



Bibblewindi Gas Exploration Pilot Expansion

Response to Submissions

Prepared by:

RPS AUSTRALIA EAST PTY LTD

Level 9
17 York Street
Sydney NSW 2000

T: +61 8270 8300
F: +61 8270 8299
E: sydney@rpsgroup.com.au

Client Manager: Sigrid Sanderson
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Prepared for:

SANTOS NSW (EASTERN) PTY LTD

Level 16
40 Creek Street
Brisbane QLD 4000

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I.0 Introduction

I.1 Background

Santos NSW (Eastern) Pty Ltd (Santos), as the coal seam gas (CSG) operator of Petroleum Assessment Lease (PAL) 2, is seeking consent to drill two additional pilot wells and operate the expanded Bibblewindi Multi-Lateral Pilot for up to three years (the proposed activity). The Bibblewindi Multi-Lateral Pilot is located within the Bibblewindi State Forest, approximately 40 kilometres south of Narrabri, north western NSW.

The proposed activity includes the construction and drilling of Bibblewindi 31 and 32 pilot wells on the existing Bibblewindi 14 and Bibblewindi 19H well leases respectively, installation of surface infrastructure to connect the two wells to the existing Bibblewindi Multi-Lateral Pilot and operation of the Bibblewindi Multi-Lateral Pilot.

The proposed activity includes:

- construction: site preparation activities at existing well leases, establishment of necessary equipment, temporary structures and facilities on the lease areas to enable drilling; drilling one vertical pilot well (Bibblewindi 31) and one lateral pilot well (Bibblewindi 32) and connection to the Bibblewindi Multi-Lateral Pilot.
- operation: operating the existing Bibblewindi Multi-Lateral Pilot with the new Bibblewindi 31 and 32 wells, management of the water and gas produced during operation for up to three years and general maintenance activities.
- post operation and rehabilitation: decommissioning and rehabilitation of pilot wells and ancillary infrastructure or suspension of wells for potential future use.

The proposed activity forms part of the Energy NSW CSG Exploration and Appraisal Program (E&A Program). The E&A Program consists of a series of CSG exploration and appraisal activities including recommencing operation of a number of existing pilot wells, drilling and operating new pilot wells and constructing and operating water and gas management facilities to support the program.

A more detailed description of the proposed activity is found in Chapter 4 of the *Bibblewindi Gas Exploration Pilot Expansion Environmental Impact Statement* (RPS, 2013a).

The proposed activity is a 'State Significant Development' (SSD) to which Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) applies in accordance with the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP).

In accordance with the requirements of the EP&A Act, an Environmental Impact Statement (EIS) was prepared for the project (RPS, 2013a) and placed on public exhibition from 24 September to 7 November 2013. Public submissions were invited during this period.

I.2 Purpose of this report

There were 185 submissions received during the exhibition of the EIS. The Director-General of the Department of Planning and Infrastructure (DP&I) provided copies of the submissions to Santos. In accordance with section 85A of the *Environmental Planning and Assessment Regulation 2000*, the Director-General required Santos to address the issues raised in the submissions as considered necessary.

This Submissions Report documents and considers the submissions received on the EIS, and details Santos' responses to these submissions. The report also includes an update on consultations undertaken since preparation of the EIS, some clarifications on the proposed activity and the EIS, and a revised Statement of Commitments (SoC) in response to the issues raised in submissions.

Following consideration of the submissions, no significant changes to the design described in the EIS are proposed.

I.3 Structure of this report

This Submissions Report comprises the following chapters:

- Chapter 1: Introduction — outlines the background to the proposed activity and the purpose and structure of this report.
- Chapter 2: Consultation — provides an overview of the consultation and public display activities undertaken during and following the EIS exhibition period.
- Chapter 3: Overview of submissions—provides details of submissions received, the approach taken to consideration of submissions and the main issues raised.
- Chapter 4: Responses to issues raised in submissions — details the issues that were raised in the submissions and provides responses to the issues raised.
- Chapter 5: Revised Statement of Commitments —outlines changes to and additions to the draft SoC from the EIS.
- Chapter 6: References.

2.0 Consultation

2.1 Consultation during public exhibition period

The EIS was exhibited for 45 days, from 24 September 2013 to 7 November 2013. A range of exhibition and consultation activities were carried out during this period.

2.1.1 Public exhibition venues

The EIS was publicly exhibited at the following display locations:

- Department of Planning and Infrastructure, Information Centre, 23-33 Bridge Street, Sydney.
- Narrabri Shire Council, 46-48 Maitland St, Narrabri.
- Nature Conservation Council, Level 2, 5 Wilson Street, Newtown.

Hardcopies were also on public display for viewing at Santos' Narrabri shop front and the Narrabri Operations Centre during business hours. During the exhibition period, the public was able to review the EIS, obtain information from display materials and seek further information from staff at these offices.

2.1.2 Project enquiries telephone line, email and websites

The project enquiries and information line (1800 071 278) and project email address (energy.nsw@santos.com) were monitored throughout the exhibition period. No specific phone calls or emails were received in relation to the EIS during this period.

The EIS was, and still is, available for electronic download on the Santos website:

<http://www.santos.com/exploration-acreage/new-south-wales/environment/environmental-approvals.aspx>
and the DP&I website: <http://majorprojects.planning.nsw.gov.au/page/>.

2.1.3 Distribution of EIS

Upon instruction from the DP&I, Santos provided copies of the EIS to the following Government agencies and special interest groups:

- Department of Planning and Infrastructure.
- Narrabri Shire Council.
- Division of Resources and Energy.
- NSW Office of Coal Seam Gas (NSW OCSG).
- NSW Environment Protection Authority (NSW EPA).
- NSW Office of Environment and Heritage (NSW OEH).
- Namoi Catchment Management Authority (Namoi CMA).
- NSW Roads and Maritime Services.
- Heritage Branch of NSW.
- Department of Primary Industries (Fisheries, NSW Office of Water and the Office of Agricultural Sustainability and Food Security).
- NSW Health – Hunter New England Health District (NSW Health).
- Nature Conservation Council.

- Rural Fire Service (RFS).
- Forestry Corporation of NSW (Forestry NSW).

A copy of the EIS was subsequently sent to the Narrabri Local Aboriginal Land Council (Narrabri LALC), upon request by the Namoi CMA.

2.1.4 Notification to key stakeholders

Information on the EIS and links to copies of the document and the process for making a submission were provided by email to key stakeholders in Santos' September and October 2013 Monthly Activity Updates. These updates are provided to:

- Forestry NSW.
- Division of Crown Lands.
- Roads and Maritime Services.
- Narrabri Shire Council.
- Narrabri LALC.
- Narrabri Community Consultative Committee (Narrabri CCC).
- neighbouring landholders to Leewood.

2.1.5 Advertisements

The exhibition was advertised by DP&I in a media release, as well as in the local Narrabri Courier newspaper.

2.2 Consultation following public exhibition

2.2.1 Project enquiries telephone line and email

The project enquiries and information phone line and email address have been maintained during preparation of this Submissions Report, and will be maintained and regularly checked during the assessment of the EIS by the DP&I and during construction and operation of the proposed activity, should development consent be granted. No specific phone calls or emails were received in relation to the EIS during the preparation of the Submissions Report.

2.2.2 Meetings and other consultation

A number of meetings have been held between Santos and government agencies and key stakeholders since the public exhibition period, including specific presentations to provide information on the EIS with:

- Narrabri Shire Council.
- Namoi CMA Board Meeting, Gunnedah.

Meetings were also held with local officers from the following stakeholder groups during this period to provide information on the broader Narrabri Gas Project:

- Roads and Maritime Services.
- NSW Office of Water.
- Forestry NSW.
- National Parks and Wildlife Service (NPWS) and Natural Resources Commissioner.
- Presentation to the Narrabri CCC.

During those meetings, officers had an opportunity to ask questions relating to the EIS as meeting attendees were aware that it was on public exhibition.

3.0 Overview of submissions

3.1 Respondents

3.1.1 Submissions

The DP&I received 185 submissions on the EIS. The full submissions can be viewed on DP&I's website at http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=5934. Of these submissions:

- 183 were received during the submissions period (24 September to 7 November 2013).
- Two were received after the submissions period had closed, but were considered and responded to in this report.
- Two individuals made two submissions each.

A summary of all submissions received, including a reference to key areas of concern, is provided in Appendix 1. In order to protect privacy, individual names of submitters have not been included.

3.1.2 Types of respondents

Submissions were received from a number of different respondents. Of these:

- Ten submissions were from government agencies – NSW OCSG, NSW EPA, NSW OEH, Namoi CMA, NSW Roads and Maritime Services, Heritage Branch of NSW, NSW Fisheries, NSW Office of Agricultural Sustainability and Food Security, NSW Office of Water and NSW Health.
- Two submissions were from councils – Narrabri Shire Council and Coonamble Shire Council.
- Eight submissions were from special interest groups – NSW Artesian BoreWater Users Association, National Parks Association of NSW, Friends of the Pilliga, Namoi Water, The Wilderness Society, Upper Mooki Landcare Group, Northern Inland Council for the Environment and the North Coast Environment Council.
- 165 submissions were from individuals.
- There were 89 submissions that contained versions of a form letter.

3.2 Approach to consideration of submissions

Each submission received was assigned a submission number by DP&I. The submissions were reviewed and individual issues raised within each response categorised. A response has been provided to each issue within this Submissions Report. Where similar issues have been raised in different submissions, a single response has been provided.

3.3 Overview of issues raised in submissions

This section summarises the issues raised by the government agencies, councils and the community. Responses to these issues are contained in Chapter 4.

3.3.1 Main issues raised by government agencies and councils

The key issues and comments raised by government agencies and councils are presented below.

3.3.1.1 Fisheries NSW

- Fisheries NSW advised that the EIS is satisfactory, and raised no issues.

Noted - no further response required.

3.3.1.2 Heritage Council of NSW

- The mitigation measure for non-Aboriginal cultural heritage provided in the EIS is considered appropriate and recommended to form part of the approval conditions.

Noted - no further response required.

3.3.1.3 NSW Environment Protection Authority

- Santos needs to submit a variation application to the NSW EPA to add the proposed activity to the Environment Protection Licence (EPL) application.
- Erosion and sediment controls should be implemented consistent with the guidelines, principles and recommended minimum design standards contained in *Managing Urban Stormwater: Soils and Construction – Volume 1* (the Blue Book).
- The unsealed road network associated with the proposed activity should be managed and maintained consistent with the guidelines, principles and recommended minimum design standards contained in:
 - *Managing Urban Stormwater: Soils and Construction – Volume 2C Unsealed Roads*
 - *Erosion and sediment control on unsealed roads – A field guide for erosion and sediment control maintenance practices.*
- A Leak Detection and Repair program should be incorporated into the fugitive emissions monitoring program, conducted in accordance with *US EPA Method 21 - Determination of Volatile Organic Compound Leaks (40 CFR Part 60, Appendix A, Method 21)*.

Responses to these comments are provided in Chapter 4 below.

3.3.1.4 NSW Health

- Implementation of the proposed groundwater and surface water monitoring regime is strongly supported.
- The proposed water management strategy should be adequate to mitigate any potential spillages or leakages if fully implemented.
- Chemicals used in the CSG industry are of great public health concern; therefore proposed control measures must be fully implemented to mitigate against environmental pollution and health impacts.
- The EIS does not include an assessment of potential fugitive emissions from the project, which could include volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs). Santos needs to consider the potential for fugitive emissions and the impact of these emissions at the nearest receptors.
- The EIS's conclusion that the proposed activity is too relatively minor in scale to negatively impact on the psychological wellbeing of individuals may be too generalised and an independent assessment should be considered.
- An independent assessment of community satisfaction with the stakeholder consultation should be undertaken.

Acknowledgments of supported measures are noted - no further response required.

Responses to other comments and issues are provided in Chapter 4 below.

3.3.1.5 NSW Office of Agricultural Sustainability and Food Security

- From a soils perspective, the EIS and Agricultural Impact Statement (AIS) provides insufficient discussion as requested by the Director General's Requirements (DGRs).
- There are no critical agricultural issues for the proposed activity, including economic impacts.

A response to the comment on soils is provided in Chapter 4 below, while no further response is required for the latter comment.

3.3.1.6 NSW Office of Coal Seam Gas

- Generally supports the proposed activity.
- The rehabilitation proposal generally satisfies the DGRs.
- Notes that the development of the revised Produced Water Management Plan (PWMP) is currently being undertaken in consultation with NSW Office of Water for approval by NSW OCSG.
- The NSW OCSG is reviewing the existing Groundwater Monitoring and Modelling Plan's (GMMP) adequacy to address the future groundwater monitoring and modelling requirements of the E&A Program. Where a revised GMMP is required, development of the GMMP will be undertaken in consultation with NSW Office of Water for subsequent approval by NSW OCSG.

Noted - no further response required.

3.3.1.7 NSW Office of Water

- Insufficient information has been provided for the NSW Office of Water to assess the validity of the model and its suitability in making the required predictions. An additional detailed modelling report should be submitted to NSW Office of Water for review, including any peer review.
- Sufficient water quality information should be provided to allow an assessment against the minimal impact consideration for water quality in the Aquifer Interference Policy (AIP) for affected water sources.
- The following should be included as conditions of approval relating to drilling and well construction:
 - Santos must ensure the protection of the shallow formations i.e. the alluvium and the Great Artesian Basin (GAB) Southern Recharge during drilling by ensuring hydraulic isolation between sequences.
 - The drilling of the proposed exploration well is undertaken in accordance with the EIS.
 - The wells be designed and constructed in accordance with the *NSW Coal Seam Gas Code of Practice Well Integrity* (DTIRIS, 2012).
- A remedial action plan in the event of adverse impacts to the groundwater such as leakage and cross contamination between aquifers as a result of the drilling and well construction process as well as possible well failure into the future should be provided.
- A remedial action plan in the event of accidental contamination from the Bibbiewindi water transfer and Leewood produced water facilities should be provided. The conditions of approval should include:
 - The Bibbiewindi water transfer and Leewood produced water facilities are constructed in accordance with the EIS.
 - Monitoring data from the facilities should be made available to the NSW Office of Water on request.
- Details of construction standards for the proposed fluid treatment facility (FTF) including mitigation and monitoring and a remedial action plan in the event of accidental contamination should be provided.
- Inconsistent reporting of locations for the proposed groundwater monitoring bores should be clarified, and further details on the monitoring program should be provided.
- Appropriate water access licences (WALs) should be in place to account for any take of groundwater.

The recommended conditions of approval are supported - no further response required.

Responses to the other comments and issues are provided in Chapter 4 below.

3.3.1.8 NSW Office of Environment and Heritage

- No specific comment to make on the proposed activity at this stage.

Noted - no further response required.

3.3.1.9 NSW Roads and Maritime Services

- The following conditions of approval are recommended:
 - The intersection of X-Line Road and the Newell Highway should be upgraded to include an Auxiliary Left Turn Treatment Short and Channelised Right Turn Treatment Short on a major road in accordance with Figures 8.3 and 7.6 Part 4A Austroads 2010 respectively and RMS supplements. The intersection works should be designed and constructed to accommodate the largest vehicle accessing the intersections. Such designs shall be appropriate for the current speed zone of 110km/h.
 - X-Line Road and Westport Road should be sealed a minimum of 30 metres from the edge of the southbound travel lane on the Newell Highway.
 - As road works are required on a State road, the developer will be required to enter into a Works Authorisation Deed (WAD) with Roads and Maritime Services prior to the commencement of roads. Roads and Maritime Services will exercise its power under Section 87 of the *Roads Act 1993* (the Act) and/or the functions of the roads authority, to undertake road works in accordance with Sections 64 and 71 and/or Sections 72 and/or 73 of the Act, as applicable, for all works under the WAD.
 - Upgrades of the intersection of X-Line Road and the Newell Highway and the intersection of Westport Road and the Newell Highway should be completed prior to the commencement of construction works associated with the proposed activity.
 - A Road Occupancy Licence is required prior to any works commencing within three metres of the travel lanes in the Newell Highway.
 - All access to the pilot should be via the intersection of X-Line Road and the Newell Highway. All access to Westport Drillers Camp should be via the intersection of Westport Road and the Newell Highway. No other access from/to the state road network (Newell and Kamilaroi Highways) from/to the project area is permitted.

A response to these recommended conditions is provided in Chapter 4 below.

3.3.1.10 Narrabri Shire Council

- There will be few socio-economic benefits realised within the Narrabri Local Government Area (LGA). However, the socio-economic impacts of the proposed activity are small.
- The SoC should explicitly include the measures described in Chapter 18 of the EIS.
- An assessment of the impacts of drilling on groundwater quality needs to be undertaken to determine whether drilling fluids will be released to the environment at toxic concentrations.
- Further information on the conceptual groundwater model and the assumptions made in the groundwater modelling should be provided.
- A recent bore census covering all of the E&A Program needs to be provided and all bores within the potential drawdown area should be identified and potential impacts quantified.
- Further deep monitoring bores should be installed, or if they already exist, they need to be incorporated

into the monitoring program and this needs to be described. The bores should be installed with sufficient time to collect baseline data prior to the start of operations. The monitoring should continue over the life of the proposed activity and until the pre-existing groundwater pressures and flows return.

- Further information is required to determine the adequacy of the monitoring program. The water quality monitoring program should include parameters indicative of contamination of groundwater by drilling fluids and vertical flow of groundwater.
- Further information on the baseline monitoring results and the proposed trigger values when contingency measures will be implemented should be provided, as well as the proposed feasible contingencies.
- Council must be provided with an opportunity to review and comment on the proposed groundwater monitoring program and any proposal for fracking.
- The start of the proposed activity should be conditional on the completion of the Bibbiewindi Water Transfer Facility.

Responses to these comments and issues are provided in Chapter 4 below.

3.3.1.11 Coonamble Shire Council

- One deep groundwater monitoring bore is inadequate to monitor the changes in the deep aquifer layers.
- The monitoring bores should be installed and baseline monitoring commenced prior to further drilling.
- The EIS has not provided an assessment of the impacts of the proposed activity (including drilling) on water quality.
- Greatly concerned with the potential impacts of CSG exploration on the groundwater quality and quantity within the GAB, as the town and community could not exist without it.
- Questions what further data is required to calibrate the groundwater model, given that there is a lack of ground-truthing of the model, which casts the modelling results into doubt. In addition, the lack of information on the assumptions as to how aquifers interact is cause for concern, as these assumptions are required for the model set up.
- The EIS does not identify future developments but Santos has confirmed plans for four major gas fields in this region, which would impact enormously on our town, communities, agricultural industries and region.
- The EIS does not propose any suitable means for long term management of produced water from CSG.
- While the Heritage component was removed from the DGRs, a full Aboriginal cultural heritage impact assessment should be conducted, in consultation with Coonamble Shire Council and the local Aboriginal community.
- Concerned about the health impact to the community, as well as the potential fire risk that CSG activity may cause.

Responses to these comments and issues are provided in Chapter 4 below.

3.3.1.12 Namoi Catchment Management Authority

- Santos should undertake a detailed impact analysis against the *Namoi Catchment Action Plan 2010-2020* thresholds and targets, and requirements of the *Extractive Industries Policy 2009* for the Namoi Catchment and the *Namoi CMA Biodiversity Offsets Policy 2011*. Ideally this would be requested as part of the DGRs.
- Acknowledges that the proposed activity should not impact on previously identified Aboriginal cultural heritage sites or objects, and should have negligible impact on biodiversity and surface water flow.
- The proposed mitigation and management measures for Aboriginal cultural heritage, surface water flow, groundwater quality, surface water quality and site rehabilitation are considered adequate.

- Acknowledges that appropriate measures have been undertaken to involve and consult with the Aboriginal community within the Narrabri LALC area and all other relevant stakeholders.
- Santos should ensure all relevant documents to the E&A Program are forwarded to all previously engaged Aboriginal stakeholders in a timely manner to enable their feedback.

Acknowledgments of supported measures are noted - no further response required.

Responses to the other comments and issues are provided in Chapter 4 below.

3.3.2 Main issues raised by the community

Most of the issues raised by the community were addressed in the EIS (as such, responses in Chapter 4 of this report generally mirror the EIS structure). The most common issues related to potential groundwater and biodiversity impacts, as well as bushfire risk. Other issues related to general objections to CSG both locally and as an industry, air quality, potential social impacts on health and community, and issues regarding Aboriginal cultural heritage, as listed below.

