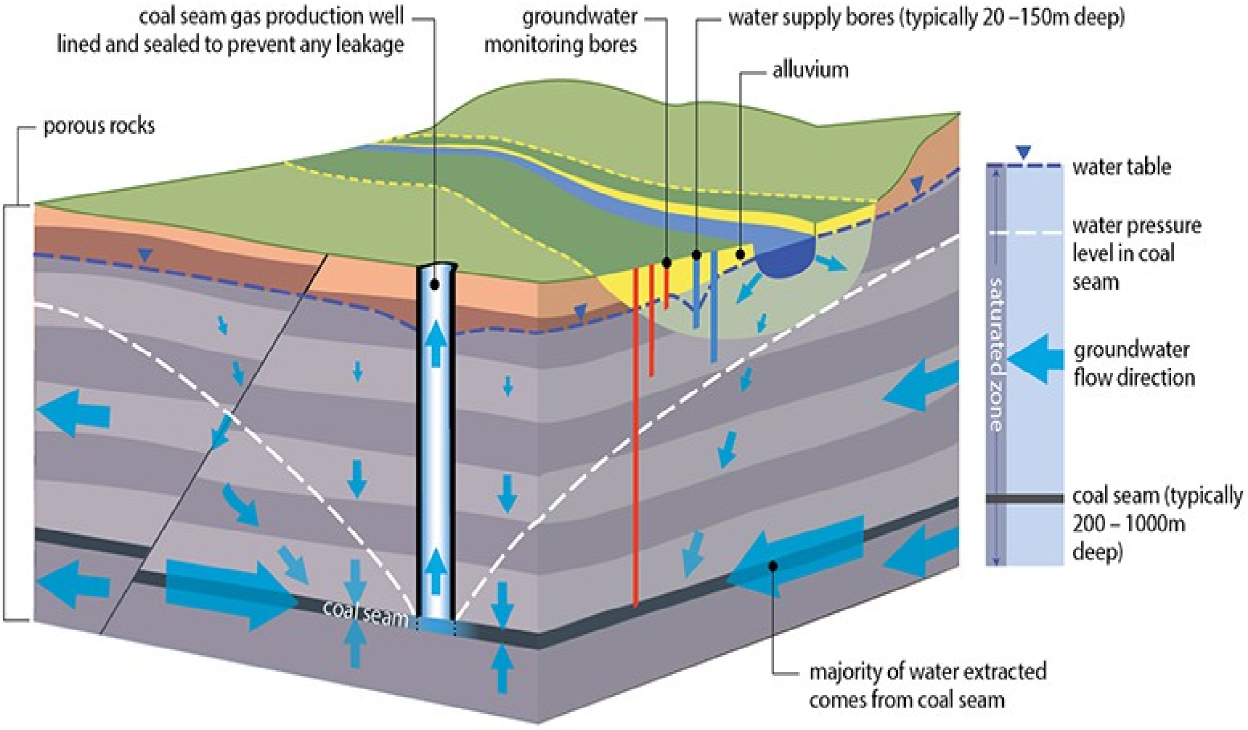
Supporting information

energy-pedia News, 22 Dec 2009

Eastern Star Gas, as operator of the ***Narrabri Coal Seam Gas Project***, has announced gas production from the ***Bibblewindi West*** tri-lateral production pilot is now in excess of 2.0 million standard cubic feet per day. Water production from the pilot continues at approximately **3500 barrels *(417,341 L)* per day** with in excess of **550 metres of head (water) pressure** still to be removed.

Due to the massive reduction in the head of water pressure above the coal seam, huge volumes of water within the ground table will be drawn down as the de-watering process continues. Much of this water will come from the Southern Recharge zone of the Great Artesian Basin that lies directly above the Gunnedah/Oxley Basin.

Diagram 9 - Cross section of landscape showing CSG pipe pumping water from the coal seam. Note: the direction the blue arrows are pointing, they indicate water movement flowing to the inlet pipe. As the coal seam is de-pressurised, more water moves down from the water table above creating the draw down effect (indicated by doted line).



