LOCK THE GATE ALLIANCE
AUSTRALIANS WORKING TOGETHER TO PROTECT OUR LAND, WATER, AND FUTURE

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Submission: Narrabri Gas Project

Thank you for the opportunity to respond to the Environmental Impact Statement for this project.

Lock the Gate Alliance objects to this project and finds the EIS to be riddled with holes and out-dated information. It is not acceptable that a project of this scale and impact should be the subject of an EIS that contains information that is three years old, and in many cases, fails to provide adequate information at all.

This proposal for an 850 well CSG production field near Narrabri is the largest development project that we are aware of ever being assessed under the *Environmental Planning and Assessment Act 1979*. The scale of what is proposed and the impacts that it will inflict are greater than anything previously considered under this legislation.

The area of the project on the surface covers 950km^2. This is three times the size of Penrith council area. It's more than four times the size of the only other two CSG production fields approved in NSW, the Camden gasfield, with 114 wells over 213km^2 and Stage 1 of the Gloucester gas project, approved for 110 wells over 50km^2, which AGL has since announced will not proceed.

We are deeply concerned that the current regulatory settings are not capable of properly weighing up the severity, extent and duration of this project across time and space.

There are serious questions of inter-generational equity that are scarcely touched upon in the EIS for this project that require the serious attention of the NSW Government. The substantial risk of drawdown or contamination of productive aquifers that supply whole communities and industries, the risk of mobilising large volumes of a potent greenhouse gas that once released will not be able to be controlled, the considerable risk of burying in unknown locations large volumes of salt with unknown chemical composition – all of these are burdens this industrial gasfield development proposes to leave for future generations, with profound and irreversible consequences.

The case that such risks and consequences must be taken is not made in the EIS presented by Santos. On the evidence available, even with the extensive inadequacies of the EIS, this project must be refused consent by the NSW Government and measures put in place to protect the recharge areas of the Great Artesian Basin permanently.

Summary of recommendations and objections

Incomplete and inadequate Environmental Impact Statement

- It is not acceptable or possible for adequate assessment of this gasfield to be undertaken without a spatial layout of the infrastructure being provided. This is crucial for understanding and describing the air quality, noise, water and biodiversity impacts the gasfield will have.
- The field protocol is not provided, nor described in detail. Those aspects of the field protocol that are described are patently inadequate.
- There are deficiencies in the data collection and analysis in a range of areas, notably groundwater, surface water quality, cultural heritage, migratory methane and fauna surveys.
- The EIS effaces mounting evidence that migratory and fugitive emissions of methane from unconventional gas development in particular have been dramatically under-estimated. We provide for the Department's consideration a recent report on the risk of migratory and fugitive methane emissions from unconventional gas as Appendix B.

Justification and economics

- There is no economic or strategic justification for this project. The economic information provided in Appendix was prepared three years ago. The market and forecast for domestic and international gas has fundamentally changed since that time.
- Santos provides no evidence to support the claim that this project will reduce gas prices on the east coast.
- On the contrary, there is evidence that the high price being demanded for gas in New South Wales now is not going to be alleviated by introducing a high cost low-yield unconventional gasfield that requires a new pipeline to be constructed and is being proposed by the very company at the centre of the current crisis.
- With production costs for this area previously estimated to be comparatively very high, the flow-on economic effects of this development must be rigorously scrutinised.
- The damaging impact that coal seam gas production has had on regional economies in Queensland indicates that this project poses considerable risk to the agricultural enterprises that are currently the economic lifeblood of the Narrabri Shire and surrounding areas. The extent of this risk, from high labour costs and competition to lost or contaminated water is not adequately addressed in the EIS.

Water and waste

- The large volume of water consumption drawdown risk created by this gasfield make it clearly unacceptable in a region that is depended on groundwater for town supplies and agriculture.
- Water loss from the Pilliga Sandstone amounts to nearly three-quarters of the total groundwater moved as a result of this project. The delayed onset of this impact and its excessive duration over many generations presents a significant challenge for NSW public agencies in properly understanding and assessing implications of this gasfield for intergenerational equity. There is no serious attempt to do this in the EIS and that is not acceptable.
- Bringing hundreds of thousands of tonnes of salt to the surface is irresponsible and unacceptable. There is no information provided in the EIS about the final destination of this dangerous waste product.
- There is a basic lack of data on the hydraulic head measurements prior to the development proceeding. This will make any landholder's attempt to secure "make good" actions from Santos next to impossible and is unacceptable.
- The EIS should provide detailed chemical characterisation of produced waters sampled during gas exploration, discussion of potential pathways for contamination and discussion and

assessment of risk and mitigation strategies. The information provided in the EIS lacks detail and critical supporting data commensurate with the significance of the risk.

- In light of the expert water reviews provided by the North West Alliance, we recommend substantial additional work be undertaken by the proponent, given the significance and severity of the risks involved:
    - At least two years of baseline monitoring of the Gunnedah-Oxley Basin hydrostratigraphic units must be conducted, using the Water Monitoring Plan monitoring bores.
    - At least two years of baseline data must be collected for the Great Artesian Basin hydrostratigraphic units, and any spatial gaps must be addressed.
    - A comprehensive baseline water quality testing regime must be conducted for at least two years, across all relevant units, that measures a systematic suite of key parameters and potential contaminants, including methane, hydrogen sulphide and uranium and other radionuclides.
    - The hydraulic conductivity of all apparent aquitards must be thoroughly determined.
    - Field-based techniques must be used to study and authoritatively assess the recharge processes and rates of the Pilliga Sandstone GAB recharge area.
    - An improved numerical model must be used, incorporating all of the above data, and then run to produce a 'worst case scenario' of potential groundwater drawdown.
    - There must be a thorough baseline microbiological characterisation of all relevant water sources.
    - Detailed life-cycle risk assessment and monitoring plans must be provided to detect and isolate contamination from structures storing and transmitting produced water.
    - Chemical assays, analyses and hazard assessments must be provided of waste brine materials
    - Baseline information on the chemical composition of produced water from the target coal seams must be collected.
    - Full disclosure must be provided on exactly where CSG wells will be drilled, and where pipelines for gas and produced water will be constructed.
    - Time-series data must be provided showing any trends in groundwater chemistry/quality through time at individual sites, or any maps showing spatial trends in groundwater quality through the region.
    - The monitoring network recommended by Dr Matthew Currell should be implemented in order to rapidly detect shallow groundwater contamination incidents resulting from produced water spills and leaks in the project area.

Social, air pollution and health

- The air quality impact of this project have not been assessed in accordance with NSW regulation. The $PM_{2.5}$ assessment is missing, and there is no adequate assessment of ozone, methane and other air pollutants known to be released by this industry.
- The social impact assessment is three years old. The gasfield must be assessed against the new social impact assessment guidelines prepared by the Department.
- The EIS claims to include a Health Impact Assessment but does nothing of the sort. There is barely even a literature review of the mounting evidence that unconventional gas has a range of deleterious health impacts associated with it.
- The Environmental Impact Statement is glib about the greenhouse and climate change contribution of gas, particularly unconventional gas and puts New South Wales at significant

risk of opening up large and uncontrolled fugitive emissions of methane directly to the atmosphere. We attach a recent report highlighting this risk for your consideration.

- The unknown quantum of methane migration and fugitive emissions into wells, bores, fractures, soils and the atmosphere presents a profound inter-generational challenge. For handful of short-term jobs, huge volumes of greenhouse gases will be mobilised that will continue affecting Australians for generations to come. There is no serious attempt to address and analyse this impact in the EIS.