- Groundwater – This was the most common concern raised. Respondents were concerned with the perceived lack of baseline data underlying the numerical groundwater model, and hence its robustness as an impact assessment tool. Other issues included general concerns about potential impacts on groundwater resources in the area, including the GAB, resulting from drilling, well integrity and ongoing operation of the wells; as well as the possible cumulative impact of any future CSG activities in the region.
- Biodiversity – A number of respondents oppose development in the Pilliga forest generally, with concerns for the effect on biodiversity. In addition, respondents were concerned with the perceived lack of baseline data and potential direct and indirect impacts to threatened species including the Pilliga Mouse, Eastern Pygmy Possum and Barking Owl.
- Bushfire risk – Respondents noted that there is already a high bushfire risk in the Pilliga forest. Concerns were raised that CSG activities within Pilliga forest may create additional bushfire risks and that Santos appears not to have a clear bushfire strategy.
- General objections to CSG – Respondents raised concerns about the industry relating to intergenerational equity and the precautionary principle. Concerns raised included substantial crossover with other issues listed here, including groundwater and air quality. Submitters claim the potential for ongoing piecemeal CSG development within the Pilliga forest to degrade the intrinsic value of the area was also raised.
- Cultural heritage – Respondents raised concerns over the perceived inadequacy of consultation with the Aboriginal community and general disregard for the Aboriginal cultural significance of the area.
- Social impacts – Respondents raised concerns about the potential impacts on other land uses, such as agriculture, as well as the impact on general community cohesion. Some submissions also identified concerns about potential health impacts. Respondents also suggested that Santos does not have a social license to operate in the community.
- Air quality – Respondents raised concerns over the adequacy of fugitive emissions baseline data and monitoring.

4.0 Response to issues raised in submissions

This chapter contains responses to the issues raised in submissions to the EIS. Where appropriate, references to relevant sections of the EIS are contained in the responses.

As noted in Chapter 3, the submissions were reviewed individually and the issues categorised to assist with compilation of responses. Where relevant, issues were categorised according to the relevant chapter or section of the EIS. Where submissions raised the same or similar issues, a consolidated response was prepared. The issues raised are numbered under the relevant general heading and then a response to each issue is provided below next to its corresponding issue number.

4.1 General objections

4.1.1 Issue description

In summary, respondents raised the following general objections to the proposed activity:

- 1) The proposed activity is a direct long term threat to the health and wellbeing of land, water and air in this region and beyond. Respondents object to disruption of this fragile area by this activity, and they believe little consideration is given to the negative aspects of the proposed activity.
- 2) General concerns about the impacts on intergenerational equality and the future condition of the region.
- 3) Objections were raised to CSG exploration within the Pilliga forest or on public land.
- 4) It is recommended that DP&I undertake an Environmental Impact Study.

4.1.2 Response

- 1) Santos is seeking consent to undertake an expansion of the Bibbiewindi Gas Exploration Pilot for the purposes of CSG exploration and appraisal. This proposed activity involves the drilling of two additional wells on existing well pads, and operation of the expanded Bibbiewindi Multi-Lateral Pilot (14 wells) for up to three years only. On completion of operations, wells and ancillary infrastructure will either be decommissioned with lease areas rehabilitated or wells will be suspended. If exploration and appraisal activities confirm the CSG resource as commercially viable, any proposed production activities at this pilot site would be subject to further environmental assessment and government approvals.

The area within which the proposed activity is located is entirely within 'Zone 4' (Forestry, recreation and mineral extraction (State Forests)) Community Conservation Area (CCA) under the *NSW Brigalow and Nandewar Community Conservation Area Act 2005* (BNCCA Act). As mineral extraction is a permitted use in Zone 4, the proposed activity is considered consistent with the BNCCA Act.

Potential impacts of the proposed activity, as well as the potential cumulative impacts of the E&A Program are assessed in the EIS. Mitigation measures have been developed to ensure any potential impacts are minimised.

- 2) The proposed activity will not consume significant quantities of non-renewable resources or produce significant quantities of waste that will lead to long term environmental implications (refer to Table 2-1 of the EIS). Groundwater will be extracted but modelling indicates that this will have negligible

impact on the upper aquifers including the Pilliga sandstone, registered bore users or groundwater dependent ecosystems (GDEs). Drilling fluids, where possible, will be recycled for use at other drilling sites. In addition, the proposed activity is not located within Biophysical Strategic Agricultural Land (BSAL), and therefore will have negligible impact on agricultural land resources.

As discussed above, the expanded Bibbiewindi Multi-Lateral Pilot is proposed to operate for up to three years only. If exploration and appraisal activities confirm the CSG resource as commercially viable, any production activities at this pilot site would be subject to further environmental assessment and government approvals.

- 3) The proposed activity is located within the dedicated State Forest area set aside by Government for the purposes of forestry, recreation and mineral extraction. It is located entirely within 'Zone 4' (Forestry, recreation and mineral extraction (State Forests)) CCA under the BNCCA Act. Section 8.5 of the Brigalow and Nandewar CCA Agreement provides strategic aims for activities within Zone 4 which include *'Provide for exploration, mining, petroleum production and extractive industry in accordance with the Mining Act 1992 and the Petroleum (Onshore) Act 1991'*. The proposed activity is consistent with the *Petroleum (Onshore) Act 1991*.

The *New England North West Strategic Regional Land Use Plan* (DP&I, 2012) identifies the site and surrounding land as having high CSG resources and underground coal exploration potential.

- 4) It is standard practice that a project proponent undertakes impact assessment activities and prepares a report on the findings for Government assessment. An Environmental Impact Study, in the form of an Environmental Impact Statement (EIS) has been undertaken by Santos to assess the potential impacts of the proposed activity in accordance with the EP&A Act. Santos has prepared the EIS in response to the DGRs. DP&I will assess the proposed activity and prepare an assessment report and the Planning Assessment Committee (PAC) will determine the application, as outlined in Figure 6-1 of the EIS.

4.2 Objections to the CSG industry

4.2.1 Issue description

Respondents raised general objections to the CSG industry, including the following:

- 1) Opposition to the expansion of the Queensland liquefied natural gas (LNG) industry into NSW. Concerns that CSG development will be proposed for the Liverpool Plains, threatening existing industries such as agriculture.
- 2) Scientific evidence suggests significant global and national impacts from the CSG industry. References were made to projects elsewhere (e.g. Tara, Qld and USA gas fields). Concerns about impacts to water quality, land, community and ecological balance of the area. CSG is considered to be an unsafe energy source and does not provide the claimed economic benefits.
- 3) Suggests that there have been leakages from existing infrastructure in Australia which are not reported upon by the companies involved.
- 4) CSG differs from other resource extraction, as exploration wells have the same environmental impacts as operational wells.

4.2.2 Response

- 1) The proposed activity is a separate project to the Santos GLNG and other LNG projects in Queensland. Development of reserves in NSW has the potential to play a role in the delivery of a secure supply of domestic gas for NSW, as well as alleviate potential gas supply shortages which may expose NSW to significant energy price increases.

The proposed activity, or the E&A Program that it is part of, is not located on any land classified as BSAL or Critical Industry Cluster (CIC). The AIS that was undertaken for the EIS (Appendix 2 of the EIS) states that the E&A Program is not located on any agricultural land (major agricultural industries e.g. cropping, grazing, horticulture and plantations). The current extent of agricultural land use within PEL 238 and PAL 2 is approximately 791,478 hectares.

The proposed activity and the wider E&A Program is not located on the Liverpool Plains.

- 2) The natural gas industry is one of the most highly regulated industries in Australia. Over the last two years both the State and Federal governments have put in place a range of new measures designed to enhance the already extensive regulation. Before any work can take place, CSG activities in NSW, including those associated with exploration and appraisal, are subject to rigorous State and Federal government assessment and approvals processes to ensure impacts have been assessed and mitigated. An EIS or Review of Environmental Factors (REF) is prepared, which contains environmental, economic and social impact assessments of the proposed CSG activities.
- 3) Santos cannot comment on other operators. Section 4.10.1.2 of this Submissions Report outlines the matter of the pollution incidents which occurred at the Bibbiewindi Water Treatment Facility prior to November 2011.
- 4) Santos is seeking consent to undertake an expansion of the Bibbiewindi Gas Exploration Pilot for the purposes of CSG exploration and appraisal. This proposed activity involves operation of the expanded Multi-Lateral Pilot (14 wells) for up to three years only, the potential impacts of which have been assessed in the EIS. On completion of operations, wells and ancillary infrastructure will either be decommissioned with lease areas rehabilitated or wells will be suspended. If exploration and appraisal activities confirm the CSG resource as commercially viable, any proposed production activities at this pilot site would be subject to further environmental assessment and government approvals.

4.3 Objections to fossil fuel development

4.3.1 Issue description

- 1) General objections were raised concerning the continued mining, export and combustion of fossil fuels. For example:
 - Continued development of fossil fuels does not support the government's responsibility in respect to intergenerational equity.
 - Approving this proposed activity will prevent resources (people and capital) focusing on other activities.
 - Fossil fuels should not be supported because resource depletion and population growth are considered to unsustainably contribute to carbon emissions.
 - Australia should aim to become a leader in developing and implementing clean renewable energy systems both within Australia and as part of our exports.

4.3.2 Response

- 1) As an Australian-owned oil and gas company, Santos believes that natural gas is a critical part of NSW's energy mix. Over one million NSW homes and businesses use natural gas for heating, cooking and commercial uses. In addition there are about 450 large industrial users of gas in NSW. Natural gas is critical for these small businesses and major industries, and cannot be easily or cost-efficiently substituted for an alternate energy source. Natural gas complements renewable energy sources, providing base load energy when conditions for renewable energy sources are sub-optimal (e.g. in the absence of adequate solar radiation).

NSW currently sources 95 per cent of its gas from interstate (Section 2.1 of the EIS). Contracted supplies are predicted to fall from 2014 and reach significantly low levels in 2017 due to a combination of factors including a strong demand for gas in other states, decreasing reserves and constraints on infrastructure. Santos supports the immediate development of an indigenous natural gas supply within NSW to:

- Ensure adequate wholesale gas supply is available to NSW, resulting in reduced dependency on interstate supply and delivering security of supply for downstream NSW customers.
- Ensure future wholesale gas supply choices beyond Victorian supply, thus reinstating competition for energy retailers and encouraging increased competition for NSW gas customers.
- Facilitate the development of distribution networks in regional centres.

4.4 Scientific uncertainty

4.4.1 Issue description

- 1) The precautionary principal should be invoked and Santos' activities in the Pilliga forest halted until the scientific studies are completed, and the essential data and information made available to enable risks to be adequately addressed.
- 2) CSG activities should not be allowed to proceed within the region until the findings and recommendations of the Chief Scientist of NSW investigation into the NSW CSG industry have been published and discussed with the community.

4.4.2 Response

- 1) The natural gas industry is one of the most highly regulated industries in Australia and the proposed activity requires separate approvals from both the NSW and Federal governments.

The use of CSG for NSW energy needs is not new. CSG was extracted at the Sydney Harbour Colliery in Balmain in the early 1900s with production continuing into the 1940s. CSG production has occurred at Camden in NSW for over 12 years.

A precautionary approach was taken during the site selection process for the proposed activity (Table 2-1 of the EIS). Based on an environmental risk assessment and in combination with the DGRs, the EIS includes investigation into a range of issues to determine the potential impacts of the proposed activity. This included commissioning groundwater, ecological, air quality, noise, traffic and economic and social technical studies, and drawing on information from technical specialists including geologists, drilling engineers and process engineers. Where appropriate conservative scenarios were considered as part of the EIS, while a range of mitigation measures will be put in place to minimise or prevent any environmental degradation.

- 2) Santos supports a robust regulatory framework that enables the sustainable and safe exploration and development of Australia's valuable and abundant reserves of gas for the benefit of all Australians. The natural gas industry is one of the most highly regulated industries in Australia and the proposed activity requires separate approvals from both the NSW and Federal governments.

The *Initial report on the Independent Review of Coal Seam Gas Activities in NSW* by the NSW Chief Scientist and Engineer was released in July 2013 and is available online at <http://www.chiefscientist.nsw.gov.au/coal-seam-gas-review/initial-report-july-2013>.

A number of technical studies have been included in the EIS, which have been undertaken to assess and address the potential environmental and social issues associated with both the proposed activity and the larger E&A Program.

4.5 Future development

4.5.1 Santos' future plans in the region

4.5.1.1 Issue description

- 1) Santos has not revealed their future developments in the area, including confirmed plans for four major gas fields in the region, despite the DGRs to state 'the likely interactions between the development and existing, approved and proposed gas exploration and production'.
- 2) Santos has purchased property at Warrah Creek. Therefore, despite Santos' recent public statements that they plan only to explore and extract in the Pilliga forest, their long term plan must include expansion across the Liverpool Plains.
- 3) General concerns about potential expansion due to the longevity of well outputs. If the volume of extraction is not maintained, the number of wells will need to increase to maintain output.

4.5.1.2 Response

- 1) The proposed activity, as part of the E&A Program, is necessary for the ongoing exploration, appraisal and evaluation of the CSG hydrocarbon potential in PEL 238 and PAL 2. The E&A Program will occur over three years between 2014 and 2017. It will assist in gaining further knowledge of coal fines, gas composition and flow rates, the deliverability of the reservoir, and investigating well design, drilling and completion technologies. This information is essential to determine the location, extent, details and planning of a commercial gas production project within the areas of PEL 238 and PAL 2. The application for the proposed activity is seeking approval for that exploration and appraisal activity.

Since the EIS for the proposed activity was finalised, Santos has released information on a future commercial gas production project, known as the Narrabri Gas Project.

The Narrabri Gas Project includes a gas field and a pipeline to transport the natural gas to the NSW market. The project could supply up to 50 per cent of NSW's natural gas needs, create 1,200 jobs during construction and up to 200 jobs during operation, contribute \$1.6 billion in royalty payments to NSW over the life of the project and \$160 million as part of the Regional Community Benefit Fund for regional programs and infrastructure.

The gas field will include:

- Up to 850 production wells.
- Monitoring of wells to provide continual information about water and gas volumes and well site security.
- A central water management and treatment facility to store and treat produced water for reuse.
- A central gas processing facility to treat and compress the natural gas.

The Narrabri Gas Project will require preparation of a detailed EIS for petroleum production activities, development consent and the granting of a Petroleum Production Licence (PPL).

Further details of the Narrabri Gas Project can be found at <http://www.santos.com/exploration-acreage/new-south-wales/narrabri-gas-project.aspx>.

- 2) In March 2010 Santos purchased a property approximately seven kilometres west of Willow Tree in the Warrah Creek area. The purchase was made at a time when an exploration program was being considered in this area. This area is not part of Santos' current plans for exploration, appraisal or gas field production activities.

The Narrabri Gas Project area that Santos proposes to develop is located south of Narrabri, well over 100 kilometres from the site at Warrah Creek. The project area is shown in the project factsheet, available on Santos' website:

<http://www.santos.com/library/FACT%20SHEET%20Narrabri%20Gas.pdf>. More than half of the Narrabri Gas Project area is located within the Pilliga forest and the proposed gas field operations will take up less than one per cent of the overall project area. The pipeline to connect the gas into the NSW domestic market will run south from the Narrabri area and link up with existing pipeline infrastructure.

- 3) The proposed activity involves the operation of the expanded Bibbiewindi Multi-Lateral Pilot (14 wells) for up to three years as part of the E&A Program. If exploration and appraisal activities confirm the CSG resource as commercially viable, any proposed production activities at this pilot site would be subject to further environmental assessment and government approvals. Exploration activities seek to measure the gas potential of the area. Different to production, there is no commitment to provide a consistent gas supply.

4.5.2 Cumulative impacts

4.5.2.1 Issue description

- 1) Cumulative impacts should be assessed more broadly, at a national and global scale.
- 2) Project staging and REFs for individual pilots has not enabled a proper cumulative impact assessment to be undertaken. The cumulative impacts of all of the Pilliga gas exploration in the past, present and future should be considered in the EIS. Broader impacts of numerous gas fields should be assessed as the EIS does not sufficiently address cumulative impacts of the whole project with 1100 wells.
- 3) Cumulative impacts of the proposed activity with the Glasserton Project need to be addressed.
- 4) DP&I needs to consider all mining activities taking place in the Pilliga forest and in context of the whole North West region.

4.5.2.2 Response

- 1) The cumulative impacts of the E&A Program have been assessed as part of the EIS. The scope of the cumulative impact assessment is considered adequate given the scale of the proposed activity and E&A Program and its likely negligible to minimal potential impacts.
- 2) The cumulative impact assessments presented in the EIS have taken into consideration existing, approved and currently proposed Santos' CSG activities for the E&A Program within the Pilliga forest, including existing infrastructure and recently approved activities. In particular, the ecological assessment has considered the clearing of vegetation that has occurred over the past 10 years by Eastern Star Gas (ESG). Any future exploration, appraisal or production activities beyond the E&A Program, including any application for the Narrabri Gas Project, will be assessed when the relevant applications are lodged. These assessments will continue to incorporate cumulative impact assessments.

A number of respondents referred to a proposed production program of 1100 wells in the region. This number originally comes from a previous ESG proposal, which was subsequently withdrawn.

In December 2013, Santos identified the proposed project area currently being considered for the Narrabri Gas Project. The project area is shown in the project factsheet, available on Santos' website: <http://www.santos.com/library/FACT%20SHEET%20Narrabri%20Gas.pdf>.

The information collected as part of the E&A Program will inform the nature and configuration of the future Narrabri Gas Project and needs to commence prior to construction of the project. The E&A Program which the proposed activity is part of will occur over three years between 2014 and 2017 whilst the Narrabri Gas Project will require preparation of a detailed EIS for petroleum production activities, development consent, the granting of a PPL and project financing.

- 3) The cumulative impacts of the E&A Program have been assessed as part of the EIS. The Glasserton pilot wells are located at Spring Ridge approximately 45 kilometres south of Gunnedah, and approximately 100 kilometres south-east of the E&A Program area. The pilot wells are currently not operating. However, even if these wells were operational, it is unlikely there would be any cumulative impacts of these wells with the E&A Program given the significant distances between the two locations.
- 4) The proposed activity will be assessed by DP&I and determined by the Planning Assessment Commission in accordance with Section 79C of the EP&A Act.

4.6 **Adequacy of the EIS**

4.6.1 **Issue description**

- 1) The EIS fails to address issues raised by government agencies. For example, Fisheries NSW required Santos to comply with relevant legislation, policies and guidelines, while NSW EPA raised water minimisation and opportunities to reuse and recycle.
- 2) The EIS appears to rely on the multiple REF documents lodged some time ago to the government, which were not made publicly available online as they should have been.
- 3) Appendix 1 of the EIS has not included 'likely interactions between the development and existing, approved and proposed gas exploration and production activities in the vicinity of the site' or 'plans of any proposed building works'.

4.6.2 Response

- 1) The EIS addresses the issues raised by government agencies, as shown in Table 5-2 of the EIS. Chapter 6 of the EIS indicates that Santos has considered, and is in the process of ensuring they comply with all necessary regulations, including obtaining required EPLs and WALs. Santos is committed to the responsible management of water resources and aims to reduce water consumption and improve the reuse and recycling of water across its sites. Santos is currently investigating water treatment technologies for the Leewood Produced Water Facility and options to beneficially reuse treated water.
- 2) The REF prepared for the existing Bibbiewindi Multi-Lateral Pilot (ESG, 2008) is referred to in the EIS, in the context of the Aboriginal cultural heritage assessment undertaken for the site. This is considered appropriate given that the proposed activity occurs within the existing Bibbiewindi Multi-Lateral Pilot site. A copy of the REF can be found on Santos' website:
<http://www.santos.com/library/PAL%20%20Lateral%20Production%20Pilot%20A.pdf>

or the NSW Division of Resources and Energy website:

http://www.resources.nsw.gov.au/_data/assets/pdf_file/0005/256514/20081029-PAL2-REF-Eastern-Star-Gas-Coal-Seam-Gas-Pilot-Narrabri-Shire.pdf

- 3) The likely interactions between the proposed activity and existing, approved and proposed gas exploration activities (the E&A Program) are discussed in Chapters 8 to 19 of the EIS as part of the cumulative assessment for each identified potential issue.

The information collected as part of the E&A Program will inform the nature and configuration of the future Narrabri Gas Project and needs to commence prior to construction of the project. The E&A Program, which the proposed activity is part of, will occur over three years between 2014 and 2017. The Narrabri Gas Project will require preparation of a detailed EIS for petroleum production activities, development consent and the granting of a Petroleum Production Licence.

There are no proposed permanent building works incorporated into the proposed activity. Temporary infrastructure will be present during drilling activities which is estimated to take 35 days (Section 4.3.1 and Figure 4.2 of the EIS).