Supporting information

Great Artesian Basin Recharge Systems and Extent of Petroleum and Gas Leases – Second Edition, March 2015

The significance of the recharge zones to the GAB is not so much as an immediate water supply to central parts of the basin and natural discharge areas, but that they provide the pressure head (or weight of water) required to drive the water to the surface.

The Southern Recharge Groundwater Source, is part of the Water Sharing Plan for the Great Artesian Basin (GAB) and is the water source from which the Narrabri Gas project will draw down the head of water pressure from, as they de-waters the underlying coal seams.

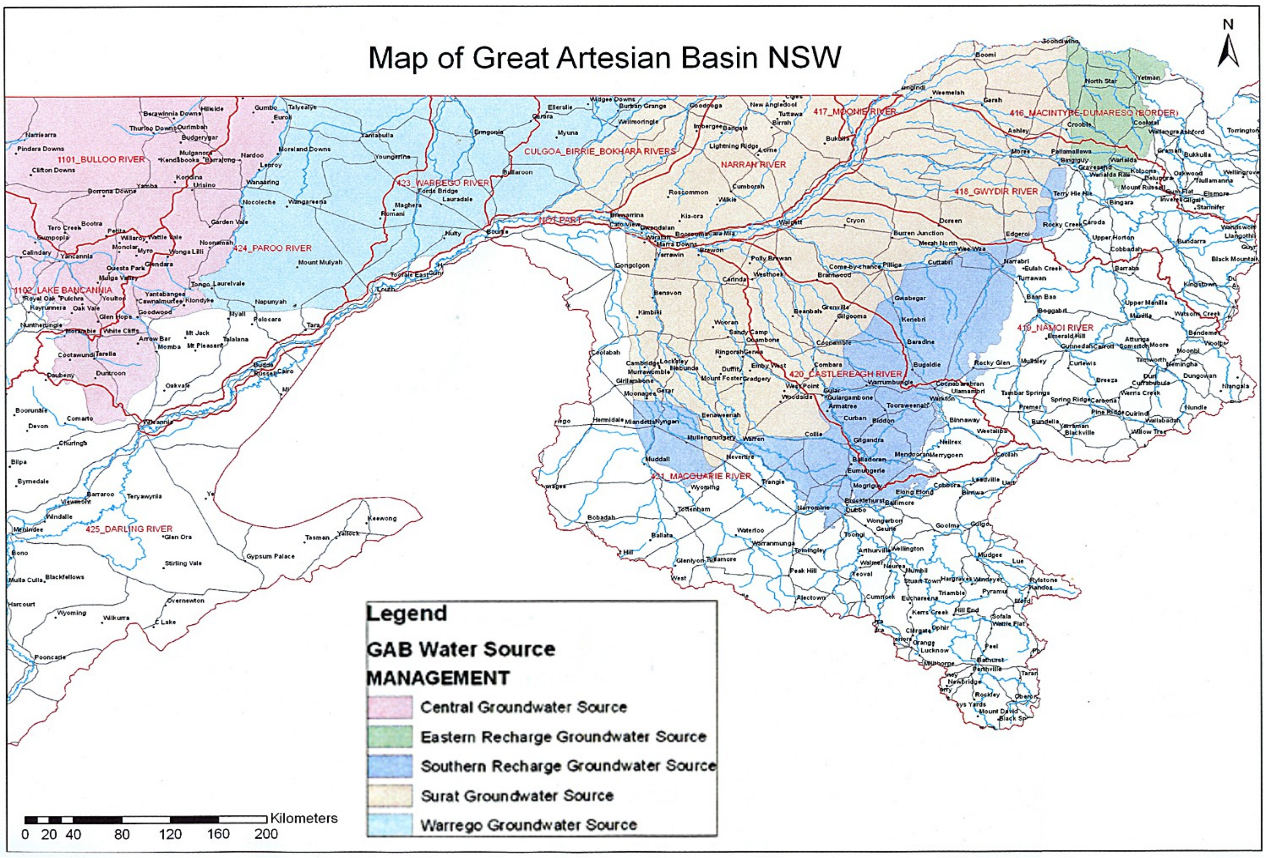
How much water goes back into the ground, on average per year, to recharge the aquifer?