Risk & insurance

- The Chief Scientist's Report recommended in 2014 that the Government consider a robust and comprehensive policy of appropriate insurance and environmental risk coverage of the CSG industry to ensure financial protection short and long term, including security deposits, enhancd insurance arrangements and an environmental rehabilitation fund.
- These recommendations have not been implemented and any decision now to approve a production CSG gasfield puts landholders and the public in the invidious position of carrying uncertain and potentially very high risk environmentally and financially.
- In the immediate term, comprehensive environmental insurance can be mandated by current legislative frameworks as conditions of consent and approval under the EP&A Act, the PO Act and the POEO Act and that must be done for this project.
- Beyond the risks to landholders and the statutory framework for rehabilitation securities, the proposal for an environmental rehabilitation fund made by the chief Scientist is similar to the long-term environmental harm mechanism identified as necessary recently by the NSW Audit Office in its review of the adequacy of mining rehabilitation security deposits and to the "future fund" proposed by Narrabri Shire Council to provide funds to deal with major future groundwater harm caused by this gasfield.
- EIS should be revised to address the Secretary's Environmental Assessment Requirement that it assess whether contingency plans are necessary to manage residual risk.
- All relevant Material Safety Datasheets and Operational Plans should be required to be made available by Santos and their agents and sub-contractors to the Department of Planning for publication prior to any project determination.
- MLA Guidelines should be consulted to determine banned chemicals compounds that cannot be used on livestock producing land and/or native habitat that could enter the food chain. Banned chemical compounds that could enter the food chain must be excluded from use in the CSG industry.

Biodiversity

- An industrial gasfield is not an appropriate land use in the nationally significant Pilliga forest.
- Attachment C to this submission is a report prepared for the Northern Inland Council for the Environment on the national significance of the Pilliga. It provide substantial additional information about the biodiversity significance and vulnerability of the area not included in the EIS and raises the concern that the future expanded development of coal seam gas extraction has the capacity to further impact on matters of national environmental significance under the EPBC Act, "and result in extinctions of local populations."
- The ecological impact assessment has failed to accurately or adequately quantify the cumulative impacts many of these species have suffered due to recent clearing for other resource projects in the region.

- The very marginal status of the Koala population in the Pilliga, once one of the largest in New South Wales, is cause for profound concern and hardly rates a mention in the EIS, except as an excuse to fragment, clear and degrade remaining koala habitat in this part of the Pilliga given that they are now, so rare.
- The results of the proponent's surveys indicate that the Koala population in the Pilliga "has declined substantially." This is an issue of profound concern, given the species' vulnerable status. Any koala habitat in the Pilliga being cleared and industrialised given the tenuous status of the entire population, could be hastening its local extinction.

Cultural heritage

- The Pilliga is a hugely significant place for Gomeroi people culturally and spiritually.
- We believe that decisions about the protection and management of Aboriginal cultural heritage should be in the control of Gomeroi people and urge the Department of Planning to ensure that there is free and informed consent by Gomeroi people in decisions about the management of the Pilliga.

Justification and context

Given the very severe and wide-ranging risks associated with introducing coal seam gas production to Narrabri, the purported justification and strategic context for this project will be crucial to the Department's evaluation of it. The decision in February 2014 to declare Narrabri CSG a "strategic energy project" was based on an evaluation of the gas market and its future at that time which has since been superceded. In general, the information presented about justification, gas market context and economics in this Environmental Impact Statement is outdated and meagre, and we urge the Department of Planning to review independent analysis of the gas market and options for demand management into the future that present a wiser and more efficient approach that the high cost-high risk and low-yield coal seam gasfield proposal being put forward with this EIS.

New analysis released in May 2017 shows that the 2018 shortfall predicted in gas supply by the Australian Energy Market Operator in March 2017 effectively vanished just eleven days later in an updated forecast. We append this report *Short-lived Shortfall* as Appendix A. The report found that:

- Increased gas prices are not a result of a shortage but due to gas companies exporting much of their gas.
- Wind and solar PV are cheaper forms of bulk energy than combined cycle gas turbines, and in some cases, the cost even of new-build renewable energy and storage is cheaper than generating electricity at existing gas power stations.
- Storage technologies are now competitive with open cycle gas turbines in providing flexible capacity.

There is severe economic stress being inflicted on New South Wales manufacturing and energy as a result of the gas price hikes that Santos and other companies set out to achieve when they initiated coal seam gas to LNG exports in Queensland. The high price being demanded for gas in New South Wales now is not going to be alleviated by introducing a high cost low-yield unconventional gasfield that requires a new pipeline to be constructed and is being proposed by the very company at the centre of the current crisis. Any assertion that this project will bring down the cost of gas must be

rigourously and independently tested by the Government as it is contrary to the evidence now available to us.

The repeated statement in the EIS that "The Narrabri Gas Project can produce sufficient gas to meet up to half of NSW's natural gas demand" is key to the Environmental Impact Statement's case that the risks this project poses to water, health and communities are justified. And yet, this statement is several years old and there is no attempt in the EIS to situate the project in the current context of the east coast gas market and its price and transparency challenges. Domestic demand for gas is falling, as is electricity demand.

The proponent describes how export demand "is effectively 'locked in' by long-term contracts between liquefied natural gas suppliers and their customers," and notes that the volume tied up in these export arrangements exceeds total domestic consumption in eastern Australia. It more than exceeds it. The 1.4 million terajoules cited by the proponent as being exported from Gladstone is more than twice the 581,000 TJ cited as the *total* size of the east coast gas market. According to Geosciences Australia, the amount of gas expected to be produced at Narrabri is 73,000TJ per annum for 25 years.[1]

Santos quotes estimates by Manufacturing Australia in 2013 that the nation-wide manufacturing industry "will be exposed to $29 billion in lost value in the event of significant increases in the price of gas" (3-3). This price rise has already begun and is the direct result of Santos' own CSG to LNG experiment in southern Queensland and was in fact the strategic objective of opening up LNG exports – to raise the price of gas domestically. Similarly, Santos cite NSW Council of Social Services submission highlighting that escalations in utility prices have caused some families to forego other essentials in order to pay utility bills.

There is no debate about this. The cause of rising gas prices has been the onset of LNG exports from Queensland, coupled with the high cost of production and low yield from coal seam gas, such as Santos is now proposing in Narrabri. The chart provided by Santos bears this out. The price of gas in Queensland last year, where CSG has been rolled out, was over $10/GJ, compared to $8/GJ average on the east coast and under $6/GJ in Victoria, where conventional gas is produced.

The demand projections used by Santos in its EIS show gas demand falling in NSW out to 2020 and then increasing again. These forecasts are volatile and unreliable. The graph shows that 24 percent of NSW demand comes from gas fired power stations, forecast to reduce significantly and then start growing again. Santos admit that industrial demand for gas in NSW has declined by 13% since 2010. Again, this is directly attributable to the activities of the proponent and other gas companies in Queensland, over-committing LNG contracts on CSG supply that has been disappointing.

Santos states, "Gas prices in the eastern Australian has market have been increasing in recent years and may rise further due to uncertainty over the development of future gas projects." This is not accurate. Indeed, Santos later contradicts this statement, admitting that gas price rises "occurred when it was announced that the east coast gas market would be opened up, thereby exposing it to international as prices. This linkage, plus the ever increasing cost of exploring and developing more challenging gas deposits has resulted in a significant increase in price and a subsequent reduction in available, uncontracted supply over the last five years" (3-5). As the graph provided demonstrates,

[1] see Geosciences Australia November 2014 "Upstream Petroleum and Resources Working Group Report to COAG Energy Council on Unconventional Reserves, Resources, Production, Forecasts and Drilling Rates" http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/Unconventional%20Reserves%20Resources%20Production%20Forecasts%20and%20Drilling%20Rates%202014_0.pdf

the gas price was stable and low until the onset of CSG and LNG exports in Queensland. Coal seam gas has raised the price of gas in three ways. Firstly, Santos and other gas companies initiated LNG exports from Gladstone, thereby linking the east coast gas market to the world market and sharply driving up the price. Second, CSG is expensive to produce, the costs are significantly higher than for conventional sources. Estimates by independent consultants put Narrabri CSG as almost the highest cost gas to produce in eastern Australia.[2] Thirdly, CSG is far lower yielding than conventional gas. There are significant losses and uncertainty over flows.

The EIS claims that "Only an increase in supply, especially for projects that are located near domestic demand centres, can assist putting downward pressure on prices." But there is no modelling or data presented to support this assertion and plenty of evidence that it is not the case.