4.7 Need and justification

4.7.1 Gas shortage

4.7.1.1 Issue description

- 1) There is no shortage of gas. Demand for gas is dropping and there is enough natural gas in production already. Gas is available under large areas of Australia, including Western Australia and Bass Strait.

Household energy prices will not be alleviated within NSW by development of the CSG industry. Gas prices are rising due to construction of processing plants and export terminals in Queensland, and a desire to export CSG, not because of any impending shortage of supply.

Concerns were also raised that gas will be used for export due to high demand and high prices, and not to supply NSW.

4.7.1.2 [Response](#)

- 1) As an Australian-owned oil and gas company, Santos believes that natural gas is a critical part of NSW's energy mix. Over one million NSW homes and businesses use natural gas for heating, cooking and commercial uses. In addition there are about 450 large industrial users of gas in NSW. Natural gas is critical for these small businesses and major industries, and cannot be easily or cost-efficiently substituted for an alternate energy source. Gas-fired power stations typically produce fewer emissions than coal-fired facilities per unit of electricity generated.

NSW currently sources 95 per cent of its gas from interstate (Section 2.1 of the EIS). Contracted supplies are predicted to fall from 2014 and reach significantly low levels in 2017 due to a combination of factors including an increase in demand for gas in other states (for domestic use and export), decreasing reserves that existing NSW contracts draw from, and constraints on infrastructure.

With contracts expiring, NSW needs to either re-negotiate new contracts (where uncontracted supply is available) or develop its own reserves.

Santos supports the immediate development of an indigenous natural gas supply within NSW to:

- Ensure adequate wholesale gas supply is available to NSW, resulting in reduced dependency on interstate supply and delivering security of supply for downstream NSW customers.
- Ensure future wholesale gas supply choices beyond Victorian and South Australian supply, thus reinstating competition for energy retailers and encouraging increased competition for NSW gas customers.
- Facilitate the development of distribution networks in regional centres.

4.7.2 **Renewable energy sources**

4.7.2.1 [Issue description](#)

- 1) Available renewable energy options should be explored over gas exploration and mining. Products from mining are temporary and finite and should be replaced with sustainable commodities. Climate change is considered a real threat.

A respondent suggested that a solar thermal plant in the Pilliga region could provide baseload power and storage, which are the two arguments most commonly cited for the need for gas.

4.7.2.2 [Response](#)

- 1) Natural gas is a critical part of NSW's energy mix. Over one million NSW homes and businesses use natural gas for heating, cooking and commercial uses. In addition there are about 450 large industrial users of gas in NSW. Natural gas is critical for these small businesses and major industries, and cannot be easily or cost-efficiently substituted for an alternate energy source. Natural gas complements renewable energy sources, providing base load energy when conditions for renewable energy sources are sub-optimal (e.g. in the absence of adequate solar radiation).

4.8 Description of the Proposed Activity

4.8.1 Hydraulic fracturing (fracking)

4.8.1.1 Issue description

- 1) Concerns were raised over the potential use of hydraulic fracturing (fracking), including:
 - The precautionary principle should be invoked as fracking is not good for the environment. It should be banned, as it is in other countries.
 - Concern that 'fracking' fluids contain benzene, toluene, ethylbenzene, xylene, uranium, bromide, lead, cyanide, nitrate and monochloramine. These will pollute the local environment with toxic chemicals and known carcinogens. Once groundwater has been contaminated by multiple chemicals, as found in hydraulic fracturing fluids, it is not possible to remove them.
 - Fracking directly impacts tectonic plates and causes seismic disturbances. In the UK in 2011, the British Geological Society confirmed seismic events were a direct result of drilling and fracking activities by Cuadrilla Resources.
 - Narrabri Shire Council must be provided with an opportunity to review and comment on any proposal for fracking.

4.8.1.2 Response

- 1) Fracking will not be undertaken as part of the proposed activity or the E&A Program (Section 9.2 of the EIS). The geology of the area indicates hydraulic fracturing will not increase gas flow rates. If additional geological data supported the use of hydraulic fracture stimulation to improve the gas flows in the future, a range of additional government approvals would be required and consultation would be undertaken.

4.8.2 Produced water management

4.8.2.1 Issue description

- 1) Concerns were raised that the EIS does not adequately explain the strategy for produced water management, including its treatment and use or disposal. The trucking of water from the existing ponds is not a long term viable option. Facilities for water treatment must be finalised before drilling commences.

No approval of the initial stages should be given until Santos has provided a detailed risk and water management plan that will be enforced by the NSW Government, addressing how Santos will deal with the produced water and salt from all their activities in the Pilliga forest. This plan must be available for public, government and independent scientific scrutiny.

4.8.2.2 Response

- 1) Santos is continually striving for best practice in produced water management and will continue to work closely with communities, regulators and other key stakeholders to ensure the most appropriate options are pursued. The water transfer and treatment process for the proposed activity will be as follows (Section 4.4.2 of the EIS):
 - At each well, the lifted water produced will be pumped through the water gathering system to Bibbiewindi Water Transfer Facility, via the existing flow line.

- the Bibblewindi Water Transfer Tank located at the Bibblewindi Water Transfer Facility will be used to provide a short buffer (up to 24 hours) prior to the produced water being pumped to the Leewood Produced Water Facility via the Leewood Water Pipeline.
- once at the Leewood Produced Water Facility, produced water will be stored in one of the 300 megalitre ponds.

Produced water from the Leewood Produced Water Facility will be transported by road tankers to an appropriately licensed facility in the Sydney metropolitan area for treatment, reuse and/or disposal.

Santos is currently developing plans to treat produced water at the Leewood Produced Water Facility by reverse osmosis or other methods instead of transporting produced water from Leewood to a licensed facility.

Based on the extensive experience from Santos' CSG operations in Queensland, it is estimated around 80 per cent of the produced water could be made available for beneficial use e.g. agricultural activities and ecosystem replenishment. For CSG activities in the Pilliga, appropriate treatment levels and identification of options for using the beneficial water are being explored, with ongoing engagement with government agencies and the community.

Following adequate project definition and concept design, Santos will apply for the appropriate environmental approvals for any water treatment facility or beneficial reuse option.

Activities within the PAL must be carried out in accordance with the Petroleum Operations Plan (POP) which has been approved by the Director-General of NSW Trade and Investment. Under the POP, a Produced Water Management Plan (PWMP) identifying storage of produced water at Leewood Produced Water Facility has been developed by Santos, and approved by the NSW Government. If treatment of the produced water at the Leewood Produced Water Facility is considered feasible, the PWMP will be revised in consultation with NSW Office of Water, for approval by NSW OCSG.

4.8.3 Rehabilitation

4.8.3.1 [Issue description](#)

- 1) The EIS does not sufficiently address remediation.
- 2) Before further damage to the environment occurs the process for rehabilitation at the Bibblewindi spill should be verified to confirm that the landscape can be returned to pre-drilling condition.

Testing of pH levels, benzene and other additives in the surrounding soil should be undertaken to ascertain and link unknown eucalyptus and native *allocasaurina* dieback to acidification of the soils.

Practices to date in the Pilliga forest have been largely unsuccessful - no regrowth after a year, dieback areas increasing, soil contamination taking 12 years to recover. Santos staff on a public bus tour on 25 October 2013 told members of the public that the kill areas would take around 50 years to regenerate.

- 3) The following recommendations were made:
 - adherence to proper restoration techniques after decommissioning of CSG infrastructure.
 - allocating lots to tree planting and letting natural regeneration of seed stock occur both aerially and through natural progression of existing plant communities repopulating old well sites; there could be potential for future conservation projects.

4.8.3.2 Response

- 1) An overview of the rehabilitation strategy for the proposed activity is provided in Section 4.5 of the EIS. The final land use would be consistent with the surrounding area as State forest.
- 2) Santos has spent much of 2012 and the first quarter of 2013 rehabilitating and upgrading a number of CSG exploration sites in the Pilliga forest. The sites were acquired in November 2011, when Santos took over from ESG.

The operations in the Pilliga forest were shut down in December 2011 and Santos began a thorough review of all existing sites.

Following this review, a detailed work program for the rehabilitation of sites in the Pilliga forest was formulated. Extensive testing was carried out and site specific rehabilitation plans were prepared to ensure each site is successfully remediated. To-date, Santos has committed more than \$17 million to remediation works and substantial progress has been made with rehabilitation of approximately 28 hectares of land throughout PEL 238 and PAL 2. Rehabilitation activities have included:

- reducing the size of existing well leases back to the minimum area required for operations.
- plugging and abandoning, according to legislative requirements, wells that are no longer required for exploration and appraisal, and rehabilitating associated well leases.
- rehabilitating a number of water storage ponds that are no longer required for exploration and appraisal activities.
- rehabilitating vegetation dieback areas resulting from ESG's previous operations.

Rehabilitation has included soil remediation (where necessary in vegetation dieback areas), replacing topsoil, creating micro-relief, re-installing habitat features such as fallen timber and bush rock, natural re-establishment of slashed and cleared native vegetation, and direct seeding where required. Rehabilitation activities have been undertaken in consultation with the NSW OCSG, Forestry NSW and NSW EPA.

Monitoring of existing rehabilitation activities has shown an overall average site value close to 45 per cent of nearby reference (control) sites after two years. The replacement of topsoil is producing encouraging results, with sites showing a high number of native species when compared to reference sites. Rehabilitation measures undertaken have been considered using adaptive management principles with monitoring informing future modifications to works and methodologies.

Rehabilitation works associated with the proposed activity will follow the methods developed for the existing rehabilitation activities.

- 3) These recommendations are in line with the rehabilitation strategy for the proposed activity provided in Section 4.5 of the EIS, particularly in regards to the rehabilitation performance criteria provided in Table 4-8 of the EIS.

4.8.4 **CSG Infrastructure**

4.8.4.1 Issue description

- 1) Construction standards for the proposed FTF, including mitigation and monitoring and a remedial action plan in the event of accidental contamination, should be provided.

- 2) The start of the proposed activity should be conditional on the completion of the Bibblewindi Water Transfer Facility.

4.8.4.2 [Response](#)

- 1) Development consent for the FTF was issued by Narrabri Shire Council on 1 October 2013 (DA769/2013). The FTF does not form part of the proposed activity and therefore the information requested by the NSW Office of Water has not been included. However, extensive information regarding the construction standards for the FTF was included in the development application (DA) made by Santos. During its assessment of DA769/2013, Narrabri Shire Council made an assessment of the environmental impacts of the FTF, in accordance with section 79C of the EP&A Act. In addition, as the application was integrated development it was referred to the NSW EPA for their approval. The NSW EPA assessed the application and provided their general terms of approval, which form part of the development consent.

The operation of the FTF will be subject to an EPL under the *Protection of the Environment Operations Act 1997* (POEO Act), which will ensure that the operations are appropriately managed and monitored.

- 2) The Bibblewindi Water Transfer Facility is currently under construction and will be completed prior to the operation of the proposed expanded Bibblewindi Multi-Lateral Pilot.

4.9 **Community and stakeholder consultation**

4.9.1 **Consultation with the Aboriginal communities**

4.9.1.1 [Issue description](#)

- 1) There is a Native Title claim over the project area and Santos must include the Gomeroi Native Title Claimants, Gomeroi Traditional Owners of the Pilliga and the Narrabri LALC in their consultation.
- 2) The Gomeroi Traditional Owners were not consulted as part of this proposed activity.
- 3) The Narrabri LALC did not receive a copy of the EIS.

4.9.1.2 [Response](#)

- 1) Santos is actively engaging with the relevant Aboriginal groups regarding Native Title in parallel to the NSW environmental approval process. Santos will work towards an agreement with the native title parties in relation to the land in which it plans to operate and ensure that Aboriginal stakeholders share in the social and economic benefits of a CSG industry. Consultation with the Gomeroi Native Title Claimants, Gomeroi Traditional Owners of the Pilliga and the Narrabri LALC is described in Section 5.3.4.2 of the EIS.
- 2) There is ongoing consultation with the Gomeroi Traditional Owners to keep them informed of the proposed activity and the broader E&A Program. This is described in Section 5.3.4.2 of the EIS.
- 3) Upon request from the Namoi CMA, a copy of the Bibblewindi EIS was sent to the Narrabri LALC. Santos will endeavour to forward documents on public exhibition to all previously engaged Aboriginal stakeholders in a timely manner to enable their feedback.

4.9.2 Consultation with the local community

4.9.2.1 Issue description

- 1) Consultation with the residents of the Narrabri area has been inadequate.
- 2) The Coonabarabran and Baradine communities are ignored and advertisements for consultation appear only in the Narrabri and Gunnedah media.
- 3) Continued consultation with Narrabri Shire Council, particularly on project and schedule updates is requested.
- 4) An independent assessment of community satisfaction with the stakeholder consultation should be undertaken, to provide reassurance of the applicant's performance in this important area and guidance for future improvement if required.

4.9.2.2 Response

- 1) Santos has developed a community engagement and consultation framework to specifically target the different needs and requirements of stakeholders and the community to inform and consult on the E&A Program and the CSG industry more broadly (Chapter 5 of the EIS). Santos is committed to undertaking ongoing community engagement and consultation. Specific consultation undertaken for the proposed activity includes:
 - A presentation at Narrabri Shire Council.
 - Narrabri CCC updates including how to lodge a submission.
 - Monthly updates published in the Narrabri Courier.
 - Hard copies of the EIS on display at Narrabri Shire Council, Santos Narrabri Operations Centre and Santos Maitland Street shopfront.
- 2) The advertisement was undertaken in accordance with Section 89F of the EP&A Act, with the process hosted on the DP&I website. The E&A Program is located within the Narrabri LGA, therefore the focus of Santos' community engagement has been within this region. If, in the future, Santos was to expand their activities outside of this region, engagement with affected communities would be established. Communities outside the Narrabri LGA are able to access information, including environmental assessments of proposed works, through the Santos website and media announcements. The Project information line and the Narrabri shopfront are also available for anyone who is seeking further information on the proposed activity.
- 3) Santos has a program of consultation with stakeholders with a specific interest in local activities including local government representatives. Consultation through regular meetings with local government staff and elected representatives has occurred. Santos will ensure that these monthly discussions will continue to be offered, in line with its commitment to the Council. In addition, quarterly Government Information Forums are held with invitations extended to local officers of state government departments to provide information on projects and work schedules.
- 4) It is unclear what benefit there would be in undertaking a post-consultation assessment for the Bibblewindi EIS. The community engagement and consultation framework that Santos has in place has been specifically written to meet the requirements set in place by the NSW Government. If the current NSW Government guidelines are perceived as inadequate and are subsequently modified, Santos will ensure that its engagement and consultation framework is updated to reflect any changes that are made to that guideline.

4.10 Planning and statutory framework

4.10.1 Regulatory compliance

4.10.1.1 Issue description

- 1) Concern over past incidents by ESG including spills to Bohena Creek, and that existing infrastructure is not adequate to prevent further incidents occurring.

Santos is requesting approval for expansion of their activities before their prosecutions have been closed out.

- 2) What type of bond is being required to make good when an accident occurs? If Santos breach again will their approvals be revoked?
- 3) One respondent raised concern over environmental compliance of the mining and industrial sectors in general.

4.10.1.2 Response

- 1) Santos Limited acquired ESG on 17 November 2011. In July 2012 ESG was issued two penalty infringement notices (PINs) for pollution incidents which occurred at the Bibblewindi Water Treatment Facility prior to November 2011. The details of these PINs are as follows:

- Pollution of Bohena Creek on 11 March 2010 due to discharge of permeate, from the reverse osmosis (RO) plant at Bibblewindi, with electrical conductivity (EC) levels above background.
- Pollution of Bohena Creek on 25 November 2010 due to discharge of permeate, from the RO plant at Bibblewindi, with EC levels above background.

Santos Limited publicly released a report in February 2012 relating to incidents at the Bibblewindi Water Treatment Facility arising from ESG's operations prior to 17 November 2011. In June 2013, proceedings were commenced in the Land and Environment Court against Santos for breaches of the *Petroleum (Onshore) Act 1991* for notification and reporting failures relating to incidents which occurred prior to 17 November 2011 in relation to ESG's CSG operations within PAL 2. Santos NSW Pty Ltd pleaded guilty to these proceedings on 20 September 2013 and the penalty hearing in the Land and Environment Court was held on 18 December 2013.

On 10 January 2014, the NSW Land and Environment Court handed down its decision regarding reporting failures in relation to coal seam gas operations in the Pilliga Forest, NSW, previously owned and operated by ESG. Santos accepted the imposed fine of \$52,500. The incidents occurred when the operations were conducted by different management and Santos recognises the importance of ensuring that industry complies with the high environmental standards expected by the community. Santos acted transparently throughout the process, releasing a report on the operational issues uncovered in the Pilliga and bringing them to the attention of the regulator.

Since ESG was acquired by Santos Limited on 17 November 2011, new management has been appointed to ESG and ESG has been renamed Santos NSW Pty Limited. The RO plant at Bibblewindi Water Treatment Facility (the subject of the incidents) ceased operation on 15 December 2011 and has been decommissioned. Santos has commenced rehabilitation of vegetation surrounding the Bibblewindi facility which was affected by the incidents. Alternative arrangements for managing existing produced water and produced water from recommencement of operations have been progressed, and approval has been granted for the construction and operation of new water storage ponds at Leewood. The ponds at the Leewood Produced Water Facility will be

double lined and will have a leak detection system. Refer to Section 3.2.1.2 of the EIS for further details of the Leewood ponds.

In addition, Santos has significant financial capital, and has many years of experience in undertaking exploration activities for CSG. As a result, it has developed an extensive understanding of the steps and measures that should be taken to prevent or minimise its impact on the environment, human health and safety when undertaking exploration activities. Santos seeks to conduct its activities in a way that avoids and minimises potential impacts on the environment.

- 2) Under the *Petroleum (Onshore) Act 1991*, a security deposit must be provided to the government. This covers the full rehabilitation costs of the proposed activity, and is not released until the proposed activity works (including rehabilitation) have been completed satisfactorily.
- 3) Santos supports operating in a robust regulatory framework that enables the sustainable and safe exploration and development of Australia's valuable and abundant reserves of gas for the benefit of all Australians.

4.10.2 Commonwealth referral

4.10.2.1 [Issue description](#)

- 1) The proposed activity and the broader E&A Program will have a significant impact on Matters of National Environmental Significances (MNES) (Water Resources) and should be referred to the Commonwealth Scientific Panel for assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- 2) Concerned that the Federal Minister for Environment did not use the 'water trigger' and did not declare Santos' current activity in the Pilliga forest a 'controlled action'. Santos' proposed actions should have been referred to the Independent Expert Scientific Committee (IESC).
- 3) The referral was (artificially) restricted to exploration but should have included the future production activities. A study of the cumulative impacts of the entire proposed project should have been done by the IESC.

4.10.2.2 [Response](#)

- 1) Santos referred E&A Program activities within the Pilliga forest (including the proposed activity), to the Federal government for a decision under the EPBC Act in June 2013 (Section 6.3.1 of the EIS). On 1 October 2013, the Minister made the decision that the proposed action is not a controlled action if undertaken in a particular manner. The referral included an assessment of the potential cumulative impacts on the 'Water Resources from CSG development and large coal mining development'.
- 2) This is a matter for the Federal government. Santos' referral of the E&A Program under the EPBC Act included an assessment against the MNES 'water trigger' (water resource, in relation to coal seam gas development and large coal mining development). The Commonwealth Minister for the Environment assessed the E&A Program and concluded the Santos' E&A Program is not a CSG development that has or is likely to have, a significant impact on water resources, provided it is carried out in accordance with particular requirements.
- 3) CSG exploration, appraisal and production planning is an iterative process whereby the results of early stage activities are used to inform later stages of project development. As such, any future

exploration, appraisal or production activities beyond the E&A Program, including the Narrabri Gas Project, will be referred as considered necessary at the appropriate time.

4.10.3 Policy

4.10.3.1 [Issue description](#)

- 1) Concerns were raised over a number of NSW Government policy issues:
 - The adequacy of CSG exclusion zones that came into effect from 4 October 2013, which enforced a two kilometre buffer for new CSG activities across existing residential zones, as well as lands identified for future residential growth.
 - The domestic gas reservation policy does not protect against gas price increases. If the proposed activity is approved, the government will be at risk of litigation regarding property devaluation, impacts on water rights and legacy costs of contamination from well integrity risks.
- 2) It would be instructive for the proponent to undertake a detailed impact analysis against the *Namoi Catchment Action Plan 2010-2020* thresholds and targets, and requirements of the *Extractive Industries Policy 2009* for the Namoi Catchment and the *Namoi CMA Biodiversity Offsets Policy 2011*. Ideally this would be requested as part of the DGRs.