Supporting information

Water Sharing Plan for the NSW Great Artesian Basin, Groundwater Sources 2008 -

The overall basis for water sharing in the Eastern Recharge and Southern Recharge Groundwater Sources is the long-term average annual net recharge to the respective groundwater source which are estimated to be as follows: a) 19,000 ML/year for the Eastern Recharge and (b) 42,400 ML/year for the Southern Recharge Groundwater Source.

Diagram 10 – Map of the NSW GAB ground water source management zones. The Billarrga sites within the Southern Recharge Zone (darker blue shaded area) and takes up around half of the land area within that zone.



As stated in the Disclosure 1, there are no impermeable layers of rock to disconnect strata layers within the aquifer system. Water, driven by extreme pressures, is free to move throughout the entire geological structure. How much of the estimated 46,750 ML per year of water being extracted from the coal seams beneath the Great Artesian Basin, will in fact be water drawn down from the Southern Recharge water source above?

What results from an extra 46,750 ML of water per year being extracted from the ground water system beneath the Billarrga, with predicted draw downs of 1000m. With only an annual recharge of 42,400ML for the entire Eastern Porous Rock Recharge zone and already fully allocated water take, the impacts on the head of pressure driving the groundwater flows within the GAB will be disastrous.

Supporting information

Great Artesian Basin Recharge Systems and Extent of Petroleum and Gas Leases – Second Edition, March 2015

Draw downs of many hundreds of metres are reported in Ransley and Smerdon (2012) for the northern Surat basin coal seam gas field where coal seams are being de watered to release gas.

Draw downs of in excess of 1000m are proposed in the pillage in the south eastern Surat Basin (ICSG Forum, 2014).

De-pressurising the coal seam changes the way water flows under the ground.

Pressure imbalances are what drives ground water flows and water will always move from an area of high pressure to an area of low pressure. The greater the pressure difference the faster the water will flow and the more easily it will be pushed through fine pore spaces.

Currently when recharge water enters the sandstone aquifer from the Billarrga, it fills the intake zone and increases the head of pressure. The weight of this water pushes down on the underlying water within the layered strata and increases flow to the lower exit points (springs and bores).

In order for this head of pressure to exist it needs to be sitting above already pressurised aquifers!

When Santos pump out the water from the underlying coal seam, a dramatic change occurs in pressure variations within the aquifer system. Because the coal deposits lay below the GAB, when the water pressure is reduced, water within the upper rock strata begins flowing from the high pressurised aquifers to the low pressurised coal seams.

As Santos continue to draw water out of the coal seam, the aquifers above drain down to equalise the water pressure difference. As this continues over many years the water level within the upper aquifer will drop dramatically. This will also cause surface ground tables to drain into the now de-pressurised upper aquifer.

The depletion of the pressure heads of the GAB, particularly in the main recharge zones, where both the Northern Surat Gas field's and the Narrabri Gas fields are located, will trigger dramatic changes to the landscape hydrology.

The water table is the head of pressure that drives the underground water flows. With the current draw downs of hundreds of meters in the Northern Surat Gas field's and the predicted draw downs of 1000m in the Narrabri Gas Project, the impacts on springs and bores all over this country will see many more streams and rivers stop flowing and ground water dependant ecosystems disappear.

Supporting information

Great Artesian Basin Recharge Systems and Extent of Petroleum and Gas Leases – Second Edition, March 2015

Both of the Pilliga and the northern Surat gas field or license areas occur in the very limited critical recharge (greater than 30mm per year) area of the GAB.

Excessive draw down of pressure heads in the recharge zones of the GAB associated with gas extraction, has the potential to reduce pressure heads on artesian waters across much of the GAB, and potentially stopping the free flow of water to the surface at springs and bores.

We cannot de pressurise the coal seams without dramatically altering the entire ground water system and the resulting surface water systems!

Devastating Climate change will be triggered – desertification, & catastrophic fire

The climate is intimately linked with the ground water, and its the plants that maintain that connection. Forests tap ground water through their roots and transpire that water out through their leaves and into the atmosphere, creating humidity over the landscape. This moist air facilitates the movement of low pressure systems inland off the ocean, bringing moist rising air and more regular, less extreme rain fall to the west.