It is fair to say that the Environmental Impact Statements presented by the proponents of the Queensland LNG projects, including Santos, did not accurately predict or describe the economic turmoil now being experienced in the wake of the CSG to LNG experiment. There has been considerable unforeseen economic upheaval. The CSIRO has estimated there has been a loss of 1.3 agriculture jobs for every gas job created. In the aftermath of CSG in Queensland, towns like Chinchilla are struggling just a few short years in, make good agreements are not finalised, companies are going back to regulatory authorities for approval for expansion projects, salt disposal is still not dealt with, offsets not yet finalised.

Field protocol approach

Rather than providing specific information about where Santos intends to place it 850 production wells, the company outlines a "field protocol" for siting wells post-approval, which it says will be amended to reflect conditions of consent.

It is fair to say that the proposed exclusion zones for this protocol barely if at all stem beyond the barest statutory minimum that would be required of Santos anyway. The first eight steps of the process outlined in the Field Development Protocol in Figure 5-1 should all have been undertaken as part of this EIS and subject to the scrutiny and feedback of the public and the agencies with statutory responsibility for the values being degraded by this gasfield.

Specifically, we see no impediment to the following elements being prepared and exhibited to the public and the agencies as part of the EIS process:

- desktop review,
- mapping constraints,
- developing initial conceptual design by overlying the constraints with the gas resource and then setting out optimal placement of infrastructure,
- reviewing the proposed infrastructure locations relative to the ecological sensitivity maps,
- reconciliation of potential disturbance of each development stage against the predicted cumulative disturbance calculations,

[2] see Core Energy's analysis Gas Production and Transmission Costs, prepared for AEMO, February 2015 https://www.aemo.com.au/-/media/Files/Gas/National_Planning_and_Forecasting/GSOO/2015/Core--Gas-Production-and-Transmission-Costs.pdf

All of these processes are described as being work that will be done in the future, but all of it is work that can and should have been done and presented in the EIS for the agencies and the public to review and comment on. The EIS presents and outline of a process for environmental assessment and project design, but this is precisely what an EIS is required, by law, in NSW to present.

So, we have the proponent's expectation that this process "will result in the majority of the well pads being located outside of high and moderate high ecological sensitivity classes" but no specific information that allows us to interrogate and review this. This is not acceptable.

The process they outline places "significant" endangered fauna habitat at the bottom of the priority list. The only habitat feature specifically listed and prioritised is hollow bearing trees, prioritised by size class, but other features, like rocky outcrops, soaks, stags are not included.

The last step in Santos' proposed protocol is to prepare and submit a "Plan of Operations" to the Department of Planning and the Federal Department of Environment and Energy. It is unacceptable that the majority of the work to be done to understand the actual impact of this project, its mitigation measures and design in the landscape is set for a future time once a consent is granted.

This Environmental Impact Statement is the public's opportunity to input into the design of the project, understand its impacts and make our views known about the balance of considerations that inform the decision to grant or refuse consent. Santos is locking the public out of this process, seeking to obscure public understanding of the nature of the impact of the gasfield by deferring accurate and detailed designing, assessment and planning of it to a later date, post-approval.

Santos provide a figure (7-1) mapping the ecological sensitivity classes. Though the scale is coarse, it is clear from this map that there are large portions of the proposed project area with areas of high and moderate-high sensitivity in the eastern and southern parts of the proposed project area. Thee high sensitivity areas are not scattered evenly throughout the forest, which would pose a challenge for planning and design, but are concentrated, presenting Santos with the opportunity to avoid putting wells, processes and associated infrastructure in these areas. They have not taken this opportunity.

Water resources

The EIS does deal with the significant risk that this project poses to groundwater and the thriving agricultural industries that rely on it. This risk primarily comes in the form of draw down and loss of water and pressure in productive aquifers, particularly the GAB, and in the risk of groundwater contamination either as a result of surface spills or well failure. Data is available about the rate of well failures leaks and spills and yet this very serious risk is hardly canvassed at all in the EIS.

A number of independent experts have reviewed the ground water and surface water components of the EIS for the North West Alliance. In light of those reviews, we conclude that:

1. The potential impacts on water resources (quality and volume) are very significant and unacceptable, both in terms of aquifer drawdown and contamination
2. The baseline datasets on which the EIS is based are demonstrably inadequate
3. The assessment of risks by Santos is flawed and fails the precautionary principle
4. The proposed project poses a major threat to intergenerational equity and rights to water

We contend that the Narrabri Gas Project represents a serious intergenerational threat to north-west New South Wales, given the short life of coal seam gas operations and the crucial importance of clean and abundant groundwater to agriculture and regional communities.

The major findings by the reviewers are that:

1. The Santos EIS fails to meet the NSW Secretary's Environment Assessment Requirements for the Narrabri Gas Project, because it has not established a groundwater baseline dataset incorporating 'typical temporal and spatial variations'.
2. The numerical groundwater model is not fit for purpose and cannot make reliable predictions of the long-term drawdown to beneficial aquifers due to CSG dewatering.
3. Santos has provided an inadequate and misleading groundwater baseline water quality dataset for formations which are considered very important in protecting GAB high value aquifers.
4. Santos cannot effectively predict the effects of CSG dewatering in the key portion of the GAB recharge area, because they do not have monitoring data representing drought periods.
5. The model is based on inadequate hydraulic properties and very limited data representing the deeper groundwater system (Jurassic, Triassic and upper Permian).
6. The groundwater model fails to provide a 'worst case scenario' showing what may happen to beneficial aquifers if modelling variables, and particularly hydraulic conductivity, are changed.
7. There is no baseline water table dataset against which to measure the Water Monitoring Plan for the Bohena alluvium.
8. The risks associated with waste water contamination are highly significant due to the unusually poor quality of the produced water and the unusually high quality of the shallow groundwater and surface water.
9. The EIS fails to properly acknowledge the outstanding national significance of the Pilliga Sandstone GAB aquifer, or to conduct any field study of recharge processes or rates of recharge
10. Using spill rates recorded in the US, up to 130 spills of wastewater could be expected to occur as a result of the project if 850 wells are drilled.
11. If spillage and leakage of wastewater occurs at rates that are standard for unconventional gas globally, it could threaten the viability of the aquifer as a potable water source as well as the long-term quality of the GAB recharge.
12. The baseline water quality data is demonstrably inadequate, and excludes key contaminant risks such as methane and uranium and other radionuclides, as well as lacking microbiological characterisation.
13. Groundwater quality baseline data does not constitute a rigorous baseline due to low number of bores in each aquifer, inadequate geographical spread
14. The risks of methane contamination are barely canvassed and the risks of spills and leakages on water resources are barely considered in the EIS.

In light of these glaring failures, we recommend that the following further work must be conducted before the Department of Planning and Environment allows Santos to proceed any further in the planning process:

1. At least two years of baseline monitoring of the Gunnedah-Oxley Basin hydrostratigraphic units must be conducted, using the Water Monitoring Plan monitoring bores.
2. At least two years of baseline data must be collected for the Great Artesian Basin hydrostratigraphic units, and any spatial gaps must be addressed.