4.10.3.2 [Response](#)

- 1) These are policy issues for the NSW Government to consider.
- 2) The *Namoi Catchment Action Plan 2010-2020* (CAP) (NCMA, 2011) identifies biodiversity, land, water and people as the major natural resource management assets of the catchment. The proposed activity is located on existing cleared lease areas and is not expected to impact CAP thresholds and targets.

The *Namoi CMA Biodiversity Offsets Policy 2011* identifies principles to be applied when offsets are implemented for a proposed development. A key principle is that offsets will be used as a last resort after consideration of alternatives to avoid and/or mitigate impacts. The proposed activity has been located on existing cleared lease areas to avoid any further vegetation clearing and is therefore consistent with this policy.

An environmental risk assessment for the proposed activity has been undertaken as outlined in Chapter 7 of the EIS, in line with the *Extractive Industries Policy for the Namoi Catchment* (NCMA, 2009a).

4.10.4 Other regulatory comments

4.10.4.1 [Issue description](#)

- 1) NSW EPA needs to be adequately resourced to enable compliance monitoring.
- 2) All mining activities should go through an EIS process.
- 3) Concern that the Aquifer Interference Approvals have not come into effect. If the development does not require approval under section 91F of the *Water Management Act 2000* due to a technicality, the situation should be reviewed and remedied. Santos' development will clearly interfere with an aquifer.

- 4) Santos will need to ensure that appropriate WALs are in place to account for any take of groundwater.
- 5) Santos will need to submit a variation application to NSW EPA to add the proposed activity to the EPL application.

4.10.4.2 Response

- 1) This is a recommendation for the NSW Government to consider.
- 2) This is a recommendation for NSW Government to consider. However, Santos believes that consideration should be given to the nature and scale of the specific activity proposed as to whether it needs to go through an EIS process (as is already the case).
- 3) Section 9.4 and Appendix 3 of the EIS states that the proposed activity will constitute an aquifer interference. In addition, the NSW Office of Water undertakes an assessment of the proposed activity against the AIP as part of its review of the EIS. The requirement for an Aquifer Interference Approval is a policy matter for the NSW Government.
- 4) Santos has currently applied for a 600 megalitre WAL to account for all take of water for the proposed activity, and will continue to work with the NSW Office of Water to ensure that it obtains all the necessary licenses for the E&A Program.
- 5) Santos will submit a variation application to the NSW EPA to vary its application for an EPL if development consent for the proposed activity is granted.

4.11 **Environmental risk assessment**

4.11.1 **Issue description**

- 1) The risk assessment is insufficient as there is no mention of the 23 reported hazardous incidents involving the spilling of produced water, no detail on the management of weeds, the *NSW Coal Seam Gas Code of Practice Well Integrity* (DTIRIS, 2012) would not mitigate risk to stygofauna, the bushfire risk is underestimated and the heritage risk assessment is lacking.

4.11.2 **Response**

- 1) The risk assessment provided in the EIS is considered to be appropriate, given the nature and scale of the proposed activity (drilling of two additional wells on existing well pads, and operation of 14 wells for up to three years) and the mitigation measures that will be adopted. The risk assessment process inherently takes into account past pollution incidents. The potential for leakage or spills, weed invasion, risks to stygofauna and bushfires were identified during the preliminary environmental risk assessment, shown in Tables 7-1 and 7-2, and considered in further detail in the impact assessment chapters of the EIS. The mitigation measures are appropriate to manage the identified risks e.g. produced water will be managed in a purpose built gathering and storage system including double lined ponds with leak detection system.

4.12 Land resources

4.12.1 Issues raised by NSW Office of Agricultural Sustainability and Food Security

4.12.1.1 Issue description

The NSW Office of Agricultural Sustainability and Food Security considered that the EIS and AIS did not provide sufficient discussion of the following land resources aspects to fulfil the DGRs:

- 1) Detailed soils and land capability has not been conducted for the proposed activity.
- 2) Contamination has not been adequately addressed, and no information on soil contamination in relation to soil and land capability is provided.
- 3) Soil erosion and sediment transport has not been assessed; only a broad estimate based on one soil type (a Sodosol) has been made, mentioning sodicity and dispersion however not mentioning erosion.
- 4) Regional salinity has not been assessed.

4.12.1.2 Response

At the request of the NSW Office of Agricultural Sustainability and Food Security, further discussion on aspects of land resources are provided below.

1) Soils and fertility

Australian Soil Classification (ASC) soil order mapping (1:100,000) prepared by OEH (2012a) shows that the project area and the surrounding landscape is characterised by a single ASC soil order (Sodosols). Rudosols and Tenosols are also mapped approximately 1.5 kilometres south-east of the proposed activity. These soil orders are briefly described in Table 1.

Table 1 Australian Soils Classification

ASC Soil Order	Description
Sodosols	Soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon is sodic and not strongly acid.
Rudosols and Tenosols	These soils have weak (Tenosol) to negligible (Rudosol) pedological organisation.

Landscape unit mapping was prepared by DECC (2002) for the NSW (Mitchell) Landscapes. The landscape unit mapping shows that the project area is defined by a single landscape unit, Coghill Alluvial Plains, which is described in Table 2.

Table 2 Soil Landscape Units

Landscape Unit	Description
Coghill Alluvial Plains	Deep texture-contrast soils with harsh clay subsoils, grey clay with gilgai.

Ternary radiometric data images were sourced from Geoscience Australia using their Geophysical Archive Data Delivery System. The data was used to assist with delineating possible soil type boundaries by visual identification of broad patterns of radioactive isotope distribution in the landscape. The proposed activity area and nearby surrounds consist of weathered materials (green-blue) and quartz rich sandy materials (black). More importantly, the hue patterns are quite consistent across the Pilliga which supports the broadscale mapping of the dominant soil types (i.e. Sodosols and Rudosols/Tenosols) over this landscape.

ESG commissioned a soil survey of the proposed gas pipeline alignment from the Bibblewindi State Forest in the south to the Wilga Park Power Station in the north (GCNRC, 2008). The survey identified that the soils along the alignment in the Pilliga and Bibblewindi State Forests were dominated by deep texture contrast soils with a sub-dominant occurrence of deep sandy soils. The subsoil of the deep texture contrast soils was described as having a high to very high dispersion potential which is characteristic of Sodosol soils. The deep sandy soils observed in the Bibblewindi State Forest were light textured (sand to sandy loam) throughout the solum and are best classified as Rudosol/Tenosol soils.

The NSW Soil and Land Information Systems database identified three local soil observations within 5 to 10 kilometres of the proposed activity area to assist in validating broadscale mapping. Profiles 79, 80 and 81 were collected by random survey for the Southern Brigalow Western Regional Assessment to establish data for the Soil Landscapes of the Baan Baa 1:100,000 Map Sheet for Liverpool Plains (Pengelly, 2010). The texture contrast soil profile descriptions and pH data (pH greater than 5.5) reported was very similar to that previously encountered by RPS for Sodosols. Of particular note was the presence of a conspicuously bleached A2 horizon at all three sites which was also noted by RPS and is indicative of poor drainage due to the strongly sodic subsoils.

A site inspection of the proposed activity area was undertaken by RPS on 3 July 2013 which consisted of observations of vegetation types and noting features of the soil surface. The vegetation at the proposed activity area was consistent with the vegetation types previously observed by RPS associated with Sodosol soils in the Bibblewindi and Pilliga State Forests. The topsoil of the undisturbed area surrounding the project area was pale orange and of a coarse sandy texture. Hard-set clay subsoils with evidence of tunnelling and finely fretted erosion features were noted in soils exposed in nearby road cuttings. These soil surface features were consistent with properties of the Sodosol soils previously encountered by RPS at soil survey sites in the Bibblewindi and Pilliga State Forests.

A soil profile was extracted 13 kilometres north of the project area, within mapped Sodosols. Based on the physical and chemical properties, the soils within this region were considered to be Sodosols and defined as non-saline to moderately saline, with strongly sodic subsoils (>150 mm depth).

According to the *Draft Inherent Soil Fertility Mapping, Upper Hunter and New England North West Strategic Regional Landuse Areas* (OEH, 2012b), the inherent soil fertility of the proposed activity site and its surrounds is moderately low.

The vegetation associations and soil surface conditions noted during the site inspection confirmed that the likely soil type at the project area is a Sodosol. The soil survey previously conducted by RPS in the Pilliga and Bibblewindi State Forests found that Sodosol soils were the dominant soil type in the surveyed landscape. Considering the current inherent soil fertility mapping and the soil type (Sodosols) of the project area, the soils are likely to have moderately low to low fertility.

Land Capability and Agricultural Land Use Suitability

According to the NSW Agriculture Agricultural Land Classification (NSW, 2002) technical manual on agricultural land classification classes, lands that need not be evaluated include State forests. The proposed activity is located within the Bibblewindi State Forest. As the proposed activity is located within a State forest no Agricultural land classification has been undertaken. However, Agricultural land is largely classified by evaluating biophysical factors that may constrain the use of land for agricultural. A desktop assessment on other land and soil capability investigations and mapping which also largely considers biophysical factors is presented below.

In NSW, land and soil capability classes (LSC Classes) have been mapped for the New England - North West region (OEH, 2012c). The mapping is based on an eight class system with values ranging between 1 and 8 which represent a decreasing capability of the land to sustain land use. The site and surrounds have been mapped as LSC Class 4 and 5. Lands in LSC Class 4 are described as having moderate to severe limitations and are generally not capable of sustaining high impact land uses unless using specialised land management practices with high level of knowledge, expertise, inputs, investment and technology. Limitations are more easily managed for lower impact land uses (e.g. grazing). Lands in LSC Class 5 are described as having severe limitations and are not capable of sustaining high impact land uses except where resources allow for highly specialised land management practices to overcome limitations (e.g. high value crops). Lower impact land uses (e.g. grazing) can be managed by readily available practices.

The Soil Conservation Service (SCS) of NSW (Land and Water Conservation) uses 1:100,000 scale maps for evaluating rural land (Emery, 1986). Mapping is based on an assessment of the biophysical characteristics of the land, the extent that these will limit a particular land use and also includes assessments of soil erosion hazards. The SCS of NSW study classed the proposed site as a State forest and did not assign a land capability classification. Similar to the SCS mapping land capability mapping the NSW Department of Primary Industries land use assessment has not assigned the Bibblewindi State forest a land use suitability class.

Cropping history is a strong indicator of land use suitability for cropping. Cropping extent was mapped for the Border Rivers-Gwydir-Namoi CMAs using a process of manually digitising cropping paddock boundaries and attributing them with cropping history data established through field observations and Landsat TM imagery (NCMA, no date). The NSW OEH combined all cropping paddock boundaries digitised with a new set of polygons produced through automated image segmentation, adding further information to the digitised data. The Cropping History Assessment (1998-2008) indicates that no cropping has occurred on the proposed activity site during this period. No cropping has occurred at the site after 2008.

Considering the above information and soil limitations, the proposed activity area would not be considered appropriate for cropping, though low intensity grazing may be suited to the site.

- 2) The project area has not been identified as an existing contaminated site. Risk of soil contamination or reduction of land capability as a result of contamination are largely associated with fuel/oil spills, however risks will be mitigated by the measures identified in section 8.4 of the EIS.

During operation, the groundwater lifted from the coal seam will flow to the balance tank located at Bibblewindi 19H via a short section of pipe. The water transfer (or balance) tank at Bibblewindi 19H will be used for temporary storage of produced water. The water transfer tank will be bunded to 100 per cent capacity to minimise impacts of any spillage. Water from the balance tank will be transferred via the existing gathering system to the Bibblewindi Water Management Facility and then to the Leewood Produced Water Facility.

There is a risk that a line failure could occur within the gathering system that transfers lifted groundwater between the wells to the transfer tank at Bibblewindi 19H. Water pressure within the pipes is monitored remotely and should this occur, operation of the well will be suspended until the problem is rectified. The extent of the impact will also be small, localised and short term.

Impacts to structural integrity, land instability or subsidence are not expected.

Considering the low and minimal contamination risks and proposed mitigation measures it is unlikely that the proposed activity will reduce the low intensity grazing capacity of Land and Soil Capability Classes of 4 and 5.

3) *Sodicity*

Land Management Units mapping in the Namoi Catchment (NCMA, 2009b) was a project commissioned by the Namoi CMA and involved soil and land capability mapping (scale: 1:100,000) of the Namoi Catchment. Derivative maps were also created and included sodicity maps.

The sodicity mapping indicates that the location of the proposed activity is characterised by localised surface sodicity and widespread subsurface sodicity. Further, investigations undertaken by RPS have also found Sodosols within the Bibbiewindi State Forest and Pilliga forest to contain strongly sodic subsoils.

Dispersion

The ESG survey (GCNRC, 2008) also analysed soil dispersion susceptibility. The nearest site, Profile 6, was located 5.9 kilometres north of the proposed Bibbiewindi 32 site. Profile 6 was also identified as a Sodosol. The dispersion percentages identified that surface dispersions (0 – 0.14 m) was slightly dispersive (dispersion % = 6 – 30), while subsoils (<0.14 m) dispersion values were very high (dispersions % = >65). Surface dispersion potential is the most important consideration for a site with possible exposure of surface soil and minimal deep disturbance.

Erosion and sediment transport

The low slope of the landscape (1%) and moderate erosivity rainfall in the Narrabri region results in a relatively low erosion risk for the development. This assumes that the site will preclude on-site runoff and the disturbed area is relatively small. However, sodic and dispersive soils have been identified by both GCNRC (2008) and RPS (2013), therefore some management is required to minimise erosion risk (Section 8.4.1 of the EIS).

Soil texture has been identified as largely sandy with some clay content. Infiltration rates for this soil will be moderate to high. The transport of sediments should be minimal.

Erosion and sediment controls, such as silt fencing, will be implemented where necessary during site preparation activities in accordance with the Blue Book (Landcom, 2004). These controls will be maintained until disturbed areas of the site are stabilised. This measure is described in section 8.4 of the EIS.

- 4) The Australian Government's Department of Agriculture, Fisheries and Forestry compiled salinity risk and hazard mapping for 2000, 2020 and 2050 (NLWRA, 2001), showing the areas considered as having either a high salinity risk or a high salinity hazard. Groundwater data has been used and where this data is inadequate, salinity assessments have been based on the presence of geological, landscape, regolith, land use and climate attributes.

The Australian Dryland Salinity Assessment Spatial Data is at a scale of 1:2,500,000 and was created in 2001. There is no assessed dryland salinity within the proposed site or the surrounding area.

Conventionally saline soils are defined as those having an ECe value greater than 4ds/m. Profile assessment undertaken by RPS within Sodosols of the Pilliga Scrub indicated that 0 (0.28 ECe

ds/cm) to 460 millimetres (2.47 ECe ds/cm) are non-saline soils, while 460 to 760 millimetres depth is slightly saline.

4.12.2 Other issues raised

4.12.2.1 [Issue description](#)

- 1) The best food-producing lands and finest natural areas are at risk from CSG activity. The science tells us that CSG puts at risk the clean water and soil that is essential for food production.
- 2) The forest should remain as a resource enjoyed by the public for bushwalking, camping, tourism, birdwatching, forestry and cultural heritage practices.
- 3) Erosion and sediment controls should be implemented consistently with the guidelines, principles and recommended minimum design standards contained in *Managing Urban Stormwater: Soils and Construction – Volume 1* (the Blue Book).

4.12.2.2 [Response](#)

- 1) The site is located within the Bibbiewindi State Forest. The site is not located on or near BSAL and/or a CIC as defined in the *New England North West Strategic Regional Land Use Plan* (DP&I, 2012). The nearest mapped BSAL is approximately 15 kilometres from the site and no CIC has been identified in DP&I (2012).

The AIS that was undertaken for the EIS (Appendix 2) concluded that there would be no impact to agricultural land.

Produced water from the wells is not from the productive aquifers accessed by farmers and the community. It comes from deep underground and is not used by farmers and the community due to its depth and high salinity. Santos has developed an extensive regional groundwater model that simulates groundwater flow and predicts groundwater drawdown. The Groundwater Impact Technical Report (Appendix 3 of the EIS) predicted the effect of the E&A Program on productive groundwater resources to be negligible.

The proposed activity is located within areas that have been previously cleared for CSG activities. As outlined in the EIS, mitigation measures will be put in place to ensure the impact of the proposed activity is minimised.

- 2) The proposed activity is located within areas that have been previously cleared for CSG activities, with no additional area to be disturbed.
- 3) Santos agrees with this recommendation; the SoC has been updated accordingly.

4.13 Groundwater

4.13.1 Baseline monitoring

4.13.1.1 [Issue description](#)

- 1) The Director General requires baseline monitoring, however there is no baseline water study completed for the Pilliga groundwater systems. The aquifer monitoring bores required have not been constructed. The proposed deep and shallow bores should be installed and monitored to establish baseline conditions prior to further drilling.

- 2) Concern over the lack of information supplied by Santos for the Namoi Catchment Water Study.

4.13.1.2 Response

- 1) Baseline groundwater monitoring has been undertaken for bores (including at private water bores and NSW Office of Water bores) as part of the Santos Regional Bore Inventory and Monitoring Scheme. The collated data from a number of sources over a period of time provides a groundwater monitoring dataset for the region. The data is included in the *Bibbiewindi Gas Exploration Pilot Baseline Surface and Groundwater Data Report*, attached as Appendix 2.

The scheme was initiated for the Narrabri region in 2012, focusing on collecting groundwater samples and static water levels from landholder bores in close proximity to the CSG activities. As this data is collected and assessed, it expands on baseline data and understanding by providing greater spatial and temporal data resolution local to CSG activities. Seventy bores (mostly private farm bores) have been documented and groundwater samples analysed so far from within PEL 238.

To support the development of a regional baseline dataset, Santos has collated historical data collected by ESG and publicly available information from the NSW Office of Water. Data gathered includes:

- Produced water extraction rates from CSG pilot wells.
- Groundwater elevations from available NSW Office of Water aquifer monitoring bores.
- Produced water geochemical data from CSG pilot wells.
- Groundwater geochemical data from landholder bores.

As additional data is collected through Santos' ongoing environmental monitoring programs it will enable the expansion of this baseline dataset. The data will be used to assist in monitoring for any unexpected changes to overlying aquifers during the operation of the proposed activity.

- 2) Santos has provided sponsorship and geological & drill stem test (DST) data to the Namoi Water Catchment Study, which was finalised in August 2012.

Santos was actively involved in providing review comments and feedback to the Namoi Catchment Water Study.

4.13.2 **Model conceptualisation, development and calibration**

4.13.2.1 Issue description

- 1) The Conceptual Hydrogeological Model in Figure 9-1 appears to be incorrect, based on Santos' own data and other published geological maps. The conceptualisation of the hydrostratigraphic beds and how they interact with each other, including the aquitards and aquicludes, appears to be incorrect.

None of the confining beds have been positively identified. A number of beds are referred to as 'probable hydraulic barriers' or as an 'impedance to groundwater', but none have been recognised as barriers to groundwater movement.

- 2) The model layers used to build the Groundwater Numerical Model are not representative of the shallow hydrostratigraphy.
- 3) The model is considered to be based on insufficient hydraulic data. The lack of information on the assumptions required for model development, in particular basic hydrogeological or geological data,

is of concern. Without this data it is hard for technical reviewers to provide informed comments as to whether the conclusions reached in the EIS are justifiable or not.

The short comings of the model and the assumptions used give rise to concerns over the robustness of the results obtained, including the assessment of potential impacts of CSG activities on groundwater resources.

There should be thorough sampling and testing across the project area, including pump testing and water quality analysis, to enable modelling of regional groundwater flows and a comprehensive impact assessment of groundwater resources and GDEs in the Pilliga region. The additional data should be fed back into the numerical groundwater model, sensitivity analysis carried out and the model rerun.

- 4) The EIS acknowledges that 'the spatial coverage of groundwater measurement is sparse and as there are no targets for calibration over large areas of the model it is not possible to calibrate these areas'. The respondent would like to know what further data is required to calibrate the model.
- 5) The Maules Creek Formation is predicted to achieve 80 per cent recovery after ten years. This would appear to indicate hydraulic connectivity. Furthermore, rapid recovery after drawdown in both the Hoskissons and Maules Creek coal seams is shown, again appearing to indicate actual or potential hydraulic connectivity to aquifers. The Maules Creek Formation is listed as being a 'negligibly transmissive unit', an apparent contradiction to the rapid pressure recovery.
- 6) Narrabri Shire Council seeks further information on the conceptual groundwater model and the assumptions made in the groundwater modelling.
- 7) Insufficient information has been provided for the NSW Office of Water to assess the validity of the model and its suitability in making the required predictions. An additional detailed modelling report should be submitted to NSW Office of Water for review, including any peer review.