If we lose our ground tables and experience the resulting loss of humidity above the landscape, low pressure systems will not easily build inland of the high country and we will effectively create a rain shadow along the length of the Great Dividing Range.

Fire will reach its peak of devastation and catastrophic fire conditions will become the norm. Desertification will be triggered on a mass scale and natural environments, farmlands and entire communities would soon disappear from inland Australia.

'Water Is Life'

Disclosure 3 – TOXIC WATER.

Let me take you back to Disclosure 1, where it was stated that hundreds of millions of years of salts and toxins, including heavy metals, volatile organic compounds and radioactive particles, have been filtered and locked away within the coal seams. The enormous amounts held in place is directly due to the enormous water pressures holding them in place.

When Santos de-pressurise the coal seam to release the gas, they also release the salts and toxins. Millions of years of waste products disassociate from there carbon bonds and dissolve back into the water. This water is then pumped to the surface and becomes the waste product the CSG industry call produced water.

With a shift in pressure and salt gradients, a mass movement occurs and water will flow from the high pressurised aquifers to the de-pressurised coal seam. The gases, dissolved salts, toxins and radioactivity will then migrate from the coal seam into the sandstone aquifers.

What salts and toxins they don't pump to the surface in their produced water will escape into our ground water system and eventually find its way to the surface through springs and bores. Methane and other toxic gasses will find their way to the surface via the myriad of cracks present within the highly fractured rock strata beneath the Billarrga.

Supporting information

The Land, May 22, 2015

Among the litany of demands, the NSW Environment Protection Authority wants to know what Santos plans to do with the **expected 500,000 litres of brine produced daily** from the Narrabri Gas Project, which had the potential to exhaust storage capacity after three years of the five-year venture.

The Department of Primary Industries also raised concerns about the "high risk of having **significant adverse impacts and potential loss" of agricultural capacity from the use of treated CSG water for irrigation.**

Santos's Leewood CSG Waste Water Facility would only have the capacity to filter, via reverse osmosis, 1ML (1,000,000L) of produced water per day. At full production (850 wells) the Narrabri Gas Project is estimated to average 127.5ML (127,500,000L) of water take per day, and up to 5 times higher during the initial de-pressurisation phase.

What does Santos propose to do with the excess 126,500,000 L of extremely toxic water that they will produce on average per day for the life of the Narrabri Gas Project?

Supporting information

Background paper on produced water and solids in relation to coal seam gas production
Report prepared for the NSW office of Chief Scientist and Engineer
Macquarie University, October 2013

Environmental Risks
a. Surface water pollution
Spills from pipes and containment structures are a key risk for the CSG industry. Depending on its location and magnitude, a produced water spill has the potential to sterilise soil and affect vegetation (such as occurred in the Pilliga incidents, as reported by Golder Associates 2012 – refer to Chapter 6); if the spilled produced water enters a watercourse it may have ecological impacts on downstream aquatic systems. The high salt and metal concentrations of produced water may result in cytotoxic responses. While ecotoxicity may not have occurred in the Talinga incident in the Condamine River (refer to Chapter 6) it may be possible

through recurring or larger spills. Soil contamination may persist for many years, and watercourse contamination may persist for months.

For CSG projects that rely on the surface disposal (e.g. through irrigation) of their produced water, the resultant increase in salinity and impacts caused by other contaminants may lead to the impairment or complete breakdown of ecosystem function. From an agricultural perspective, such an impairment or breakdown could affect the long-term capacity of the soil to sustain productivity.

b. Groundwater contamination
The contamination of aquifers from produced water is one of the greatest long-term concerns associated with CSG and shale gas projects. The risk is real for shale gas, as shown by the contamination of groundwater, including drinking-water supplies, in Dimock, Pennsylvania, and Pavillion, Wyoming. The shale gas reserves in the United States are typically deeper and harder than the coal seams under exploration and production in NSW, requiring greater amounts of water and pressure to hydraulically fracture the shale seam. The shallower depths between the coal seams and aquifers used for drinking and agriculture in NSW may mean there is greater potential for the vertical migration of produced water through cracks, faults and wells, notwithstanding water and energy requirements for hydraulic fracturing, and consequently a higher risk of contamination.