3. A comprehensive baseline water quality testing regime must be conducted for at least two years, across all relevant units, that measures a systematic suite of key parameters and potential contaminants, including methane, hydrogen sulphide and uranium and other radionuclides.
4. The hydraulic conductivity of all apparent aquitards must be thoroughly determined.
5. Field-based techniques must be used to study and authoritatively assess the recharge processes and rates of the Pilliga Sandstone GAB recharge area.
6. An improved numerical model must be used, incorporating all of the above data, and then run to produce a 'worst case scenario' of potential groundwater drawdown.
7. There must be a thorough baseline microbiological characterisation of all relevant water sources.
8. Detailed life-cycle risk assessment and monitoring plans must be provided to detect and isolate contamination from structures storing and transmitting produced water.
9. Chemical assays, analyses and hazard assessments must be provided of waste brine materials
10. Baseline information on the chemical composition of produced water from the target coal seams must be collected.
11. Full disclosure must be provided on exactly where CSG wells will be drilled, and where pipelines for gas and produced water will be constructed.
12. Time-series data must be provided showing any trends in groundwater chemistry/quality through time at individual sites, or any maps showing spatial trends in groundwater quality through the region.
13. The monitoring network recommended by Dr Matthew Currell should be implemented in order to rapidly detect shallow groundwater contamination incidents resulting from produced water spills and leaks in the project area

Despite the demonstrable weaknesses of the Santos modelling, it still acknowledges that CSG extraction will induce flow from the Pilliga Sandstone GAB recharge and the Namoi alluvial aquifer to the coal seams below. It states that "ultimately, 37.5 gigalitres of water extracted for the project must be replenished by downward flows from overlying water sources." (11-48)

In all, the EIS shows that nearly three quarters of the 38.5 billion litres of groundwater that will be removed as a result of this project will be coming from the Great Artesian Basin. Under the high case scenario of water usage "induced storage release" from the GAB southern recharge is 120ML in the peak years 180-200 (see Table 6-25 Appendix F Part 1). In total, the high case scenario would see 65GL removed from the GAB.

Even the flawed Santos' EIS demonstrates that loss of water from the Pilliga Sandstone will occur long into the future after the gasfield has ceased operation.

The chapter on groundwater says "the project would require the extraction of approximately 37.5 gigalitres of groundwater from the Gunnedah-Oxley Basin Groundwater Source over 25 years, which is an average extraction rate of 1.5 gigalitres per year from deep groundwater sources that are hydrologically disconnected from the Namoi Alluvium." This is not accurate and is contradicted by the groundwater impact assessment provided as an appendix which clearly shows that the water removed from the Gunnedah Oxley Basin coal seams will be replenish with water from the overlying aquifers, including the Pilliga Sandstone and the Namoi alluvium.

Santos' core contention is that the loss of water from the overlying strata takes place over such a long time that it will not affect other users or groundwater dependent ecosystems. But this contention is based on the input of modelling parameters that do not present the "worst case"

scenario. If hydraulic conductivity between the coal seams and the overlying strata is greater than Santos estimate (without having data to inform their estimate) then the impact on the GAB and the alluvium could be faster and greater than predicted in the modelling. The risk that this might be the case is real and should have been addressed by Santos with additional model runs with varying parameters. The importance of these water sources cannot be overstated and a highly precautionary approach with the best data that can be obtained is called for. Santos

We note the impacts that are predicted on the highly productive aquifers are not expected to occur for more than 100 years. This means that all the risk is shifted away from Santos and on to future water users and the public. The time to reach the maximum drawdown of the Pilliga Sandstone is 200 years in the high case and 325 years in the base case (Groundwater Chapter 11-47). The impact assessment states that "Extraction of water from deep coal seams in the Gunnedah-Oxley Basin is likely to result in depressurisation and drawdown of hydraulic head that will span hundreds to several thousands of years" (Appendix F). The impact of this gasfield in spatial and temporal scale is such that the current legislative framework will struggle to deal with it. Proper and sober consideration of the risks it poses are a matter of intergenerational equity and we do not believe that Santos has been sufficiently precautionary in its assessment.

Nearly three quarters of the 38.5 billion litres of groundwater that will be removed as a result of this project will be coming from the Great Artesian Basin. That seems tiny compared to the overall size of the Basin, but the impacts will be occurring for centuries after Santos has finished removing the gas, so who will be around to rectifying the loss of pressure and water availability that might ensue?

The potential cumulative impacts have not been considered. Santos modelled only the "base case" in conjunction with the adjacent Narrabri coal mine and in that model, draw down of the Pilliga Sandstone was 1.8m and occurs in 50 years. This raises the possibility that the "high case" impact cumulatively with the Narrabri coal mine could exceed 2m draw down in the medium term. If the hydraulic connectivity parameter is underestimated and the high case of water removal eventuates, what will be the draw down effect on the Pilliga Sandstone?

No assessment of the impact of the project on bores and Santos' language is non-committal throughout. Section 7.6 of Appendix F Part 1 refers to make good provisions "that *may* be followed" (our emphasis) and these appear to only be on the table for "unanticipated consequences" The anticipated consequences for existing users bores do not appear to be outlined in the report. In the event of these unanticipated consequences, the groundwater assessment says, "Santos *may* undertaken an assessment of the bore to determine the extent to which the bore is impaired and the likelihood that the impairment has been caused by the activities of the project. If impairment of the bore is shown to be an impact of the project, Santos may enter into a make good agreement with the bore owner…" (Appendix F Part 1 7-18)

Without baseline data being collected now to establish the water and pressure levels in the bores that use the aquifers that may be affected, the commitment to make good is meaningless. Landholders will have to spend considerable time and money demonstrating that the gasfield is responsible for the water they have lost and Santos will contest their assertions and hire experts to refute them.

The EIS proposes that Santos be allowed to undertake "Managed release of treated water to Bohena Creek when the flow in the creek equals or exceeds 100ML per day." This raises the question that capacity to hold water at the site and transport it might not be sufficient. If stream flow does not reach 100ML per day, but the site has excess water to deal with, what will Santos do?

Santos proposes that the Leewood water treatment plant will have a maximum design capacity of 14ML per day at the peak of the produced water volumes, which is 50% more than expected by the modelling, presumably the base case. But it is expected produced water volumes to peak at 10ML per day 2-4 years in. If the 10ML per day is the peak of the base case, then Santos need to ensure that there is sufficient capacity to handle the high case scenario daily water peak as well. They are bringing low-quality water to the surface in an area known to provide recharge for high quality Great Artesian Basin aquifers. The risk of contamination of highly productive groundwater by way of surface spills and leaks, accident or intended discharge to waterways or well failure is not given serious consideration.

The salinity of this water 14,000 micro siemens per centimetre on *average*. Very little other information is provided about the chemical make-up of the produced water that will be brought to the surface. Given that Santos has been exploring for gas in the area, they should be able to provide the agencies and the public with a chemical analysis of the coal seam water.

There are huge volumes of salt expected to be produced by the water treatment plant. It is unclear what volume of this is intended to be stored on site at any one time. It is also unclear what the final destination of this salt will be. Santos says it will be "disposed off-site to a licenced landfill" but provides no evidence there is a landfill facility with the capacity and willingness to take these volumes of salt.

One of the greatest risks of the proposed Narrabri Gas Project is that it may lead to contamination of groundwater resources.

An expert review by Dr Matthew Currell, who is a Senior Lecturer in hydrogeology, geochemistry and groundwater modelling at RMIT, has identified glaring weaknesses in the Santos EIS assessment of water impacts.

Groundwater contamination risk identified by Matthew Currell

As Dr Matthew Currell points out in his review of the EIS, which is provided by the North West Alliance as part of its submission, Santos falsely states in the Executive Summary of the EIS that the project is "not located in a major recharge area for the Great Artesian Basin." However, Currell notes on the contrary that there is strong evidence included elsewhere in the EIS that is, "consistent with parts of the project area being a significant recharge area" for the Pilliga Sandstone which is a recognised Great Artesian Basin aquifer.

He notes that, "the project areas is one of the few major areas where the Pilliga Sandstone (a GAB aquifer) is exposed at the surface, and that previous studies of the Great Artesian Basin (E.g. Habermahl et al, 1997; Brownbill, 2000; Herczeg et al, 2008; Ransley and Smerdon, 2012), map the area as a region of recharge and subsequent north-westerly groundwater flow to the wider Great Artesian Basin." He also cites further evidence provided by the unusual freshness of the water, particularly in relation to the low chloride concentration, and the presence of "rejected recharge springs" occurring nearby which are both recognised indicators of high recharge rates.

Currell also notes that elsewhere in the EIS, (Figure 11-3 of Chapter 11 and Table 2-2 of Appendix G3) it is noted that the Pilliga Sandstone "represents a GAB recharge bed."