4.13.2.2 Response

- 1) Figure 9-1 in the EIS is a schematic cross section and reflects the current conceptual understanding of geology and hydrostratigraphy in the E&A Program area (based on Santos geological model data and agreed with Santos geologists). Further detail to support the schematic cross section and descriptions used is provided in the Groundwater Impact Technical Report (Appendix 3 of the EIS).

Table 3-1 of the Technical Report presents the hydrogeological classification of each model layer, and therefore each hydrostratigraphic unit. The litho-stratigraphy has been classified into significant transmissive units (STU) and less significant transmissive units (LSTU), probable negligibly transmissive units (PNTU) (restricting the transmission of groundwater) and negligibly transmissive units (NTU) (impeding groundwater flow). The purpose of these definitions is to recognise the relative significance of hydraulic properties of different units to the hydrogeological response of the system without attributing labels that carry generally-accepted but potentially inappropriate connotations, such as 'aquifer', 'aquitard' and 'aquiclude'. Hence a highly conductive, high-yielding stratum would be considered a typical example of a STU and a low-yielding stratum would be considered a LSTU.

- 2) The model was developed as a regional model to assess the impact of depressurisation of the target coal seam on the overlying formations. The focus of the model was not on the shallow system, but the groundwater system as a whole and the potential propagation of drawdown as a result of coal seam depressurisation. The model design and development was based on all information available

at the time. The Bohena alluvium is modelled as Hydrostratigraphic Unit (HSU) 1 while the Pilliga Sandstone and Keelindi Beds are modelled as HSU10. Minimal information is available relating to the Keelindi Beds. On the basis of its characteristic lithologies, it has been subsumed into the underlying Pilliga Sandstone for the purpose of its inclusion in the hydrogeological conceptualisation and numerical groundwater flow model.

- 3) The model is a Level 1 model, developed in accordance with the *Australian Groundwater Modelling Guidelines* (Barnett *et al.*, 2012), and is intended to provide the basis for an initial assessment of the responses of the system to hydraulic stress. Santos considers the level of data utilised in the model to be suitable for the level of assessment undertaken. As with the development of all scientific models, additional data will assist in model refinement.

A conservative approach, consistent with the precautionary principle, has been taken to all aspects of the design of the model in order to ensure that the model is sensitive to the simulated hydraulic stress (CSG water extraction). The approach taken to construct and parameterise the model has been extensively peer reviewed by leading independent authorities. Model construction utilised all baseline data available. In the absence of measured parametric data, values derived from relevant calibrated models in the locality were used. Extensive and targeted sensitivity analysis has been conducted to determine the significance of aspects of the model design and the hydraulic parameterisation of the model and ensure adequate conservatism.

By the end of 2013 Santos will have drilled and installed seventeen new groundwater monitoring bores, targeting the Upper and Lower Pilliga Sandstone, Orallo formation and Purlawaugh formation and one deep aquifer monitoring bore targeting strata surrounding the Black Jack and Maules Creek Coal measures. The data that will become available through the ongoing Regional Bore Inventory and Monitoring Scheme will be used to refine and validate the model, in accordance with the *Australian Groundwater Modelling Guidelines* (Barnett *et al.*, 2012).

- 4) Santos has utilised data available at the time of model construction to calibrate the model. As more data becomes available, the model parameters will be refined to incorporate this new data. Santos has a detailed geological model covering the entire project area and therefore has detailed information on the depth of all formations, including aquifer units.
- 5) The fast initial recovery is mainly due to the minimal storativity of the Maules Creek Formation which means a small amount of water, during extraction or during recovery, yields a large change in head.
- 6) Santos has approached the Narrabri Shire Council with the offer to meet and discuss various groundwater matters including numerical model conceptualisation and the monitoring program.
- 7) Santos is currently liaising with the NSW Office of Water, and will provide the groundwater model and independent peer review reports for review. Santos will continue to work with the NSW Office of Water to seek clarification on the comments they have made in their review and to respond to their concerns and questions.

4.13.3 Potential impacts to groundwater resources

4.13.3.1 Issue description

- 1) Concerns raised over the potential contamination of groundwater resources through leakages of chemicals used during drilling and cross-contamination between aquifers. Contamination could impact on the health of the community and environment, as well as create flow-on effects to local industries reliant on the groundwater resource.

- 2) Concerns raised over the potential drawdown of aquifers due to the extraction of groundwater. The drawdown of groundwater levels could potentially cause these resources to become inaccessible to native plants, crops or bores, or disconnected to local streams.
- 3) The EIS has not provided an assessment of the impacts of the proposed activity (including drilling) on water quality. Sufficient water quality information should be provided to allow an assessment against the minimal impact consideration for water quality in the AIP for affected water sources.
- 4) Concerns raised that the potential impacts on groundwater due to CSG are not known. The development of a CSG industry threatens the local community as it risks impacting on the groundwater supply and quality. These impacts could be long-term. Santos cannot guarantee water supply will not be adversely affected as a result of CSG activities.

4.13.3.2 Response

- 1) It is considered highly unlikely that water quality from the deeper water sources would have a pathway to migrate upwards. This is confirmed in the groundwater flow model. Wells will be designed and constructed in accordance with the *NSW Coal Seam Gas Code of Practice Well Integrity* (DTIRIS, 2012), as stated in Section 9.3.1 of the EIS. This Code of Practice includes mandatory requirements for well design, casing, cementing, wellheads and drilling fluids. Further to this, Santos will adopt best practice site environmental management measures to minimise the likelihood of accidental spillage, and have appropriate management and mitigation plans in place should a spillage occur as outlined in Section 8.4 of the EIS, to contain and prevent environmental harm.
- 2) Groundwater modelling has been undertaken at a regional scale to predict the impact of depressurisation of deeper water bearing strata on locally utilised aquifers. The groundwater impact assessment (Appendix 3 to the EIS) concluded that there is unlikely to be a significant decline in the shallow aquifer system, and this will prevent impacts on GDEs, local bore users and watercourses (including perennial watercourses outside of the Pilliga forest). Surface water baseline monitoring within the Pilliga forest indicates that many of the creeks are ephemeral, and therefore flow during high rainfall events only (Section 9.1.1 of the EIS).
- 3) Section 9.1.4 of the EIS presents a summary of water quality, while further details of baseline groundwater water quality data is presented in the *Bibblewindi Gas Exploration Pilot Baseline Surface and Groundwater Data Report* (Appendix 2). Furthermore, groundwater quality is assessed as a construction impact in Section 9.3.1 of the EIS. The groundwater flow model confirms that during operation it is considered highly unlikely that the more saline water from the deeper water sources would have a pathway to migrate upwards. Potential impacts to surface water during both construction and operation of the proposed activity are provided in Section 10.2.2 of the EIS. Given the scale of the proposed activity, and the implementation of appropriate mitigation measures, these are considered to be minimal.

During drilling, the circulating drilling fluid will establish a wall cake (a low permeability 'skin' around the wall of the hole) and maintain pressure on the various aquifers intercepted. This will prevent the ingress of groundwater to the pilot well, mixing of groundwater between aquifers and discharge of groundwater to the surface. It will also limit the ingress of drilling fluid into the aquifers in the immediate vicinity of the pilot well.

The focus of the AIP with regard to water quality is the alluvial aquifer. The AIP sets minimal impact considerations for water quality. For deeper aquifers, including both Porous Rock Water Sources and the Fractured Rock Water Sources, the AIP states that changes in groundwater should not change the beneficial use category of the groundwater source beyond 40 metres from the activity.

The NSW GAB Groundwater Source WSP states a range of beneficial uses. Santos' monitoring program will identify if impacts to the groundwater quality system are occurring.

- 4) Santos acknowledges the sensitivity of the availability of groundwater as a resource within the region. A detailed monitoring program has commenced and will be continued throughout the duration of Santos' activities in the Narrabri region. The monitoring program will identify if impacts to the groundwater system are occurring. If impacts to groundwater are identified, Santos' groundwater extraction activities in the localised area of the impact will cease, the issue investigated and appropriate mitigation and management measures will be implemented. In the event that Santos' operations are found to have impacted the capacity or quality of a useable aquifer, Santos will adhere to 'make good provisions' under the AIP.

4.13.4 Great Artesian Basin

4.13.4.1 Issue description

- 1) The Pilliga forest is a recharge area for the GAB and contributes surface water flows to the Murray-Darling Basin. Concerns that the GAB is at risk from proposed intensive CSG drilling, with potential declines in water quantity or quality which could have flow on effects to other industries. These impacts may not be easily fixed or compensated.

4.13.4.2 Response

- 1) Santos acknowledges that the Pilliga Sandstone which outcrops in parts of the Pilliga forest acts as a recharge bed for the GAB, and the need for due care when operating in the outcrop area. This has been reflected in the sensitivity of the receptor within the impact assessment. The groundwater impact assessment (Section 9.4 and Appendix 3 of the EIS) indicates that there will be negligible impact to the GAB due to the cumulative effects of the E&A Program.

4.13.5 Drilling techniques and well integrity

4.13.5.1 Issue description

- 1) Concerns that there is a risk of leakage of produced water or drilling fluid into the freshwater aquifers as a result of poor bore construction, creating potential groundwater quality impacts. In particular, drilling through the casing of wells poses a risk to the GAB and other aquifers as it is very difficult, if not impossible, to seal the junction between the casing and the lateral.
- 2) Concerns that there is a risk of leakage of produced water to the freshwater aquifers as a result of improper site practices, operational procedures or fracturing of casing and grouting. Gas wells fail over time, with seven per cent leaking immediately and 50 per cent within 20 years.
- 3) The *NSW Code of Practice for Coal Seam Gas Well Integrity* (DTIRIS, 2012) guidelines are being relied upon by the NSW Government to ensure Santos does not contaminate the water resource. Santos, however, is only required to adequately seal off 'producing aquifers' from each other. The Bohena alluvial aquifer might not be a 'producing aquifer' but it is still a lower quality aquifer that will be connected to the Pilliga during drilling activities and therefore poses a risk of leaking lower quality water into the GAB aquifer.

4.13.5.2 Response

- 1) The Biblewindi 31 and 32 wells will be designed and constructed in accordance with the *NSW Code of Practice for Coal Seam Gas Well Integrity* (DTIRIS, 2012) (Section 4.2.1 of the EIS). The Code of Practice established a best practice framework for the design, construction and maintenance of a

well, has undergone peer-review and been endorsed by the NSW Chief Scientist and Engineer. Complying with the Code of Practice is a condition of Santos' licence to explore in the Narrabri project area, to ensure the proposed activity is undertaken safely and the groundwater is protected.

During drilling, the circulating drilling fluid will establish a wall cake (a low permeability 'skin' around the wall of the hole) and maintain pressure on the various aquifers intercepted. This will prevent the ingress of groundwater to the pilot well, mixing of groundwater between aquifers and discharge of groundwater to the surface. It will also limit the ingress of drilling fluid into the aquifers in the immediate vicinity of the pilot well.

- 2) All Santos CSG wells are designed to ensure they are safe and prevent any interconnection between hydrocarbon bearing formations and aquifers and to ensure that gas is contained within the well and associated pipework and equipment without leaking. To achieve this, a completed well will consist of three layers of steel casing and cement. These casing strings and cement layers serve to maintain the well opening, isolate the coal seams from the overlying geologic formations and aquifers, and provide a conduit for fluids to flow from the formation to the ground surface.

Santos conducts regular monitoring and maintenance of all its wells. Routine operational visits are also undertaken to monitor well-head pressure and inspect casing and well-head equipment.

- 3) The GAB is classified as a beneficial aquifer, based on the definitions within the *NSW Code of Practice for Coal Seam Gas Well Integrity* (DTIRIS, 2012), and will therefore be isolated with cement in accordance with the Code of Practice. Furthermore, the Bohena alluvium is an intermittent aquifer fed primarily by rainfall and therefore not considered to be of poor quality. In areas where the Bohena alluvium intercepts the Pilliga Sandstone, it provides a direct source of recharge to the GAB.

4.13.6 Cumulative impacts

4.13.6.1 [Issue description](#)

- 1) The cumulative groundwater impact modelling should incorporate the proposed 400 production wells. The EIS does not address cumulative risk of drilling and extraction of groundwater.

4.13.6.2 [Response](#)

- 1) The numerical groundwater model used for the EIS assesses the cumulative impact of the operation of the six pilots that form the E&A Program including the proposed activity. Any future exploration, appraisal or production activities beyond the E&A Program, including the Narrabri Gas Project, will be modelled and assessed cumulatively as part of the environmental assessment documentation which supports any applications for approval once they are made.

In December 2013, Santos identified the proposed project area currently being considered for the Narrabri Gas Project. The project includes a gas field and a pipeline to transport the natural gas to the NSW market. The gas field will include:

- Up to 850 production wells.
- Monitoring of wells to provide continual information about water and gas volumes and well site security.
- A central water management and treatment facility to store and treat produced water for reuse.
- A central gas processing facility to treat and compress the natural gas.

Further details of the Narrabri Gas Project can be found at <http://www.santos.com/exploration-acreage/new-south-wales/narrabri-gas-project.aspx>.

4.13.7 Registered bores

4.13.7.1 Issue description

- 1) Bore census information is not presented in the EIS to verify the conclusion that there are no known bores extending into the Gunnedah-Oxley Basin groundwater source in the E&A Program area. A bore census covering all of the E&A Program area should be provided.
- 2) The EIS identifies that there are five registered extraction bores within five kilometres of the wells, however the predicted drawdown extends beyond this distance. All bores within the potential drawdown area should be identified and potential impacts quantified.

4.13.7.2 Response

- 1) Santos utilises groundwater data from registered bores which is publically available through the NSW Natural Resource Atlas (<http://nratlas.nsw.gov.au/wmc/custom/homepage/home.html>) or on the NSW Office of Water's *Pinneena 3.2 – New South Wales groundwater data archive*, the latest version of which was released in 2010.

Baseline groundwater data collation and monitoring has been undertaken for bores (including accessible private water bores and NSW Office of Water bores) in the vicinity of the E&A Program area as part of the Santos Regional Bore Inventory and Monitoring Scheme. This information, including bore locality data, is presented in the *Bibbiewindi Gas Exploration Pilot Baseline Surface and Groundwater Data Report* (Appendix 2).

- 2) The five kilometre buffer was used for assessing impacts to groundwater during construction. As stated in Section 4.6 of the Groundwater Impact Technical Report (Appendix 3 of the EIS), there are no known registered bores sourcing water from formations deeper than the Pilliga Sandstone in the E&A Program area. The predicted impact on registered water supply bores is stated in Section 4.6 of the Groundwater Impact Technical Report.

4.13.8 Groundwater monitoring program

4.13.8.1 Issue description

- 1) A hydrology and water quality baseline monitoring program should be implemented as part of the program that covers all aquifers potentially impacted by CSG production, including shallow aquifers.
- 2) One deep groundwater monitoring bore is considered inadequate to monitor the changes in the deep aquifer layers. Additional deep monitoring bores should be installed, or if they already exist, they need to be incorporated into the monitoring program. The bores should be installed with sufficient time to collect baseline data prior to the start of operations. The monitoring should continue over the life of the project as well as during recovery.
- 3) Inconsistent reporting of locations for the proposed groundwater monitoring bores between what is reported in the EIS and what was provided to the NSW Office of Water in the *Narrabri Gas Field Monitoring and Modelling Plan* should be clarified.
- 4) Narrabri Council requires further information to determine the adequacy of the monitoring program. The water quality monitoring program should include parameters indicative of contamination of groundwater by drilling fluids and vertical flow of groundwater. Council seeks that the monitoring suite includes: pH, EC, major ion, fluoride, silica, dissolved metals, nutrients, dissolved gases,

hydrocarbons and isotopic analysis. Monitoring must be undertaken using sampling protocols that have been approved by an appropriate agency e.g. NSW OCSG. It is essential that the monitoring program including isotope testing be implemented before any further wells are constructed. As part of this program the process to rehabilitate and repair the damage to the aquifers needs to be included.

- 5) Further information on the baseline monitoring results and the proposed trigger values when contingency measures will be implemented should be provided to Narrabri Council, as well as the proposed feasible contingencies.
- 6) Narrabri Council must be provided with an opportunity to review and comment on the proposed groundwater monitoring program.
- 7) The conclusion that there will be no significant impacts to groundwater pressure or flows will need to be confirmed as part of a rigorous groundwater monitoring program.

4.13.8.2 Response

- 1) Santos has baseline groundwater monitoring data for the E&A Program area, which is presented in the *Bibbiewindi Gas Exploration Pilot Baseline Surface and Groundwater Data Report* (Appendix 2). Santos is continuing baseline surface water quality sampling across the wider project area, stretching from the foothills of the Liverpool Ranges to downstream of Wee Waa. Further to this, Santos has committed to drilling shallow and deep groundwater monitoring bores to act as sentinel monitoring locations against which any impacts can be identified, with appropriate mitigation and/or management measures to be adopted where necessary.
- 2) As part of the E&A Program Santos is installing and operating a groundwater monitoring network to detect any changes in groundwater levels.

Over the appraisal program, Santos will install a regional deep aquifer monitoring bore (Dewhurst 8A) with pressure monitoring devices targeting the formations (Digby Formation, Arkarula Formation, Porcupine Formation and the top of the Maules Creek Formation) in the likely zones of depressurisation overlying the targeted coal seams. This bore is strategically located at the eastern periphery of the Narrabri Gas Project area within the Permo - Triassic strata from which depressurisation originates. Potential changes to fluxes due to vertical propagation between Triassic and Jurassic hydrostratigraphic units will be captured in this monitoring bore. The depressurisation data will complement existing depressurisation data derived from within the laterally extensive appraisal pilot wells.

This monitoring will also act as a sentinel for impacts on Groundwater Dependent Ecosystem (GDE) recharge springs at the Pilliga/Purlawaugh junction. Baseline groundwater pressure and quality data for deep formations are also available from the existing pilot wells. The depressurisation of the coal seams will be constantly monitored with data being utilised to update and calibrate the groundwater model.

- 3) Indicative groundwater monitoring bore locations were presented and discussed with the NSW Office of Water in the development of the *Narrabri Gas Field Monitoring and Modelling Plan*. The final locations of the bores are determined based on a number of factors, including review of hydrogeological data and accessibility issues.
- 4) Santos has offered to meet with the Narrabri Shire Council and discuss various groundwater issues, including numerical model conceptualisation and the monitoring program. As part of its Regional Bore Inventory and Monitoring Scheme, Santos undertakes water quality testing using analytical

suites which include pH, EC, major ion, fluoride, silica, dissolved metals, nutrients, dissolved gases and hydrocarbons.

- 5) Water quality data from the surface water and groundwater monitoring network will be made available to the public via an internet portal <http://www.santoswaterportal.com.au>.

The monitoring program discussed in Section 9.5.3 of the EIS has commenced and will continue throughout the duration of Santos' activities in the Narrabri region. The monitoring program will identify if impacts to the groundwater system are occurring. If impacts to groundwater are identified, Santos' groundwater extraction activities in the localised area of the impact will cease, the issue investigated and appropriate mitigation and management measures will be implemented. In the event that Santos' operations are found to have impacted the capacity or quality of a useable aquifer, Santos will adhere to 'make good provisions' under the AIP.

- 6) Santos has approached the Narrabri Shire Council with the offer to meet and discuss various groundwater issues, including numerical model conceptualisation and the monitoring program.

Activities within the PAL must be carried out in accordance with the POP which has been approved by the Director-General of NSW Trade and Investment. Under the POP, a GMMP has been developed by Santos, and approved by the State government.

- 7) Santos is in agreement with this statement.

4.13.9 Protection of water resources

4.13.9.1 Issue description

- 1) The Water Catchment Authority's recommendations, which were in a report submitted to the government, should be followed in full. The protection of water supply should be the first priority.
- 2) A remedial action plan in the event of adverse impacts to the groundwater such as leakage and cross contamination between aquifers as a result of the drilling and well construction process, as well as possible well failure into the future, should be provided.
- 3) A remedial action plan in the event of accidental contamination from the Bibbiewindi water transfer and Leewood produced water facilities should be prepared.