As reported in Chapter 6, naturally occurring BTEX chemicals were found in groundwater aquifers at the Moranbah and Dalby CSG operations in Qld, highlighting the need to consider 'natural' pollution and the possible contamination that may occur if such groundwater is released.

Change in near-surface aquifer water chemistry as a consequence of contamination by gases and produced water derived from deeper strata can also affect groundwater systems. For example, methane has low solubility (26 mg/L at 1 atm, 20 °C) and can seep through cracks, faults and wells into groundwater systems. It can be oxidized by bacteria, resulting in anoxic conditions that, in turn, can increase the solubility of arsenic and iron and reduce sulfate to sulfide, causing water-quality problems. In extreme cases, the methane can explode if concentrations exceed 10 mg/L (Révész et al. 2010). The fate of chemicals used in well construction and maintenance and in hydraulic fracturing may also have environmental consequences (refer to Chapter 8).

c. Groundwater security
Uncertainties about groundwater plumes dynamics (Chadwick et al. 2005) and their contribution to the contamination of aquifers is an important consideration in CSG projects, particularly where the injection of produced water is proposed as a disposal option. Environmentally, long-term changes may affect the quality and quantity of groundwater aquifers, springs, hanging swamps and surfacewater systems.

For regions and activities that rely on groundwater as their principal water source or as a back-up during drought, the additional impacts of water extraction and injection due to CSG may have broader and longer-term consequences. Such consequences can affect the security and reliability of water supply for drinking water, agriculture and other energy and mining projects, including electricity generation, open-cut and underground coal mining and other mineral extraction.
CSG is an emerging industry that has also been identified as playing a key role in the state's energy security. Therefore, aquifer security, both spatially (local and regional) and temporally (years to hundreds of years), must be a foremost consideration in strategic planning, approval and monitoring.

Health risks
Produced water contains a range of chemicals that can have health consequences if they contaminate drinking-water supplies. Once a groundwater aquifer is contaminated, it can be many years before a safety declaration can be made based on intense monitoring and evaluation by an independent regulator. In the meantime, a back-up water supply must be provided for drinking or agricultural purposes. The presence of

elevated methane and other fugitive gases in drinking-water wells within 1 km of gas wells (Jackson et al. 2013b) or in the atmosphere within several kilometres of gas wells (Tait et al. 2013) is evidence of contamination. Whether the presence of water-borne gases is a precursor to other water contaminants remains uncertain. From a worst-case and risk perspective, this is an aspect of the unconventional gas sector (both on shale and coal) that demands close monitoring.

Where produced water is used for irrigation, there exists a risk of the bio-accumulation of certain contaminants in cereal crops and stock, which may affect human health. Characterising the chemical composition of produced water, and how this may change during treatment and disposal, will assist the assessment of risk.

A variety of chemicals have been used in hydraulic fracturing, many with known health risks. Of 353 chemicals used in the United States for hydraulic fracturing, 75% could affect human skin, eyes and other sensory organs and the respiratory and gastrointestinal systems, 40–50% could affect the brain/nervous system, immune and cardiovascular systems and kidneys, 37% could affect the endocrine system, and 25% could cause cancer and mutations (Colborn et al;. 2011).

Moral and legal ethics would dictate that such enormous impacts on Australia’s water security and food security would demand immediate action from our government and authorities. The loss of affordable and reliable clean water would have far reaching impacts on our future economic prosperity.

The continued gross miss-management of our natural resources and the utter disregard for economic, social and environmental sustainability has lead all Australians to the brink. It literally is '**now or never'** if we are to avoid disaster and create positive change for our children and grand children’s future.

Finally, I would like to speak for MOTHER. Our connection to land is sacred and the destruction of the landscape is our greatest shame. **We must protect the water!**

'Cooperation Is The Key'

Researched and written by Ian Sutton

on behalf of the Pilliga Push Camp

'United We Stand'

#pilligapush