Not only has Santos incorrectly claimed that the site is not a major recharge area for the Great Artesian Basin, but it has dramatically under-estimated the likely recharge rate for the Pilliga Sandstone aquifer in the project area and its significance. Currell derives an estimate of recharge

volume to the Pilliga Sandstone using available data and concludes that, “This is a significant recharge volume, and higher than most of the Australian continent (see Herczeg, 2011 p.52) and most of the Great Artesian Basin (e.g., Ransley and Smerdon, 2012).”

He also notes that: “The restricted geographic areas where aquifer units are exposed at the surface and where direct groundwater recharge occurs are the hydrogeological equivalent to the ‘headwaters’ of a river catchment. In a recharge area, any impact to groundwater quality (e.g. due to CSG wastewater spills or leaks) will in the long term affect groundwater further down-gradient in the aquifer– in the case of the Narrabri Gas Project area, this means the GAB aquifers to the northwest of the project.”

Currell goes on to conclude that, “groundwater is of an unusually high quality in the Pilliga Sandstone” and that “most shallow aquifers on the Australian continent do not contain water so fresh and suitable for potable use.” We agree with Dr Currell’s conclusion that the importance of the Pilliga Sandstone as a recharge area means that it warrants additional protection, and urge the NSW government to make the area an exclusion zone for coal seam gas.

In contrast to Santos who have attempted to dismiss water risks, after reviewing the available information, Currell has concluded that: “Using … spill rates, which are based on tens of thousands of wells across the U.S., something on the order of 15 to 130 spills of wastewater could be expected to occur in association with the Narrabri Gas Project, if the planned 850 wells are drilled.” Currell notes that the quality of the waste water that is produced from extracting gas from the deep coal seams is particularly low in the project area. He concludes that: “If spillage/leakage of wastewater occurs at rates that are standard for unconventional gas around the world (e.g. Patterson et al, 2017, see section 1.2) this could have a significant material impact on the quality of groundwater in the area, and threaten the viability of the aquifer as a potable water source, as wells as the long-term quality of the groundwater recharge entering the Pilliga sandstone.”

Currell notes that contamination of shallow aquifers with stray gas has occurred in a number of areas in the US and that “most instances of fugitive gas contamination impacting shallow groundwater due to unconventional gas have to date taken place due to problems with the casing and cementing of gas and/or water wells…..”

He notes that “abandoned (legacy) wells are another possible conduit for cross-contamination of aquifers with fugitive methane.” He also identifies substantial risks from faults in gas wells, citing data ‘showing that between 3 and 6% of wells in the Marcellus Shale in Pennsylvania (a highly developed shale gas resource in the United States) experienced failures within the first 3 years of operation” and recognising that “well failures and faults will be likely to occur at some stage.”

Currell identifies numerous flaws in the baseline data and monitoring program provided by Santos, which has resulted in inadequate characterisation and poor knowledge of current water quality and thus a very limited ability to detect contamination. The most notable weaknesses are:

- The lack of any further study of recharge processes and rates of the Pilliga Sandstone using field-based techniques
- The failure to provide detailed chemical assays, analyses and hazard assessment of the brine material
- The failure to include detailed life-cycle risk assessment and monitoring plans to detect and isolate contamination from structures storing and transmitting produced water
- Monitoring network unlikely to be adequate in order to rapidly detect shallow groundwater contamination incidents resulting from produced water spills and leaks in the project area

- Groundwater quality baseline data does not constitute a rigorous baseline due to low number of bores in each aquifer, inadequate geographical spread
- Groundwater quality baseline data analysis provides inadequate number of parameters and constituents (ie missing redox potential, and some of the most likely contaminants including dissolved methane, hydrogen sulfide and uranium and other radionuclides)
- A lack of time-series data showing any trends in groundwater chemistry/quality through time at individual sites, or any maps showing spatial trends in groundwater quality through the region
- A lack of any reported baseline information on the chemical composition of produced water from the target coal seams
- A lack of microbiological characterisation of the groundwater and produced water.
- Lack of an indication of where exactly the CSG wells will be drilled, and where pipelines for gas and produced water will be constructed.

Groundwater impact assessment inadequacies identified by Andrea Broughton

In addition to the points outlined above, we would draw the Department's attention to the inadequacies of the groundwater impact assessment identified by Andrea Broughton, whose review is provided by the North West Alliance with its submission. Broughton identifies very serious inadequacies in the baseline groundwater data and conceptual model. She states that the "numerical model is not fit for purpose" and that "long-term predictions of drawdown effects due to CSG dewatering cannot be made reliably." She concludes that the Santos EIS fails to meet the NSW Secretary's Environment Assessment Requirements for the Narrabri Gas Project, because it has not established a groundwater baseline dataset incorporating "typical temporal and spatial variations."

She also raises questions as to whether the EIS meets the Commonwealth Governments *Significant Impact Guidelines 1.3: Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources,* due to the absence of statistically significant baseline data which characterises the hydraulic nature and quality of groundwater over time and space for each hydrostratigraphic unit.

Santos have failed to properly measure the transmissivity of key geological formations which they are claiming are aquitards that will act to limit the drawdown on beneficial aquifers of the Great Artesian Basin, the Namoi Alluvium and the Bohena Alluvium. According to Broughton, critical information is missing with regard to the ability or inability of key hydrostratigraphic units to transmit, store and yield groundwater. Specifically, baseline data for the following key aquitards is considered to be inadequate:

- Gunnedah-Oxley Basin (GOB) Permian aged Upper Maules Creek, Porcupine and Watermark Formations,
- Gunnedah-Oxley Basin Triassic aged Digby and Basal Napperby Shale Formations, and
- Great Artesian Basin (GAB) Jurassic Purlawaugh Formation.

Broughton notes that, "the baseline dataset is not statistically viable (which would require at least 6 samples per bore). Given the importance of understanding the baseline water level and water quality of these aquitards, they are not sufficiently represented in the Narrabri Gas Field dataset."

Broughton provides the following points about the weaknesses of the baseline datasets:

- Gunnedah-Oxley Basin baseline datasets are lacking temporal and spatial data for key HSUs.

- The Black Jack and Napperby Formations include aquifers and aquitards. However, the strata in which the baseline monitoring bore is screened has not been identified, and therefore this does not allow for a meaningful baseline hydraulic head dataset.
- Variation in hydraulic head conditions in the five Santos bores located in the Gunnedah-Oxley Basin HSUs are temporally limited (one year) and therefore do not give representative baseline conditions in these deep hydrostratigraphic units especially since these units experience lag effects measured in years.

Broughton considers that the water monitoring network proposed for the Gunnedah-Oxley Basin should have been in place for the Water Baseline Report. She notes there are only two baseline water quality monitoring datasets provided for the GOB, and groundwater pressure has only been monitored for one year. She concludes that "Santos has provided an inadequate and misleading groundwater baseline water quality dataset for formations which are considered to be very important in protecting the GAB high value aquifers. In my opinion, at least two years of baseline monitoring, aiming for a temporally representative dataset, should occur using the WMP monitoring bores before the Santos EIS can be considered adequate and the NGP approved."

Broughton also contends that there is inadequate data for the GAB units: "Great Artesian Basin hydrostratigraphic units are well represented spatially, but not temporally, for the Pilliga Sandstone, Orallo and Mooga Formations which are part of the Keelindi Beds." She explains that, "The Santos bores in the Jurassic hydrostratigraphic units lack temporal coverage within the NGP. Only two bores have at least two years of data with the remaining having 1 to 1.5 years of data. This is not sufficient to form a temporally representative baseline dataset as these formations have lag periods measured in years." Since the effect of drought could take more than a year to manifest, she concludes that the effects of CSG dewatering this portion of the GAB recharge cannot be effectively predicted.

Aquitard groundwater chemistry can provide important datasets showing how leaky the aquitard can be perceived, however the data provided in the baseline dataset is inadequate for the key 'aquitards' which Santos rely on to control the extent of drawdown on beneficial aquifers. Broughton notes that, "The Great Artesian Basin Purlawaugh Formation leaky aquitard chemical characteristics are not statistically viable and have become hidden as a result of the incorrect incorporation of its dataset into the Permo-Triassic HSU dataset, which is also not representative."