4.13.9.2 Response

- 1) Recommendations from both the Namoi Water and the Namoi Catchment Management Authority submissions have been considered, and are addressed within this submissions report as outlined in Appendix 1.
- 2) If impacts to groundwater are identified, Santos' groundwater extraction activities in the localised area of the impact will cease, the issue investigated and appropriate mitigation and management measures will be implemented. In the event that Santos' operations are found to have impacted the capacity or quality of a useable aquifer, Santos will adhere to 'make good provisions' under the AIP.
- 3) The tank at the Bibbiewindi Water Transfer Facility and the ponds at the Leewood Produced Water Facility will be double lined and have a leak detection system (Section 3.2.1 of the EIS). In the event of any spills or leaks Santos will employ its emergency response plan to manage and mitigate the situation.

4.13.10 Report discrepancy

4.13.10.1 Issue description

- 1) The EIS states 'no decline in groundwater level or change in flux' in the GAB Surat Pilliga Sandstone in Section 9.4.2. However, it also states that the Pilliga Sandstone aquifer will not be significantly impacted by the proposed activity in Section 9.4.4.

4.13.10.2 Response

- 1) To clarify, there is negligible predicted impact (defined as less than 0.5 metres) in the Namoi alluvium and the Pilliga Sandstone from the E&A Program, as provided in Section 4.1.2 of the Groundwater Impact Technical Report (Appendix 3 of the EIS).

4.14 Surface water

4.14.1 Issue description

- 1) It is a misunderstanding to state that there is only intermittent water in the creeks. The water courses may be filled with sand but the water table is close to the surface. The ecosystems of the Pilliga forest depend on this water and contamination or depletion should not be risked. There is a risk of contamination of streams and rivers caused by spills of produced water due to interconnectivity of aquifers and their surface expressions.
- 2) The EIS assumes that there will be no impact to registered surface water users because there aren't any. There are licensed water holders that have legal water rights to these ephemeral streams. Regardless of whether their works are developed or not, these water licence holders have a licence that is recognised under the *Water Management Act 2000*.

4.14.2 Response

- 1) Section 9.1.1 of the EIS acknowledges the presence of perched aquifers in the alluvium (thin veneers associated with the more minor tributaries), which would have a level of interconnectivity with the ephemeral streams during periods of higher rainfall. Santos will adopt best practice site environmental management measures to minimise the likelihood of accidental spillage, and have appropriate management and mitigation plans in place should a spillage occur as outlined in Section 8.4 of the EIS, to contain and prevent environmental harm.
- 2) Potential impacts to surface water during both construction and operation of the proposed activity are provided in Section 10.2 of the EIS. Given the scale of the proposed activity, and the implementation of appropriate mitigation measures, impacts to surface waters and their users are considered to be minimal. Santos will adopt best practice site environmental management measures to minimise the likelihood of accidental spillage, and have appropriate management and mitigation plans in place should a spillage occur as outlined in Section 8.4 of the EIS, to contain and prevent environmental harm.

4.15 Biodiversity

4.15.1 Baseline monitoring

4.15.1.1 Issue description

- 1) Ecological surveys to establish parameters for maintaining the viability of threatened wildlife have not been carried out. There must be baseline ecological surveys to assess the population dynamics and status of threatened wildlife, including the Pilliga Mouse, Eastern Pygmy Possum and Barking Owl.

Concern that there is a lack of sufficient scientific evidence and baseline studies on impacts to biodiversity.

4.15.1.2 Response

- 1) The proposed activity will not involve any clearing of vegetation as construction (including drilling) and operation is confined to existing lease areas, therefore negligible impacts to biodiversity are anticipated.

More than 3,000 hours have been spent conducting ecological surveys in the north-east Pilliga forest since 2002. Surveys have been undertaken specifically for the purpose of establishing the baseline ecological values to assess the potential impact of CSG development.

4.15.2 Survey methodology

4.15.2.1 Issue description

- 1) The survey methodology has not been adequately explained, including the spatial coverage, search effort and effectiveness of measures employed.
- 2) The use of Biometric Vegetation Types is not appropriate as it does not discriminate between small scale vegetation structural and floristic characteristics and habitat attributes.
- 3) The area of impact is insufficient. It should be greater than the well lease pad plus 20 metres, particularly for indirect impacts.

4.15.2.2 Response

- 1) The proposed activity will not involve any clearing of vegetation as construction (including drilling) and operation is confined to existing lease areas, therefore negligible impacts to biodiversity are anticipated.

However, detailed descriptions on methodology and results can be found in the ecological assessments prepared for the E&A Program (including the proposed activity) (RPS, 2012a-d; RPS, 2013b-e). These ecological assessments form the foundation of the Impact Assessment under the EPBC Act report (ELA, 2013a; refer to Appendix 3) for activities included in the E&A Program.

- 2) The proposed activity will not involve any clearing of vegetation as construction (including drilling) and operation is confined to existing lease areas.

However, the vegetation classification system used in the Impact Assessment under the EPBC Act report (ELA, 2013a; refer to Appendix 3) follows the NSW OEH survey and assessment guideline for classifying native vegetation in NSW (OEH, 2013a).

At the time of the assessment, this was the best available mapping at a scale which effectively covered the E&A Program and existing exploration and appraisal activities, allowing a comparison of vegetation and habitat loss within the study area.

- 3) The proposed activity will not involve any clearing of vegetation as construction (including drilling) and operation is confined to existing lease areas, therefore negligible impacts to biodiversity are anticipated.

Potential temporary indirect impacts such as weed invasion, disruption of breeding cycle, noise, dust, light and fauna/vehicle road interactions were considered in Section 5.2.9 - 5.2.15 of the Ecological Assessment for the proposed activity (RPS, 2013e).

4.15.3 Cumulative impacts

4.15.3.1 Issue description

- 1) CSG exploration in the Pilliga forest to date has resulted in substantial environmental damage, including clearing of vegetation, habitat loss and fragmentation. Continued CSG activity could result in further loss of habitat, fragmentation of continuous forest and edge effects which will have an impact on the territories, distribution and abundance of threatened species. There are also risks of impacts on biodiversity due to contamination and fugitive emissions. Need for a detailed description of the likely interactions between the development and existing, approved and proposed gas exploration and production.
- 2) Impact assessment under the EPBC Act is insufficient.
- 3) No description of how the measures to avoid, minimise and mitigate have been applied
- 4) The occurrence of the Critically Endangered Ecological Community (CEEC) *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* needs to be considered.
- 5) There was no reference to findings in *The ecological values of the Pilliga East Forest and threats posed by Coal Seam Gas mining 2011-2012* (NICE and CUCCLG, 2012) report.
- 6) Roads and pipelines should be considered effective barriers to movement of fauna and are different to forestry roads as they will carry more consistent and higher volumes of traffic.

4.15.3.2 Response

- 1) A detailed assessment of the E&A Program (including the proposed activity) and existing exploration and appraisal activities has been undertaken through the preparation of cumulative impact assessments under the EPBC Act and the *NSW Threatened Species Conservation Act 1995* (TSC Act) (ELA, 2013a,b), attached as Appendices 3 and 4 respectively.

CSG exploration, appraisal and production planning is an iterative process whereby the results of early stage activities are used to inform later stages of project development. As such, any future exploration, appraisal or production activities beyond the E&A Program, including the Narrabri Gas Project, will be assessed when the relevant applications are lodged. These assessments will continue to incorporate cumulative impact assessments, and additional approvals will be required by both State and Federal government.

CSG exploration and appraisal activities in the Pilliga forest and north of the Pilliga from 2002 to present have resulted in the loss of approximately 175.5 hectares of vegetation. This includes

vegetation recently cleared for the E&A Program and represents a total loss of approximately 0.37 per cent of vegetation within the study area (defined as an area covering approximately 48,000 hectares and includes (in part) Pilliga East State Forest, Bibblewindi State Forest, Jacks Creek State Forest and Pilliga East State Conservation Area as well as Crown Land and privately owned land).

While there has been clearing of vegetation and loss to fauna habitats as a result of the exploration and appraisal activities, the total loss is not considered significant in relation to the amount of available habitat within the study area and region.

Given the relatively small amount of clearing as a proportion of available habitat, the current land uses and extent of rehabilitation (completed and proposed), exploration and appraisal activity impacts are not expected to significantly fragment or reduce the availability of habitat in a way which will adversely affect species within the study area.

A detailed fragmentation analysis was undertaken as part of the cumulative impact assessment for the EPBC Act report including the proposed activity which is included at Appendix 3. The analysis concluded that small number of additional short-term breaks across potential movement pathways was unlikely to significantly affect threatened species.

- 2) The proposed activity involves no clearing and is highly unlikely to significantly impact any EPBC Act listed threatened species, populations or communities, or their habitats. The level of assessment provided in the Appendix 4 of the EIS is therefore considered adequate. Santos separately referred E&A Program activities, including the proposed activity, to the Commonwealth government for assessment under the EPBC Act in July 2013. The Impact Assessment under the EPBC Act report (ELA, 2013a included as Appendix 3) which accompanied that referral is based on the results of more than 3,000 hours of ecological surveys in the north-east Pilliga forest since 2002.

Targeted surveys were undertaken for the E&A Program (including the proposed activity) by RPS (2012a-d, 2013b-e) which address the potential impacts of the E&A Program on MNES.

The purpose of the cumulative impact assessment (Appendix 3) was to assess the impact of the E&A Program on MNES and provide a cumulative assessment as to whether the E&A Program, when added to the existing exploration and appraisal activities, would be likely to have a significant impact on MNES.

- 3) Details on measures taken to avoid, minimise and mitigate impacts are contained within the ecological assessments (RPS, 2012a-d; RPS, 2013b-e) which support the Impact Assessment under the EPBC Act report (ELA, 2013a; refer to Appendix 3).
- 4) The E&A Program (including the proposed activity) does not require clearing of any vegetation which could be considered to constitute *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*.
- 5) More than 3,000 hours have been spent conducting ecological surveys in the north-east Pilliga forest since 2002. Surveys have been undertaken specifically for the purpose of establishing the baseline ecological values to assess the potential impact of the E&A Program and the proposed Narrabri Gas Project. These surveys form the foundation of the Impact Assessment under the EPBC Act report (ELA, 2013a; refer to Appendix 3).

The NICE and CUCCLG (2012) report information has informed the preparation of, and is directly cited in, the cumulative impact assessment report prepared for the EPBC Act Referral in relation to

determining the presence and potential significance of the species *Pseudomys pilligaensis* (Pilliga Mouse) and included as Appendix 3.

While the NICE and CUCCLG (2012) report is not directly cited in relation to all species, a range of other studies (e.g. NPWS, 2000; NPA, 2002; Ecotone, 2009) including threatened species data from NSW Bionet (Atlas of NSW Wildlife) have been included and are considered adequate for determining the significance of impacts to threatened species.

- 6) There are no roads or pipelines to be installed as part of the proposed activity. However in response to the comment made, as stated in the cumulative impact assessment (ELA, 2013a; refer to Appendix 3), up to 60 per cent of the clearing associated with flow lines and water and gas gathering systems, other components of the E&A Program, will be rehabilitated following installation. This effectively reduces a short-term width of 10 metres for flow lines and water and gas gathering systems down to four metres for an access track following construction.

These access tracks will carry increased volumes of traffic during construction with reduced volumes during operation and are considered unlikely to be long-term barriers to movement of fauna.

A detailed fragmentation analysis was undertaken as part of the cumulative impact assessment for the E&A Program under the EPBC Act report (including the proposed activity) (Appendix 3). The analysis concluded that a small number of additional short-term breaks across potential movement pathways are unlikely to significantly affect threatened species.

4.15.4 Threatened species

4.15.4.1 [Issue description](#)

- 1) Potential impacts (including cumulative) to threatened species, such as *Pseudomys pilligaensis* (Pilliga Mouse), *Cercartetus nanus* (Eastern Pygmy Possum), *Macropus dorsalis* (Black-striped Wallaby), *Nyctophilus corbeni* (South-eastern Long-eared Bat) and *Phascolarctos cinereus* (Koala) need to be considered.
- 2) A Species Impact Statement (SIS) should be undertaken.

4.15.4.2 [Response](#)

- 1) The proposed activity does not require any additional clearing of vegetation and therefore no threatened species will be directly affected by the proposed activity.

Cumulative impact assessments, considering both direct and indirect impacts, have been completed for the E&A Program for threatened species and communities listed under the TSC Act and the EPBC Act including *Pseudomys pilligaensis* (Pilliga Mouse), *Cercartetus nanus* (Eastern Pygmy Possum), *Macropus dorsalis* (Black-striped Wallaby), *Nyctophilus corbeni* (South-eastern Long-eared Bat) and *Phascolarctos cinereus* (Koala) (ELA 2013a,b) These are provided as Appendices 3 and 4 to this report.

The cumulative impact assessments concluded that given the relatively small extent of clearing as a proportion of available habitat (both within the study area and the Namoi CMA region), minimisation of fragmentation impacts by locating linear infrastructure (flow lines) along existing tracks wherever possible, and measures proposed to avoid, minimise and mitigate impacts, the E&A Program (including the proposed activity) and existing exploration and appraisal activities are not expected to significantly fragment or reduce the availability of habitat in a way which will adversely affect ecological values listed under the TSC Act or EPBC Act within the study area.

- 2) Species Impact Statements (SIS) are not required for SSD - Schedule 1, clause 2 (1)(f) of the *Environmental Planning and Assessment Regulation 2000*, however cumulative impact assessments have been completed for threatened species and communities listed under the EPBC Act and the TSC Act (ELA, 2013a,b; refer to Appendices 3 and 4).

4.15.5 Pilliga Mouse

4.15.5.1 Issue description

- 1) Targeted surveys for the Pilliga Mouse have not targeted breeding habitat or habitat characterised by vegetation regenerating after relatively recent fire with a dense, floristically diverse, low shrubby understorey, a sparsely vegetated ground layer and a well-developed leaf litter layer.
- 2) It is incorrect to link the Pilliga Mouse with the widespread *Pseudomys delicatulus* (Delicate Mouse).
- 3) Santos has admitted that their CSG exploration will destroy habitat for the Pilliga Mouse. The safety of the Pilliga Mouse cannot be assured under this proposed activity.

4.15.5.2 Response

- 1) Surveys were not undertaken as the proposed activity will not involve any clearing of vegetation as construction (including drilling) and operation is confined to existing lease areas. Therefore, the Pilliga Mouse is unlikely to be directly affected by the proposed activity.

However, surveys for the E&A Program specifically targeted *Pseudomys pilligaensis* (Pilliga Mouse) breeding habitat using appropriate methodology (RPS 2012a, 2012c, 2013b) and resulted in the detection of this species.

- 2) The cumulative impact assessment prepared for the EPBC Act referral (ELA, 2013a; refer to Appendix 3) does not attempt to 'downgrade' the status of Pilliga Mouse, rather it presents currently accepted information presented in both the Department of Environment's (DoE) threatened species guidelines (SEWPaC, 2012) and other recent publications (Breed and Ford, 2007; Ford, 2008) regarding the uncertainty surrounding the presence of a distinct *Pseudomys* species in the Pilliga.

The cumulative impact assessment (Appendix 3) goes further to comment that 'this taxonomic change has not yet been formally recognised under the EPBC Act, hence this report considers the Pilliga Mouse as currently listed'. This recognises that although there is uncertainty in respect to the status of the Pilliga Mouse, the assessment has proceeded on the basis that the Pilliga Mouse is a distinct taxa as listed under the EPBC Act.

- 3) The proposed activity will not involve any clearing of vegetation as construction (including drilling) and operation is confined to existing lease areas. Therefore, the Pilliga Mouse is unlikely to be directly affected by the proposed activity.

Full consideration of the impact of the E&A Program (including the proposed activity) and existing exploration and appraisal activities on the Pilliga Mouse is contained within the cumulative impact assessments completed for threatened species and communities listed under the EPBC Act and the TSC Act (ELA, 2013a,b; refer to Appendices 3 and 4) and within the ecological assessments (RPS, 2012a-c; RPS, 2013b-d) which support the cumulative impact assessments.

4.15.6 South-eastern Long-eared Bat

4.15.6.1 Issue description

- 1) No assessment of high frequency noise on the South-eastern Long-eared Bat.
- 2) No assessment of the potentially damaging effects that drinking water from holding ponds is likely to have on the South-eastern Long-eared Bat.
- 3) No assessment of loss of foraging habitat and increased fragmentation on the South-eastern Long-eared Bat.
- 4) Detail required on targeted surveys undertaken for South-eastern Long-eared Bat. Assumptions made about Pilliga forest representing a stronghold for the species. Inadequate assessment of impact to hollow bearing trees required for roost and maternity sites, noise, impact on foraging habitat and vegetation gaps.

4.15.6.2 Response

- 1) The potential impacts of noise have been considered in the Section 5.2.11 of the Ecological Assessment for the proposed activity (RPS, 2013e).

The proposed activity may result in short-term increased noise pollution, which has the potential to temporarily disrupt foraging and roosting behaviour of some native fauna species (including the South-eastern Long-eared Bat). However, considering the paucity of intact overstorey vegetation, including a general lack of hollow bearing trees, the habitat surrounding the proposed activity is considered unlikely to contain large numbers of this species.

Considering the lack of suitable habitat resources and the short-term duration of the proposed activity, it is considered unlikely that the proposed activity will have a significant impact on the South-eastern Long-eared Bat.

- 2) The storage ponds at Leewood are located to the north of the Pilliga Forest and are unlikely to pose a significant risk to the South-eastern Long-eared Bat population. Bats are drawn to natural systems which are surrounded by native vegetation, have good flyways and good habitat structure in wetland areas which provides habitat for their prey. The location, lining and maintenance of the storage ponds is likely to minimise the potential for the development of a food resource for the South-eastern Long-eared Bat. As such the storage ponds would be considered relatively low risk for any potential impacts on the South-eastern Long-eared Bat.
- 3) The proposed activity does not require any additional clearing of vegetation and therefore no threatened species will be directly affected by the proposed activity.

A detailed fragmentation analysis was undertaken as part of the Impact Assessment under the EPBC Act report (including the proposed activity) (ELA, 2013a; refer to Appendix 3). The analysis concluded that a small number of additional short-term breaks across potential movement pathways was unlikely to significantly affect threatened species.

- 4) The proposed activity does not require any vegetation clearing and will not impact on any hollow-bearing trees.

Surveys for *Nyctophilus corbeni* (South-eastern Long-eared Bat) have been previously undertaken as part of ecological studies into the biodiversity values of the north-east Pilliga Forest for the

purpose of establishing the baseline ecological values to assess the potential impact of CSG development.

The Pilliga forest region is known to be the distinct stronghold for the South-eastern Long-eared Bat (OEH, 2013b). There are numerous records for this species within the study area and Pilliga Forest region.

Surveys by NICE and CUCCLG (2012) captured 21 individuals at eight sites over 20 trap nights within and adjoining the study area, suggesting a relatively large population of South-eastern Long-eared Bat occurs in the north-east Pilliga Forest.

An assessment of the impact to hollow bearing trees is contained within the ecological assessments (RPS, 2012a-c; RPS, 2013b-d) which support the Impact Assessment under the EPBC Act report (ELA, 2013a; refer to Appendix 3).

This information has informed the preparation of the Impact Assessment under the EPBC Act report (Appendix 3) in determining the presence and potential significance of this species. Whilst the NICE and CUCCLG (2012) report is not directly cited in relation to the South-eastern Long-eared Bat, a range of other studies (NPWS, 2000; NPA, 2002; Ecotone, 2009) including threatened species data from NSW Bionet (Atlas of NSW Wildlife) have been included and are considered adequate for determining the significance of impacts to this species.

4.15.7 Invasive species and pathogens

4.15.7.1 Issue description

- 1) Impacts of invasive species (feral animals) are likely to increase with CSG development.
- 2) *Phytophthora* is already present at drilling sites.
- 3) Increased potential for weeds and *phytophthora* as a result of additional traffic. Mitigation measure of vehicles to be washed down where they have been exposed is not sufficient. Washdown should occur for all vehicles.

4.15.7.2 Response

- 1) Populations of invasive species such as the *Vulpes vulpes* (European Red Fox) and *Felis catus* (Feral Cat) are already well established and move freely through the study area.

Studies undertaken in 2013 detected significant numbers of invasive species including the European Red Fox and Feral Cat with remote cameras.

The E&A Program (including the proposed activity) is unlikely to exacerbate the impacts of invasive species as it has been designed to minimise fragmentation impacts by locating linear infrastructure (flow lines) along existing tracks wherever possible which limits the creation of new pathways for invasive species.

- 2) *Phytophthora* has not been identified on any current Santos drilling sites.
- 3) The Ecological Assessment for the proposed activity (Appendix 4 of the EIS) includes a procedure to wash down all plant and machinery (including vehicles) prior to being transported to the site to prevent the spread of weeds and importation of *Phytophthora cinnamomi*. This is considered appropriate.

4.15.8 Stygofauna

4.15.8.1 Issue description

- 1) The EIS states that no stygofauna has been found within the sampled groundwater however, a study by Serov in 2012 shows that there are unique stygofauna populations within the alluvial groundwater of the Pilliga East State forest area.
- 2) Stygofauna must be studied to determine and describe the species and community present and identify their conservation significance. There must be comprehensive baseline assessment of GDEs (including stygofauna), including the potential impacts of any drawdown.

4.15.8.2 Response

- 1) Section 5.2.1 of the Ecological Assessment (Appendix 3 of the EIS) states that '*Recent investigation by Eco Logical has not identified significant stygofauna populations within groundwater sampled from monitoring wells located in similar groundwater sources.*' This references monitoring undertaken from groundwater sources of similar nature to the target coal seam aquifers.

Section 11.3.5 of the EIS report acknowledges that stygofauna are known to occur within the Namoi River alluvial aquifer, with limited potential for their presence in the shallower GAB sandstone aquifers present within the proposed activity area.

- 2) Stygofauna is unlikely to be present in the shallower GAB sandstone aquifers located within the proposed activity area, such as the Pilliga Sandstone (Section 11.3.5 of the EIS). For these to be suitable for stygofauna, they would have to be highly fractured or weathered enough to allow stygofauna movement and a sufficient flux of water, oxygen and organic matter. The suitability of these rock aquifers as stygofauna habitat diminishes with depth from the surface.

The deeper target coal seam aquifers are unlikely to contain stygofauna as:

- the space available for movement is reduced significantly with increasing depth
- there is an overall decline in water quality as depth from surface increases.

The proposed activity potentially poses the following threats to stygofauna:

- Penetrating suitable habitat during drilling and the subsequent draining of the aquifer or contamination through trans-boundary flow between aquifers
- Depressurisation of underlying aquifers causing a change in the physical structure of stygofauna habitat that may result in drainage or contamination from more saline water.

Further details are provided in *Pilliga Stygofauna Review – Santos Energy NSW Coal Seam Gas Exploration and Extraction Activities*, prepared by Eco Logical Australia (attached as Appendix 5).

Neither of the proposed wells requires drilling through alluvial aquifers, significantly reducing the potential for impact to stygofauna.

Provided drilling, operation and closure activities are undertaken in accordance with the relevant guidelines and legislation, the proposed CSG drilling and extraction activities are unlikely to pose a significant threat to any known or likely stygofauna habitat.

4.15.9 Pilliga conservation

4.15.9.1 Issue description

- 1) The Pilliga forest has significant biodiversity values which are threatened by CSG development and should be protected.
- 2) The E&A Program area in the Pilliga East Forest was identified as Tier 1 biodiversity in the NSW Government Draft Strategic Regional Land Use Policy.

4.15.9.2 Response

- 1) In recognition of the high ecological and landscape value of the Pilliga forest, over 240,000 hectares of conservation reserve have been gazetted under the NPW Act since the 1960s. The Pilliga Nature Reserve (83,000 hectares) was first reserved in 1968. Thirty years later, regional assessments of the Brigalow and Nandewar Bioregions (NPWS, 2000) culminated in the NSW Government's decision in 2005 to conserve an additional 160,000 hectares of CCA in the Pilliga region under the BNCCA Act. This area focuses on the central, southern and western extents of the Pilliga forest. Today, approximately half of the Pilliga forest is now reserved under the NPW Act, with the other half retained as State forest for commercial timber production, recreation and mineral extraction.

As part of the BNCCA Act, four CCA zones have been defined:

- Zone 1: Conservation and recreation (National Park)
- Zone 2: Conservation and Aboriginal culture (Aboriginal Area)
- Zone 3: Conservation, recreation and mineral extraction (State Conservation Area)
- Zone 4: Forestry, recreation and mineral extraction (State Forests)

Of the 240,00 hectares of reserve, a total of 146,000 hectares, including Pilliga Nature Reserve, four CCA Zone 1 reserves (National Parks) and two CCA Zone 2 reserves (Aboriginal Areas) are precluded from logging and mineral/petroleum exploration. Three CCA Zone 3 reserves (State Conservation Areas) totalling 94,000 hectares, were created to 'protect important conservation values in western NSW and ensure the long-term sustainability of the region's important timber, gas, minerals and apiary sectors'.

The area within which the proposed activity is located is entirely within 'Zone 4' (Forestry, recreation and mineral extraction (State Forests)) under the BNCCA Act. As mineral extraction is a permitted use in Zone 4, the proposed activity is considered consistent with the BNCCA Act.

- 2) An overview of the NSW Government's Strategic Regional Land Use Plan (SRLUP) is included in Section 2.2.3 of the EIS. The final SRLUP does not include mapping for biodiversity values.

4.15.10 Other biodiversity concerns raised

4.15.10.1 Issue description

- 1) Potential for work to extend outside area investigated – conflicting information presented in the ecological assessment.
- 2) Indirect impacts such as noise and light impacts on fauna during operation have not been assessed.
- 3) Offsets are inadequate in protecting threatened species.

- 4) No data on the presence of hollow bearing trees has been included.

4.15.10.2 Response

- 1) All work will be contained within the existing cleared footprints associated with the Bibblewindi 14 and 19H lease areas (refer to section 3.1.1 of the EIS). There is no proposal to extend work outside of the existing cleared area. Any future proposal to extend works outside of the lease areas and access tracks would require additional ecological assessment and government approvals.
- 2) Potential temporary indirect impacts such as weed invasion, disruption of breeding cycle, noise, dust, light and fauna/vehicle road iterations were considered in Section 5.2.9 - 5.2.15 of the Ecological Assessment (Appendix 4 of the EIS).
- 3) The NSW Government has developed a set of principles that apply in determining the impacts of SSD on biodiversity in NSW. These principles set out a hierarchy of control to deal with impacts upfront, the methods to calculate impacts, legal context and the types of offsets that may apply.

The proposed activity does not require any additional clearing of vegetation and therefore no threatened species will be directly affected by the proposed activity. As such no offsets are required for this proposed activity.

- 4) The proposed activity will not involve any clearing of vegetation, including hollow-bearing trees, as construction (including drilling) and operation is confined to existing lease areas.

However, cumulative hollow-bearing tree data for the E&A Program is presented in the ecological assessments (RPS, 2012a-c; RPS, 2013b-d) which support the cumulative impact assessment for the E&A Program (ELA, 2013a; included as Appendix 3).

4.16 **Air quality**

4.16.1 **General concerns raised**

4.16.1.1 Issue description

- 1) Concerns about the potential negative impact this exploration will have on air quality.
- 2) Recommendation of a peer review of the modelling used to ascertain the Nitrous Oxide conversions and modelling methodology described on page 13 of the Air Quality Impact Assessment (Appendix 5 of the EIS) to ensure these calculations are correct.
- 3) The EIS does not include an assessment of potential fugitive emissions from the project, which could include VOCs and PAHs. It is recommended that the proponent considers the potential for fugitive emissions and the impact of these emissions at the nearest receptors.

4.16.1.2 Response

- 1) An Air Quality Impact Assessment was undertaken as part of the EIS (Appendix 5). The assessment concluded that the additional air quality impacts arising from the proposed activity would be minor at the surrounding sensitive receptors. It also concluded that changes in air quality due to the proposed activity is unlikely to be detectable, with results showing that the levels would be well below the relevant criteria for the pollutants assessed.
- 2) The DP&I and NSW EPA will review the Air Quality Impact Assessment in conjunction with the EIS.

- 3) To safeguard against fugitive emissions there will be sensors at transitional points across the well head and pipe network that will trigger automatic shutdown of wells in the event of a leak, until it is found and repaired. Further, the nearest sensitive receptor is located 7.5 kilometres from the proposed activity and is unlikely to be affected by any fugitive emissions.

4.16.2 Baseline data and monitoring

4.16.2.1 Issue description

- 1) The DGRs state that an assessment of the risk of fugitive emissions on environmental and human health should be undertaken. The baseline atmospheric methane data collection against which to assess any future potential fugitive emissions and Independent Health Impact Assessment (HIA) of north-west NSW to establish baseline health data and air quality information has not yet been conducted. One of the DGRs is to assess the risk of these emissions and their effect on the environment and human health, therefore it is imperative that HIAs be a compulsory part of any planning of major works and industry that could cause long and short term health issues for communities. Determining these methane baselines should be the first priority, and no development should occur before baseline data is collected.
- 2) A Leak Detection and Repair program should be incorporated into the fugitive emissions monitoring program, conducted in accordance with *US EPA Method 21 - Determination of Volatile Organic Compound Leaks*.
- 3) Concern about the lack of suitable site-specific nitrogen dioxide (NO₂) data being available to quantify the existing ambient levels at the site. Using data from the Muswellbrook NSW EPA monitoring site is inappropriate. The air quality in the heavily industrialised Muswellbrook and the forest ecosystem of the Pilliga are completely different. A suitable ambient monitoring station should be set up in the vicinity of the proposed activity before drilling commences.

Suitable site-specific carbon monoxide (CO) data collection points to quantify the existing ambient levels at the site are also required. Without these baselines, there will be no way to accurately measure or prove increasing levels as a result of the CSG drilling in the Pilliga forest.

4.16.2.2 Response

- 1) Santos and the University of Adelaide have been undertaking baseline atmospheric methane sampling with a Picarro Cavity Ring Down Spectrometer. The device is accurate to less than one part per million and takes a sample approximately every second. Sampling has been undertaken at existing and proposed CSG exploration and appraisal sites in PEL 238 and PAL 2 to gather baseline data. Samples have been taken while existing pilot wells have been shut in and before any drilling for the E&A Program had commenced. Santos is committed to continuing these studies to include sampling while the pilots are being operated. In the Gunnedah Basin more broadly the baseline sampling has been undertaken in proximity to a number of land uses and most intensively throughout PEL 238.
- 2) Santos is aware that US EPA Method 21 has been used elsewhere in NSW for leak detection and repair programs in association with CSG operations. The US EPA Method 21 was developed prior to the availability of the current mobile Cavity Ring Down Spectrometer devices. A more robust and effective leak detection and repair program for pilot wells would be based on the use of this new technology, taking full advantage of the sensitivity of the device and its mobility. The SoC have been amended accordingly.

- 3) The Muswellbrook NSW EPA monitoring site is the closest available site for background ambient NO₂ data. Due to the presence of human activity, including residential areas, traffic, major highways and industry, the Muswellbrook monitoring location is likely to experience higher levels of NO₂ pollutants than the areas in the vicinity of the site, which is largely rural and undeveloped. Therefore the use of the Muswellbrook data to represent local ambient NO₂ levels in the air quality analysis for the proposed activity will be conservative as it would overestimate the likely levels of air pollutants.

Suitable site-specific CO data was not available to quantify the existing ambient levels at the site. Combustion activities are the cause of CO emissions and spatially there is very little such activity in the area apart from power generation, motor vehicles and wood heaters. Therefore, ambient concentrations of CO are expected to be low (i.e. <0.02 µg/m³ (8hour average)).

The air quality assessment for the proposed activity has been conducted using the best available information currently available and represents a conservative estimate of air quality impacts. The air quality assessment (Appendix 5 of the EIS) concluded that the additional air quality impacts arising from the proposed activity would be minor at the surrounding sensitive receptors and that change in air quality due to the proposed activity is unlikely to be detectable with the results showing that the levels would be well below the relevant criteria for the pollutants assessed. Therefore air quality monitoring at the site, which would necessitate localised baseline monitoring, has not been considered necessary as a mitigation measure for the proposed activity.

4.17 Greenhouse gases

4.17.1 Issue description

- 1) The flare and vent stack impacts should have been assessed as part of this EIS, despite being stated as an unlikely occurrence. If venting or flaring does take place, there should be exact measuring and reporting of the emissions.
- 2) Concerns about cumulative effects of climate change from the carbon emissions of the E&A Program, particularly methane.
- 3) Fugitive emissions from the expected expansion of this industry, including future production of natural gas by Santos in the Pilliga forest is considered unacceptable. As a greenhouse gas (GHG), methane, which is the major component of natural gas, is 105 times more potent than carbon dioxide (CO₂) over a 20 year period and 33 times more potent over a 100 year period with an uncertainty of 23 per cent. These statistics indicate the importance of assessing even small leaks of methane and ensuring that an independent body assesses and monitors emissions prior to drilling, as well as ongoing.

The EIS states that *'The beneficial aspects of the proposed activity provides significant GHG mitigation potential through the supply of CSG for power generation, which represents a 58 per cent emissions saving (per gigajoule) over more traditional large-scale energy sources such as coal'*. However, emissions per unit of electricity produced by burning CSG are not less than that for burning coal when emissions for the whole CSG production cycle, including mining, liquefaction and transport, are included in the calculations.

- 4) The loss of carbon sequestering woodland and bushland cleared for the development of the drill sites, pipes, gas field infrastructure and roads must be considered.

4.17.2 Response

- 1) The GHG profile presented in Section 13.2 of the EIS included both direct emissions from the extraction of the gas (such as leakage, mud degassing, flaring and onsite power generation), and indirect emissions from the use of plant and equipment to establish the wells and transport personnel.

Santos will record each vent and flare event, which will inform both the voluntary (Annual Sustainability Reporting) and mandatory (National Greenhouse and Energy Reporting) GHG profiles.

- 2) The cumulative impacts of the E&A Program were addressed in Section 13.4 of the EIS, in line with the certainty of the available data and within the bounds of commercially sensitive information. This will be revisited as the confidence in the extractable-gas reserves and project certainty increases. Any future exploration, appraisal or production activities beyond the E&A Program, including any application for the Narrabri Gas Project, will be assessed when the relevant applications are lodged. These assessments will continue to incorporate cumulative impact assessments.
- 3) The Emission Factors provided in the National Greenhouse Account Factors (NGA Factors) (DCCEE, 2012) were applied, as shown in Table 13-1 of the EIS. DCCEE (2012) specifies a leakage factor for CSG which has been applied, and accounts for the Global Warming Potential (GWP) of both methane and nitrous oxide as recognised by the Federal Government and the United Nations Framework Convention on Climate Change for reporting.

Santos believes that, if done correctly, CSG has an important part to play in the transition to a low-carbon economy. This means controlling leakage, understanding and responding to the geology of the area and properly sealing and rehabilitating the sites at the end of their productive life.

The established emission intensity from the combustion of CSG has been calculated to be 51.33 kilograms of CO₂^e per gigajoule (GJ) of gas (NGA Factors). Bituminous coal is calculated to be 88.43 kilograms of CO₂^e per GJ. Based on this gigajoule for gigajoule, CSG is approximately 40 per cent cleaner than coal (or 45 per cent when compared to brown coal). This is additional to any benefit gained from higher efficiency equipment used in the combustion process (where less gigajoule are needed to do the same amount of work or produce the same amount of power).

Table 21-1 of the EIS states *"The beneficial aspects of the proposed activity provides significant GHG mitigation potential through the supply of CSG for power generation, which represents a 58 per cent emissions saving (per GJ) over more traditional large-scale energy sources such as coal."* The emissions savings percentage is incorrectly detailed in this table. It should state a 42 per cent emissions saving (per GJ); as it represents 58 per cent of the coal emission profile, based on the established emission intensity profile (DCCEE, 2012).

There is no consistent comparison of the extraction of CSG to coal in DCCEE (2012). RPS estimates the process to be in the range of five to six kilograms of CO₂^e per GJ of gas.

- 4) No vegetation clearing is required for the proposed activity.

Approximately 36.5 hectares of eucalyptus woodland will be cleared for the E&A Program to allow for well pads, flow lines and access tracks. Pipework will be co-located with access tracks wherever possible to minimise clearing.

This clearing is estimated to impact approximately 9,890 T CO₂^e of carbon sink, calculated using the Federal Government's FullCAM model. Following construction, well pads will be reduced from one hectare to 0.04 hectares each. This revegetation may recapture a small portion of the lost carbon sink.

4.18 Traffic and transport

4.18.1 Recommendations from Roads and Maritime Services

4.18.1.1 Issue description

1) The following conditions of approval are recommended:

- The intersection of X-Line Road and the Newell Highway should be upgraded to include an Auxiliary Left Turn Treatment Short and Channelised Right Turn Treatment Short on a major road in accordance with Figures 8.3 and 7.6 Part 4A Austroads 2010 respectively and RMS supplements. The intersection works should be designed and constructed to accommodate the largest vehicle accessing the intersections. Such designs shall be appropriate for the current speed zone of 110km/h.
- X-Line Road and Westport Road should be sealed a minimum of 30 metres from the edge of the southbound travel lane on the Newell Highway.
- As road works are required on a State road, the developer will be required to enter into a Works Authorisation Deed (WAD) with Roads and Maritime Services prior to the commencement of roads. Roads and Maritime Services will exercise its power under Section 87 of the *Roads Act 1993* (the Act) and/or the functions of the roads authority, to undertake road works in accordance with Sections 64 and 71 and/or Sections 72 and/or 73 of the Act, as applicable, for all works under the WAD.
- Upgrades of the intersection of X-Line Road and the Newell Highway and the intersection of Westport Road and the Newell Highway should be completed prior to the commencement of construction works associated with the proposed activity.
- A Road Occupancy Licence is required prior to any works commencing within three metres of the travel lanes in the Newell Highway.
- All access to the pilot should be via the intersection of X-Line Road and the Newell Highway. All access to Westport Drillers Camp should be via the intersection of Westport Road and the Newell Highway. No other access from/to the state road network (Newell and Kamilaroi Highways) from/to the project area is permitted.

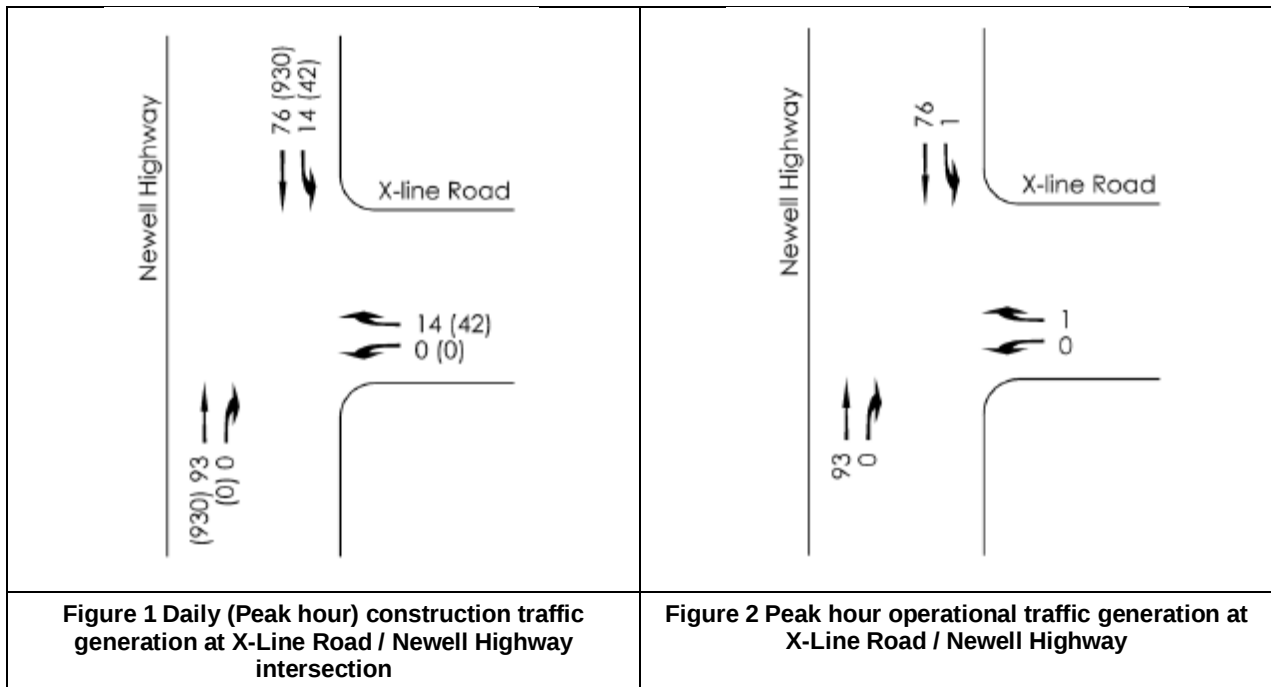
4.18.1.2 Response

- 1) Since the EIS was prepared Santos has undertaken a revised cumulative traffic assessment for the E&A Program based on more current information provided by the construction and drilling contractors and in consultation with the Roads and Maritime Services. The E&A Program will be conducted over the next two to three years and will include an overlap of several construction activities. Works associated with the E&A Program includes site preparation, drilling and surface facilities at pilot wells, with access generally via X-Line Road. Traffic generation will be higher in the earlier years while pilot wells for the E&A Program are drilled. In the latter years, the pilots will be in operation and traffic will reduce.