She also notes that "Although the Purlawaugh Formation aquitard dataset is not statistically viable there is evidence that it has relatively low EC (at least an order of magnitude than the underlying Triassic aquitards) which indicates it may be able to transmit water more easily than is reflected in the conceptual model."

Lastly, she notes that ANZECC guidelines (200) require that there should have been an assessment of organic compounds, such as methane, and failure to capture methane concentration measurements means that it will not be possible to track whether methane migration/contamination of aquifers is occurring.

Broughton identifies very serious inadequacies in the conceptual model, concluding that the 'numerical model is not fit for purpose' and that 'long-term predictions of drawdown effects due to CSG dewatering cannot be made reliably'. This is the result of using the lowest model confidence level classification (Level 1) and the limited spatial and temporal data on which it relies.

She states that: "In my opinion, hydrogeological properties, and in particular vertical hydraulic conductivity (Kv), of the Triassic Digby and basal Napperby Shale and early Jurassic Purlawaugh Formation aquitards are not adequately represented in the conceptual model." She contends that

Santos should have measured the Kv of the critical units (Purlawaugh Formation, Basal Napperby Shales, Digby Formation, Watermark-Porcupine-Upper Maules Ck Formations), which are relied upon to protect the Pilliga Sandstone and alluvial aquifers, rather than using generic values.

She also notes that:

1. The model is calibrated only for steady state flow in the Namoi alluvial aquifer and not for transient state flow.
2. The predictive model time frame far exceeds that of calibration time based on the transient data period.
3. The model is based on inadequate hydraulic properties and very limited data representing the deeper groundwater system (Jurassic, Triassic and upper Permian).
4. CDM Smith did not undertake a Monte Carlo assessment to see what potential outcomes could occur with a range of hydraulic conditions and scenarios.
5. Given that CDM Smith state the aquitards are critically important, serving to physically dampen drawdown effects and temporally retard the pumping production water from the Permian coal seam measures, in my opinion, the predictive modelling is not entirely appropriate.

Broughton also finds that, "The Bohena alluvium has no baseline water table dataset to measure the Water Monitoring Plan against." She also notes that there is a discrepancy in the baseline water quality data for the Bohena alluvium as to whether it was collected over three months or two years. The Bohena alluvium is an important beneficial aquifer in areas where the Namoi alluvium is absent. Broughton concludes that the shallow Bohena Alluvium is not adequately represented by baseline data "in the eastern portion of the NGP where leakages and spillages can occur from the Leewood Water Treatment Plant, brine ponds, irrigation fields, and pipeline infrastructure."

She also considers that the Water Monitoring Plan bores for the Bohena alluvium are inadequate, and recommends that an additional four bores are established – two to the northwest of the Leewood Water Treatment Facility and two to the north-east.

Other specific issues raised by Broughton that need to be addressed by the Department include: The EIS does not specify which subsystem of the Namoi alluvium the bores are screened in.

1. Only two bores represent the crucial basal Jurassic Purlawaugh Formation 'aquitard', with one collecting data for just one year.
2. There is no baseline data given for the Orallo Formation in the Bibblewindi Field area. This is significant because it is expected to protect the Upper Pilliga Sandstone from lower quality water which may be present in the Bohena Alluvial aquifer due to past contamination events.
3. Santos has not used a bore to provide baseline data for the Napperby Formation (Napperby Shale beds).
4. The water quality dataset for Bohena Creek should have been be split into continuous flow and ceased flow datasets.
5. Failure to measure two nested bore sites concurrently has resulted in failure to get baseline groundwater head dataset for the Permo-Triassic-Jurassic HSUs.
6. CDM Smith state that water level impacts of gas extraction would be 'Not Measurable', which does not reflect predictions in the drawdown identified by the GIA.
7. CDM Smith also state that 'changes to groundwater-surface water interactions' would be 'Not Measurable', which is contested.
8. CDM Smith fail to consider the impacts of un-managed leaks from ponds and pipelines.

9. There is a discrepancy as to whether Santos' nested bore BWD28 is a Level 1 or Level 2 monitoring bore (it is a Level 1 bore in Figure 3-5 but a Level 2 bore in Table 3-5). In my view, it should be a Level 1 bore.

Climate change and energy

The Environmental Impact Statement is glib about the greenhouse and climate change contribution of gas, particularly unconventional gas and puts New South Wales at significant risk of opening up large and uncontrolled fugitive emissions of methane directly to the atmosphere.

The statement that, "Gas has an important role to play, not only in the future economic success of NSW, but also in enabling NSW and Australia to meet its international climate change commitments" (3-4) effaces mounting evidence that the fugitive emissions of unconventional gas in particular have been dramatically under-estimated. We provide for the Department's consideration a recent report on the risk of migratory and fugitive methane emissions from unconventional gas as Appendix B.

This report, from Melbourne Energy Institute, explores the risks of methane gases from a coal seam migrating to the surface as a result of coal seam dewatering and depressurisation for coal seam gas production. It identifies that such migratory emissions are a potentially significant source of greenhouse gases from coal seam gas extraction, but concludes that there is very limited data available to assess the full scale of the risk. It hypothesises that in the Surat Basin, dewatering and depressurisation of the Walloon coal measure for CSG extraction, together with continued agricultural water extraction from the Condamine alluvium, could enhance methane gas flow. It finds that migration of methane along existing natural faults and fractures is possible and may increase with continued depressurisation by coal seam gas mining. It notes that presence of free methane in water bores can be the direct consequence of depressurisation of the coal seams. It finds that due to a lack available data the likelihood of migratory emissions occurring as a result of gas extraction is difficult to assess, and highlights that to date the presence or scale of such emissions has been completely un-measured.

All of these risks are substantial and very difficult to mitigate, once unconventional gas drilling has been allowed to proceed. The EIS's comparison between the cost and scale of storage technologies and gas as an energy option is glib and out of date.

We urge the Department to review these claims in context, with an eye to the rapidly falling costs of renewable energy and storage and the significant uncertainties about the greenhouse gas profile of unconventional gas.

Social impacts and health

The social impact assessment provided in the Environmental Impact Statement is not adequate. Insufficient time has been spent directly consulting with people in the affected area and surrounding districts, including local Indigenous people. Table 6 of Appendix T1 indicates that it has been three years since Santos' consultants engaged with stakeholders for the preparation of the SIA. This considerable amount of time could have been spent conducting genuine data collection, consultation and analysis of the social impacts of this project, which are already occurring, but Santos have chosen instead to present meagre and out of date information.

The social impact assessment is out of date and should be revised to reflect the new social impact assessment guidelines prepared by the Department of Planning. Specifically, the role of the Pilliga

and Yarrie Lake in the lives of people from Narrabri and Coonabarabran and the effect that degradation of the forest by an industrial gasfield will have is not addressed. The EIS anticipates that the "diffuse nature of the gasfield" would mean less impact on recreational enjoyment of the Pilliga, but it our view, precisely the opposite is true – a full 950 square kilometres of the forest will be radically changed in character, with lighting, noise and air quality changes that fundamentally change the community's relationship with the area. There is no evidence that Santos approached bird-watching, bushwalking or camping groups or businesses that support these activities to gather evidence to support its sweeping generalisations.

The EIS makes repeated reference to establishment of a Gas Community Benefit Fund which would receive an estimated $120 million through the life of the project." This estimate is based on outdated royalty estimates which have been updated in the EIS without also updating the Community Benefits Fund portion of overall royalty contribution.

The creation of this Fund could bring benefits to the local area, but this is by no means assured. Depending on the governance and consultation surrounding the Fund, it could, in fact, have a negative impact socially in Narrabri, intensifying already mounting divisions over mining and its impacts and splintering a hitherto cohesive community.

The EIS claims to include a Health Impact Assessment but does nothing of the sort. There is barely even a literature review of the mounting evidence that unconventional gas has a range of deleterious health impacts associated with it. Santos cite the Queensland health study at Tara, but not the regularly updated compendium of health studies produced by the Concerned Health Professionals of New York. The community Tara reported experiencing headaches, eye irritations, nosebleeds and rashes, and these symptoms are similar to symptoms reported by communities living near other unconventional gasfields, including Camden in western Sydney.

For mental stress, Santos briefly and broadly cite another Queensland study, but there is no evidence that it has conducted any serious assessment of the Narrabri area.

This is not a serious attempt at addressing an issue that is of profound concern for the communities that will have to live with this gasfield.

Over the last 4-5 years, community-based, neighbour to neighbour, surveys have been diligently conducted by local communities across the North West region. Survey teams visited every house in their district, inviting residents to respond to the question, "Do you want your land/road gasfield free?" Across the North West, 101 communities in the North West have overwhelmingly rejected gasfield expansion on their lands and rural communities and declared themselves gasfield free by this process.

Community survey teams were diligent in visiting every house in their locality and the results are overwhelming: on average, 96% of respondents want their homes, farms and communities to be gasfield free across an area covering 3.28 million hectares surrounding the Pilliga.

Air quality

The air quality assessment has not addressed the range of air pollutants and toxics that are associated with the drilling and processing of unconventional gas. In the absence of Santos providing detailed information about the likely layout of the gasfield, a proper assessment of the dispersement of pollutants from across the 950 square kilometres of the project area is hardly possible, nor is an

adequate assessment of possible exposure pathways for communities living nearby. This is not acceptable.

As the air quality assessment makes clear, only a very limited number of pollutants were dealt with in any details: “The key air pollutant assessed for the project operations phase was nitrogen dioxide from gas and diesel fuel combustion sources associated with power generation, boilers, gas flaring and well head pumps. Other minor contaminants include fine particles and volatile organic compounds. The key air pollutants assessed for the project construction phase was dust as PM_{10}.” (Appendix L)

In a glaring omission, Santos has incorrectly applied the old air quality assessment methodology, which means they have not properly assessed emissions of $PM_{2.5}$. The “AUSPLUME” assessment was not applied to $PM_{2.5}$ for either construction or operation. Neither was it assessed for the power generation plant. Dispersal modelling for all health-harming air pollutants and methane must be undertaken. This includes toxics from the flares and $PM_{2.5}$ particulates for all stages of the operation.

Economic

Cotton is the major industry in the Narrabri shire, which hosts two of the five largest exporters of cotton in Australia. In Queensland, according to GISERA, 1.3 agricultural jobs were lost for every gasfield job created. This has implications for the future of agriculture in Narrabri shire and the critical cluster of cotton-related businesses and research institutions that operate there.

The macro-economic study in Appendix U2 makes clear that agriculture and its associated processing and transport are the primary drivers of economic activity in the region. This productivity is dependent on the natural resources that this project and potential wider coal seam gas development puts at risk. It is also intimately tied to the functional social bonds that an invasive gasfield puts at risk. If people are driven away and leave the area, as has occurred in southern Queensland areas adjacent to and amid gasfields, the social fabric that supports the agricultural productivity of the region will be put in jeopardy. The concentration of cotton farming, processing, transport, servicing and research activities in the Narrabi and Wee Waa area warrants protection under the State Environmental Planning Policy as a critical industry cluster.

The discussion of the “opportunity” from coal and gas development for Boggabri and Narrabri is simplistic and superficial and utterly at odds with the recent experience of Boggabri with the Maules Creek mine and with the experiences of towns in Queensland that have hosted the gas industry.

In the town, cost-of-living, labour market competition, increased housing demand will all have distorting effects. This latter is cited in Appendix T1 as a benefit of the project but it will not benefit low-income renters. Table 16 of Appendix T1 shows that 30% of the population of Narrabri shire rent, and 61% of Narrabri’s Indigenous population rent. Rental vacancies are already low. Table 15 shows that 37% of the Shore population and 53% of its Indigenous population are on less than $400 per week income. The effect of the project on cost-of-living in the Shire needs to be modelled, assessed and considered, as do the labour dynamics of the project.

The macro-economic analysis claims “tourism will remain important” but unlike for mining and agriculture, does not explore the number and distribution of tourism businesses, jobs and services in the Narrabri Shire and surrounding region. Evidence is emerging from Queensland that coal seam

gasfields, because of the extensive surface infrastructure they require, has a negative impact on tourism in the surrounding area.

The very features that attract tourists to the region: the dark night, the peace and quiet, the extensive intact bushland, will be lost or jeopardised as a result of this project. Nowhere is this impact described and explored in the assessment material.

The macro economic study cites MDBA research that shows the extent of economic shocks the region would experience were there to be less water available for agriculture. The assessment fails to mention the prospect that the arriving of coal seam gas production might contribute to this loss of water. Indeed, it mentions that CSG production might *bring* water to the region, if produced water were of irrigation or town water quality.

Biodiversity

The Pilliga is the largest intact temperate woodland in Australia. It is part of the Brigalow Belt, one of 15 national biodiversity hotspots and a stronghold for many declining woodland bird species. Its national and state significance is not adequately described in the EIS, nor is the severe environmental stress that it is already experiencing. This context, the importance of the extensive habitat in the Pilliga and the stress and threat it is already facing due to bushfire and climate change is crucial to understanding the significance of the impact of this gasfield.

With that in mind, we attach to this submission a report prepared for the Northern Inland Council for the Environment on the national significance of the Pilliga. This report is Attachment C and it provides substantial additional information about the biodiversity significance and vulnerability of the Pilliga and raises the concern that the future expanded development of coal seam gas extraction has the capacity to further impact on matters of national environmental significance under the EPBC Act, “and result in extinctions of local populations.”

The area to be cleared for the gasfield is 988.8ha with an additional indirect impact on another 181ha, so 1,000ha of vegetation in the Pilliga would be affected, but this clearing will take place over a huge area and the edge effects and indirect impacts associated with industrialising this part of the forest is not adequately addressed by the EIS. The assessment attempts to downplay the significance of this large area of clearing by noting that it is 1.29% of the vegetation across the huge area affected by the gasifeld. This does not ameliorate the impact. It arguably makes it worse. Fragmentation, clearing, traffic, disturbance and pollution will be introduced across a huge area of the largest temperate woodland in New South Wales. It will fundamentally change and degrade that woodland and this is hardly acknowledged in the EIS at all.

Of the vegetation being cleared, 796ha is habitat for Regent honeyeater, 449ha is habitat for koala and 135ha is breeding habitat for Pilliga Mouse. There is also breeding habitat for Yellow-bellied sheathtail bat and huge losses of large hollow bearing trees.

The ecological impact assessment has failed to accurately or adequately quantify the cumulative impacts many of these species have suffered due to recent clearing for other resource projects in the region. Notably, the Maules Creek and Boggabri mines have both cleared extensive areas of habitat for the Regent honeyeater and Yellow-bellied sheathtail bat and the Watermark coal mine is approved to clear significant areas of Koala habitat. More than 200 koalas are expected to be displaced by the Watermark coal mine only a 100 or so kilometres to the south.

Furthermore, the very marginal status of the Koala population in the Pilliga, once one of the largest in New South Wales, is cause for profound concern and hardly rates a mention in the EIS, except as an excuse to fragment, clear and degrade remaining koala habitat in this part of the Pilliga given that they are now, so rare. The results of the proponent's surveys indicate that the Koala population in the Pilliga "has declined substantially." This is an issue of profound concern, given the species' vulnerable status. Any koala habitat in the Pilliga being cleared and industrialised given the tenuous status of the entire population, could be hastening its local extinction. This prospect does not seem to be seriously addressed by the EIS.

Detailed assessments are provided for the Pilliga Mouse and the Koala, but not for the threatened bats and birds or the Black-stiped Wallaby. This is a serious omission and must be rectified with assessments considering the landscape context of the Pilliga for all threatened and migratory bird and bat species, the cumulative loss of habitat for these species over the last ten years and a frank assessment of the importance of the Pilliga habitat to be cleared and fragmented by this proposal to their survival.

The tables provided by Santos listing the disturbance limits for vegetation communities and habitat do not indicate which communities are listed under the State and Federal threatened species legislation or their status. This is important information to help the public understand the impact Santos is proposing to inflict. Nor do they provide, with these tables, any indication of community equivalences to listed communities with other names.

The numbers of records collected during surveys for this project are remarkably low compared to other recent surveys and not sufficient to assess the population patterns and high use areas that might be able to inform a "field protocol." There is little to no information about habitat values collected, mapped and presented in the EIS. The "Field Protocol" as presented in the EIS is woefully inadequate for the task of avoiding high conservation value areas and protecting key habitat features. This is no doubt caused by the EIS's failure to actually map such features in any detail. Hollow-bearing trees, for example, must be retained and all streams should have substantial exclusion zones for all surface infrastructure. The only areas where they are excluding surface development are State Conservation Areas. The "high constraint area" and "moderate constraint area" have the same prohibited and permitted activities.

Insurance

The Chief Scientist's Report recommended in 2014, "That Government consider a robust and comprehensive policy of appropriate insurance and environmental risk coverage of the CSG industry to ensure financial protection short and long term. Government should examine the potential adoption of a three-layered policy of security deposits, enhanced insurance coverage, and an environmental rehabilitation fund."

This has still not been implemented and the prospect of Santos securing consent to develop a full-scale production project in the absence of these arrangements is alarming landholders in the area.

As the first production project seeking approval since the report was completed, the Government's dealing with this project is a test of its commitment to implementing the Chief Scientist's report.

We note that the proposal for an environmental rehabilitation fund made by the chief Scientist is similar to the long-term environmental harm mechanism proposed recently by the NSW Audit Office in its review of the adequacy of mining rehabilitation security deposits and to the "future fund"

proposed by Narrabri Shire Council to provide funds to deal with major future groundwater harm caused by this gasfield.

In the immediate term, we are of the view, and have obtained legal advice that supports this view, that comprehensive environmental insurance can be mandated by current legislative frameworks as conditions of consent and approval under the EP&A Act, the PO Act and the POEO Act. This must be done for this project.

Advice from landholders is that their farm insurance does not cover liabilities from unconventional gas activities that is of a creeping long term nature, that occurs over a wide area, and that is carried out under a Land Access Agreement or Conduct and Compensation Agreement. Standard farm insurance policy terms and conditions have provisions that:

1. Pollution is *generally excluded* in many common Farm Insurance policies[3] unless the pollution event arises from a sudden happening which is unintended and takes place entirely at one specific location.
2. "General Exclusions" may also exist where the damage or liability was *intentionally caused* or incurred by a person acting with the landholders express or implied consent[4]. This exclusion could include resource depletion and pollution arising from unconventional gas activities such as drilling, fracking, depressurising coal seams, etc
3. Landholders have a duty under s21(1) of the *Insurance Contracts Act 1984* to disclose every matter that the insured knows, or could be reasonably be expected to know, that is relevant to the insurers decision to insure the insured.

This duty of disclosure may mean that when gasfield operations begin, nearby landholders may need to disclose that event. This could lead to modifications to their existing farm insurance policies such as increased premiums, and doubts that existing insurance policies may not cover damages or liabilities that arise from gasfield operations.

The SEARs for the project included a requirement that Santos address "whether contingency plans would be necessary to manage any residual risks." This is not addressed in the EIS. Without insurance gas companies are managing the residual risk via risk transferring risk to landholders and the public. This is achieved through a combination of:

1. refusing to provide detailed, site specific baselines, including hydraulic head of water bores, water quality data and other environmental data.
2. Refusing to provide material safety data sheets and operational data, and the chemical makeup of proprietary chemical mixtures used in the drilling and treatment processes.
3. Insisting on legal indemnities in land access agreements that must be enforced in court. Enforcement success is remote due to a lack of baselines, monitoring and operational data identified in 1 and 2 above

The EIS does not include any commitments to carry comprehensive environmental insurance. This is consistent with the Santos Chairperson's avoidance of the issue and failure to commit to comprehensive environmental insurance in a waffling response to a direct question at the 2017 Santos AGM. His long winded answer caused serious concern among landholders in the project area. The Chairperson's assertion that Santos has never contaminated an aquifer and that its record

[3] Elders Farm Insurance, Product Disclosure Statement May 2016 https://www.eldersinsurance.com.au/uploads/PDS/QM3234-0516%20Elders%20Farm%20Pack_web_0516.pdf
[4] ibid

speaks for itself gives no comfort, since Santos's record includes a finding by the EPA in 2013 that an aquifer was contaminated by Santos near the Bibblewindi Water Treatment Facility.

By not taking out environmental insurance cover, Santos is effectively divesting its residual risk by transferring that risk to landholders, the environment and the public. This is clearly inequitable. Landholders, the environment and the public purse are subsidising the Narrabri Gas Project by unwillingly shouldering this risk - a risk that grows with heavy concern about Santos' finances and track record. Santos' track record in the Pilliga should be sufficient for the state government to insist that Santos be fully insured for any activities that they undertake. Recent statistical analysis of well failure and spills and leaks from all forms of unconventional gas wells in the United States, the limited data input and uncertainty analysis in Santos' modelling is further reason to fear there is considerable residual risk that for which there is no contingency plan either by Santos or the New South Wales government.

Farmers and landholders, in many cases have a multi-generational, low risk profile, seeking to minimise risk and pass on the property to the next generation in as good or better condition than they found it. Oil and gas companies, who seek to maximise shareholders returns, tend to have a high risk appetite, precisely because they don't own the land and have no monetary or long term interest in the land or the environmental services that it provides.

In general gas companies carry Public Liability Insurance only and their production operations represent a significant change to the risk profile of the farm and farming family. Insurance disclosure rules mean that farmers that host CSG activities on their land need to disclose this fact. Depending on the insurer and the farmer's bank, the disclosure could mean a significant increase in insurance costs, some exemptions to claimable events, the inability to get a new loan and/or an increase in the cost of finance. In fact Rabobank in its submission to NSW Inquiry into CSG in 2011 said there was a risk to Asset Values:

> When coal seam gas (CSG) mining activities are undertaken concurrently with agricultural activities on agricultural land, the size and scale of farming operations can be impacted, the production and efficiency base of the agricultural enterprise can be constrained and a new spectrum of operational risks could emerge.[5]

Rabobank went further in 2013 by banning loans to unconventional gas fuel projects including farmers who host unconventional gas operations.[6]

Livestock Producers hosting CSG are advised in the Livestock Protection Assurance (LPA) Guidebook, "A risk assessment must be carried out when any changes to the enterprise's current activities occur, such as a change in land use on the property. It will be examined in detail should your property be subjected to a random audit." [7] To manage risk, landholders need to identify the risks and mitigate where necessary and/or where mandated by industry or accreditation schemes.

For example the LPA scheme requires landholders to develop a Risk Assessment Plan (RAP) and manage risk. The LPA scheme specifically asks, "Do livestock have access to leaking electrical transformers, capacitors, hydraulic equipment or coal mine wastes?"[8]

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[5] Rabobank Australia and New Zealand, 2011, Submission 455 NSW Inquiry into Coal Seam Gas
[6] *The Australian*, 10 July 2013 "Rabobank bans loans to shale gas and tar sands" Retrieved 21.4.2017
[7] LPA Guidebook for Assessment http://www.mla.com.au/globalassets/mla-corporate/meat-safety-and-traceability/documents/lpa_guidebook_v7.pdf
[8] ibid

Landholders and land managers should be given access to the Material Safety Datasheets for all chemicals proposed to be used by Santos for these operations, including drilling and treatment fluids and documentation of gasfield operational practices. The landholders RAP may also require baselines of water and soil quality along with regular water testing. All this can become very expensive when taken over multiple sites and water sources. Such information should be provided by Santos as part of the EIS process to ensure that landholders that experience loss or damage can seek redress.