Access to the forest via Westport Road will be discouraged to reduce impacts to sensitive receivers along this road. It is also noted that workers accommodated at the drillers camp will be fly in-fly out and would arrive in mini buses rather than private vehicles as assumed in the Traffic and Transport Assessment report (Appendix 7 of the EIS). Movements associated with relocating the drill rig between sites and drillers travelling between the drillers' camp and site will all occur within the Pilliga forest.

For the E&A Program, the X-Line Road/ Newell Highway intersection will need to accommodate up to 84 vehicles per day (two-way) and up to 28 vehicles during a site activity peak hour throughout

construction works. This includes approximately 14 vehicles turning left into X-Line Road and 14 vehicles turning right out of X-Line Road (refer Figure 1).



The maximum projected 84 vehicles per day will only occur when equipment is delivered to well lease areas immediately after drilling. This will occur on approximately 10 to 15 occasions in the six month period to June 2014, with less than 60 vehicles anticipated on a typical day during the same period. Once works associated with the Leewood site and the Bibbiewindi Water Transfer Facility are complete, approximately 46 vehicles per day will use the X-Line Road/Newell Highway intersection, with 26 vehicles on a typical day.

During operation (from Q4 2014 to Q1 2015) of the E&A Program, traffic volumes will significantly decrease (refer Figure 2).

It has been agreed with Roads and Maritime Services that the 169 vehicles per hour (two-way) as collected by Roads and Maritime Services in April 2012 is representative of current Newell Highway traffic volumes and has been adopted for the purposes of this assessment.

With the highest average peak hour of 169 vehicles on the Newell Highway, and 76 northbound vehicles, The Austroads *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* determines a range for an appropriate left turn treatment as follows:

- 0-80+ left turning vehicles per hour - Basic Left Turn Treatment
- 80+ left turning vehicles per hour - Auxiliary Left Turn Treatment Short.

Based on the estimate of 14 left turning vehicles in any peak hour, the cumulative traffic generation at X-Line Road would not trigger the requirement for an auxiliary left turn treatment.

No vehicles would be required to turn right into X-Line Road from the Newell Highway. As such, a channelised right turn treatment would also not be required.

Accordingly, Santos does not propose to upgrade the intersection of X-Line Road/Newell Highway apart from sealing the first 30 metres. As construction traffic will be required to use X-Line Road in preference to Westport Road, Santos also does not propose to upgrade Westport Road.

Santos confirms that access to the pilot shall primarily be via the intersection of X-Line Road and the Newell Highway. All access to Westport Drillers Camp shall be via the intersection of Westport Road and the Newell Highway. No other access from/to the state road network (Newell and Kamilaroi Highways) from/to the project area is proposed. The SoC have been amended accordingly.

4.18.2 Other issues raised

4.18.2.1 Issue description

- 1) The unsealed road network associated with the proposed activity should be managed and maintained consistent with the guidelines, principles and recommended minimum design standards contained in:
 - *Managing Urban Stormwater: Soils and Construction – Volume 2C Unsealed Roads*
 - *Erosion and sediment control on unsealed roads – A field guide for erosion and sediment control maintenance practices.*
- 2) Traffic speeds are currently higher than 20 kilometres per hour and there is an increased potential for roadkill.
- 3) There will be a significant, long term increase in the number of traffic movements once the project restarts, far more than the stated 'minor increase' of 16 vehicles movements per day. It's the longer operation phase that brings the average down.

4.18.2.2 Response

- 1) Santos will manage and maintain the unsealed road network in line with the Permit to Occupy issued by Forestry NSW. As stated in Table 20-1 of the EIS, Santos' SoC for the proposed activities includes that '*any damage to roads caused by construction activities would be repaired at Santos cost in accordance with the Permit to Occupy*'.
- 2) Santos' SoC for the proposed activities include the following to assist in monitoring speed limits of employees and reducing fauna strike (Table 20-1 of the EIS):
 - Construction and operational vehicles/plant will only travel on the designated access tracks. Site speed limits will be imposed to reduce the potential of fauna strike and to reduce dust generation.
 - An in-vehicle monitoring system (IVMS) will be fitted to all Santos vehicles.
- 3) The estimated traffic volumes for the construction and operational phases of the proposed activity were modelled separately, as outlined in the Traffic and Transport Assessment report (Appendix 7 of the EIS). Section 4.5 of this report states that '*for the construction of the two pilot wells, the estimated traffic generation has been calculated based on the site supporting up to 40 workers at any one time, anticipated to occur during drilling activities.*' The anticipated construction vehicle volumes, as well as the underlying calculation assumptions, are provided in Section 4.5.3 of the Traffic and Transport Assessment report.

4.19 Waste

4.19.1 Issue description

- 1) The gas field will produce vast quantities of waste that cannot be properly disposed of. The surface works, and storage and disposal of water and chemicals will increase the risk of damage to the surrounding environment and surface waters.

4.19.2 Response

- 1) Prior to commencement of the proposed activity, a waste management plan will be developed based on the waste reduction hierarchy of avoid, reduce, reuse, recycle, recover, treat and dispose outlined in the *NSW Waste Avoidance and Resource Recovery Strategy 2007* (DECC, 2007). During construction, the management of the drilling fluid and drill cuttings will be undertaken as outlined in Section 16.4.1 of the EIS. Throughout the proposed activity, Santos will adopt best practice site environmental management measures in compliance with the POEO Act and *Protection of the Environment Operations (Waste) Regulation 2005* to minimise waste and potential impacts associated with waste generation and disposal.

The produced water abstracted from the aquifer will be captured at the wellhead and transferred through the water gathering system to Bibbiewindi 19H. As outlined in Section 4.4.2 of the EIS, the water will then be stored in a transfer tank and transferred by the existing pipeline to the Bibbiewindi Water Transfer Facility, and then on to the Leewood Produced Water Facility.

4.20 Hazards

4.20.1 Bushfire risk

4.20.1.1 Issue description

- 1) Bushfire is a major concern in this area as the Pilliga forest is highly susceptible to fires. Activities associated with CSG could increase the risk of bushfires. Santos does not appear to have a clear bushfire strategy.
- 2) Concerns that Santos is allowed to operate in such a vulnerable area with a large risk of fire from flaring, particularly as flares are exempt from fire ban. It is understood that they cannot be shut down in the event of catastrophic fire conditions, or that if they are that the gas will explode.

An industry insider has advised that the knowledge on how to shut down the attached infrastructure of a well that contains an operating gas flare that catches alight is not available in Australia and that an individual would need to be brought from the USA to carry out this work.

- 3) Santos is closing off areas of the Pilliga forest, endangering lives and potentially hampering RFS access.

4.20.1.2 Response

- 1) Santos has a Bushfire Management Plan that provides direction for Santos' operations on how to prepare for, manage and respond to the risk of bushfire in the area of operations. It outlines the statutory requirements of occupiers of land to prevent bushfires and provides information about Santos' bushfire season preparedness tasks that includes hazard reduction, potential ignition source management, establishment and maintenance of asset protection zones, permit requirements for

high risk activities and staff and contractor education. Santos also has an Emergency Response Plan that details actions required in the event of a bushfire incident or emergency.

Santos continues to consult and work with RFS and Forestry NSW on best practice bushfire management practices, shared learnings and implement agreed practices.

- 2) The pilot infrastructure does allow for the ability to remotely shut in wells at the well head, while the gas pipelines are buried at least half a metre below ground.
- 3) Santos continues to consult and work with RFS and Forestry NSW to ensure the safety of all users of the Pilliga forest.

Forestry NSW was requested to enact a temporary exclusion area immediately surrounding one of Santos' work sites, under the provisions of the *Forestry Regulation 2012* (Part 2, Division 1, Clause 7), to ensure the safety of Santos staff, contractors and members of the public.

4.20.2 Chemical risks

4.20.2.1 Issue description

- 1) The EIS does not explore the impact that the loss of chemicals through lost circulation fluid will have on the aquifers. While many CSG companies state they use food based polymers, these are often removed or cleaned up using acid-based products which also has potential for increased risks.
- 2) The EIS states 'all chemicals used during drilling will be non-toxic'. This is incorrect. The ecotoxicity of a chemical will depend on its concentration in the environment. An assessment of the impacts of drilling on groundwater quality needs to be undertaken to determine whether drilling fluids will be released to the environment at toxic concentrations.
- 3) The list of chemicals is different to that provided as part of the DA Application (DA 546/2013) for the drilling fluid treatment facility.
- 4) Query raised as to what chemicals are used in place of benzene, toluene, ethylbenzene, and xylenes (BTEX) chemicals.

4.20.2.2 Response

- 1) During drilling, the circulating drilling fluid will establish a wall cake (a low permeability 'skin' around the wall of the hole) and maintain pressure on the various aquifers intercepted. This will prevent the ingress of groundwater to the pilot well and discharge of groundwater to the surface. It will also limit the ingress of drilling fluid into the aquifers in the immediate vicinity of the pilot well.

As noted in the submission, drilling fluids use primarily food products such as sugar and starch-based products. These compounds are biodegradable in the formation and surplus drilling fluid (prior to cementing) is generally flushed to surface with water.

- 2) The chemicals used in drilling have been assessed and determined to pose no long term risks to the environment. In accordance with Australian and International standards, a hazard assessment has been conducted on the chemicals used in drilling. This hazard assessment methodology assesses the persistence, bioaccumulation and toxicity (PBT) of chemicals to determine if chemicals could persist or accumulate in the environment at concentrations that could pose risks to receptors. None of the chemicals used in drilling have been identified as PBT chemical.

- 3) The DA for the chemical storage facility at Santos' Narrabri Operations Centre included chemicals to be used in fluid treatment processes. Therefore, not all chemicals identified in the storage facility DA will be present at the drilling site. Since preparation of the EIS, it has been identified that some additional chemicals may be required for use in drilling. These are identified in Table 3.

Table 3 Drilling chemical additives in addition to those listed in the EIS (RPS, 2013)

Chemical trade name	Description	Purpose
Rheoben NT (Bentonite, Maxigel, Aus-Gel, Trugel 13A. Gel)	Water absorbent clay. Montmorillonite. Naturally occurring clay mineral in Australia.	Thickens the mud so it can carry the drilled rock out of the hole. Also forms a 'wall cake' on the side of the hole to prevent mud from leaching into the ground.
SAPP (Disodium Pyrophosphate)	Sodium Acid Pyro Phosphate	Used with Citric Acid to free pipe from side of the hole. Also used to clean bentonite from the hole when finished.
STARCH-B	Natural corn or potato starch	Reduces the amount of fluid seepage from the mud into the ground which can cause the hole to become sticky, unstable and less productive.
Potassium Chloride	KCl	Helps to keep the drilled clays dry and less sticky. Used if potassium sulphate not available.
RHEOLUBE	Vegetable oil-based surfactants	Improves drilling Rate of Penetration and prevents stuck pipe and twist-offs.
Salt	Sodium Chloride (NaCl)	Prevents hole collapsing and high pressure gas or water from escaping (i.e. 'Blowout'). Legal requirement for well control.

- 4) Chemicals that may be used in the drilling process or held on site during the drilling process and their purposes are summarised in Table 4-3 of the EIS and Table 3 above.

4.2I Social and economic

4.2I.1 Employment

4.2I.1.1 Issue description

- 1) The EIS identifies that during construction 5.6 Full Time Equivalent (FTE) positions (of which it is proposed that 4.2 are fly-in-fly-out) during construction and only two FTE positions during operations. The EIS then applies an economic multiplier to create a further 16 indirect jobs. However as the EIS states that the employees to be housed at the Drillers Camp at Westport (for the 15 weeks of the construction phase and are likely to be specialised personnel) this multiplier effect will be reduced. It is therefore unlikely that a significant portion of the identified benefits of the project will be accrued in the local community.
- 2) The industry is needed for the economic benefit of the state, and to create employment, but there is concern over the potential environmental and social impacts that arise from a short term gain.

4.2I.1.2 Response

- 1) The economic benefit of the proposed activity was calculated using an Input-Output model calculating economic and employment multipliers for different industries. The multipliers have been calculated in line with the methodology proscribed by the Australian Bureau of Statistics in *Information Paper Australian National Accounts Introduction to Input-Output Multipliers* (Cat No 5246.0). The calculations utilise data from *Australian National Accounts: Input-Output Tables - Electronic Publication, 2007/08 Final* (Cat No. 5209.0.55.001), namely Tables 5 and 20.

- 2) Santos will manage the risks with the proposed mitigation strategies outlined in the SoCs, and compliance with relevant legislation and policy.

4.21.2 Impacts on the community

4.21.2.1 Issue description

- 1) Developing industrial gas fields within the rural landscape will potentially damage rural areas, impact on long-term sustainable farming and force unwanted change onto communities. It is in direct conflict with farming and rural life, and land values will decline in the area.
- 2) There is community opposition to CSG by farmers. The Narrabri community has not given Santos a social license to operate. A number of communities across the Liverpool Plains have been surveyed with results showing that greater than 90 per cent of residents do not want CSG, particularly in such important ecosystems as the Pilliga forest.
- 3) Santos approached Forestry NSW to obtain closure of the Pilliga forest in order to deter peaceful protest.
- 4) The SoC should explicitly include the measures described in Chapter 18 of the EIS i.e. ongoing contributions to the local sponsorship program; ongoing provision of four rental properties in Narrabri to project workers; and implementation of a buy local program seeking to promote local contractors, services, equipment and products.
- 5) Ongoing contractor forums to inform local businesses of opportunities associated with the project are encouraged.

Santos should seek to procure at least 50 per cent of goods and services from local, and in particular locally owned, businesses.

- 6) A social impact assessment is essential and must be completed for full consideration before any more CSG extraction is undertaken in the Pilliga forest.

4.21.2.2 Response

- 1) The proposed activity is being undertaken within a State forest, and will have negligible impacts to agricultural land as discussed in section 8.2.1 of the EIS and the accompanying AIS (Appendix 2 of the EIS). Based on groundwater modelling, with best practice mitigation measures in place the proposed activity should have negligible impacts on groundwater resources. The cumulative E&A Program is also predicted to have minimal impact on land resources, being predominantly located within State forest, and not located on land classified as BSAL or CIC.
- 2) Santos continues to work hard to maintain a social licence, with a commitment to transparent communication and ongoing engagement with the community. Santos has a long history of working with regional communities and understands that the community has concerns about the industry. Issues raised are addressed through the community engagement and consultation framework, and by making information about the E&A Program readily available through:
 - Community shopfronts in both Narrabri and Gunnedah
 - Conducting regular site tours of the operations and holding regular information sessions throughout the assessment process.

- 3) Forestry NSW was requested to enact a temporary exclusion area immediately surrounding one of Santos' work sites, under the provisions of the *Forestry Regulation 2012* (Part 2, Division 1, Clause 7), to ensure the safety of Santos staff, contractors and members of the public.
- 4) Santos is in general agreement with this recommendation; the SoC has been updated accordingly.
- 5) Santos acknowledges this support, and will continue operating ongoing contractor forums to inform local businesses of opportunities associated with the E&A Program, wherever the opportunity arises to ensure that local contractors, businesses and community groups can benefit from the E&A Program where possible.
- 6) A social impact assessment was undertaken for this proposed activity, and was incorporated into Section 18.3 of the EIS.

4.21.3 Impact on other industries

4.21.3.1 Issue description

- 1) The economic assessment has not adequately considered loss of revenue from tourism and the potential impacts on the agriculture industry from groundwater impacts. The benefits have not been demonstrated to outweigh the costs. Other industries such as agriculture and tourism face labour shortages and rising costs whilst losing land and assets to mining. It will industrialise an agricultural area and destroy the tourist industry.
- 2) Questions why the mining industry is given preference over industries such as farming, thoroughbred /horse racing and wineries (particularly in the Hunter Valley).
- 3) Mining and extractive industries are unsustainable in the long term, whereas farming and agriculture has the ability to support the region indefinitely. The sustainability of the forestry industry should be assessed for a CSG field involving hundreds of cleared pads.

4.21.3.2 Response

- 1) The proposed activity is being undertaken within a State forest, and will have negligible impacts to agricultural land as discussed in section 8.2.1 of the EIS and the accompanying AIS (Appendix 2 of the EIS). Based on groundwater modelling, with best practice mitigation measures in place the proposed activity should have negligible impacts on groundwater resources. The cumulative E&A Program is also predicted to have minimal impact on land resources, being predominantly located within State forest, and not being located on land classified as BSAL or CIC.

The AIS concluded that there would be no change to existing recreational tourism opportunities in Bibbiewindi State Forest such as hiking, camping and bird watching as a result of the proposed activity, particularly as the proposed activity will be confined to an existing lease area. The presence of equipment and small stockpiles during the construction stage of the proposed activity will result in some visual clutter however this is unlikely to be noticeable other than by users of the forest in the immediate area.

- 2) The proposed activity will not affect any farming, thoroughbred/horse racing or viticulture/wineries industries.
- 3) The proposed activity is being undertaken within a State forest, and should have negligible impacts to agricultural land as discussed in section 8.2.1 of the EIS and the accompanying AIS (Appendix 2 of the EIS). The cumulative E&A Program is also predicted to have minimal impact on land

resources, being predominantly located within State forest, and not being located on land classified as BSAL or CIC.

Although production forestry is mapped within PEL 238 and PAL 2, there are minimal exotic plantations. Rather, these areas include State forest used for timber harvesting and nature reserves. Timber harvesting within the Pilliga forest has been reduced largely due to conservation efforts; therefore any impact on such enterprises are not considered significant. Additional clearance due to the E&A Program has a very small extent within the State forest (less than 50 hectares), when compared to the extent of the State forest in the Pilliga region (over 190,000 hectares).

4.22 Cultural heritage

4.22.1 Issue description

- 1) Respondents were disappointed that Aboriginal Heritage requirements were taken out of the DGRs.
- 2) Gomeroi Traditional Owners have a strong connection to the Pilliga, as it is considered to have a high Aboriginal cultural significance. The area has many sacred sites, including rock shelters, burials, grinding grooves and scarred trees that are not included on the Aboriginal Heritage Information Management System (AHIMS) register. There is concern that the proposed activity will damage this cultural heritage.
- 3) It is important that a full Aboriginal cultural heritage impact assessment is conducted in consultation with Coonamble Shire Council and the local Aboriginal community.

4.22.2 Response

- 1) This was a decision based on the inherent risk to Aboriginal heritage acknowledging that the proposed activity is contained within existing lease pads and access tracks that were previously cleared and the ground prepared for CSG activity.
- 2) Prior to the establishment of the Bibbiewindi 14 and 19H lease areas, on which the proposed activity will be located, a cultural heritage survey was completed with local Indigenous community participation. Despite the proposed activity's location on these existing disturbed areas, an archaeological inspection of the existing well leases and surrounding area was undertaken by RPS on 27 November 2012, as stated in Section 19.1.2 of the EIS. The inspection was consistent with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*.

No Aboriginal objects, sites, places of significance or culturally modified trees were identified within the site or immediate surrounds. No evidence of Aboriginal objects or sites were identified along the tributary of Cowallah Creek. The potential for any previously unidentified Aboriginal objects or sites to be located within the site or immediate surrounds is considered to be nil to low.

Despite the perceived low potential for impact, a number of mitigation measures were provided in the SoC (Table 20-1 of the EIS) to reduce the potential for any impacts on Aboriginal cultural heritage.

- 3) The sites of proposed activities within the E&A Program have been assessed for potential to impact Aboriginal cultural heritage. Ongoing dialogue has been established between Narrabri LALC and all future works will be completed with local participation. The proposed activity and other activities as part of the E&A Program are not located within the Coonamble Shire LGA, therefore it is considered more appropriate to consult with the local Aboriginal community in regards to cultural heritage matters at this time.

4.23 Health

4.23.1 Issue description

- 1) Concerns about the health impact to the Coonamble community when Santos expands the gas field to Coonamble (as Santos has stated their intention but not assessed in cumulative impacts of in their EIS).
- 2) Concerns about the risk of emissions impacting on the health and wellbeing of humans and wildlife. There are reportedly cancer clusters forming around the gas fields on the Darling Downs, as well as other noticeable health effects. A study by Dr McCarron suggests that they are from airborne BTEX chemicals. But as the gas industry does not disclose the chemicals used, it is hard to test for them.

CSG can have a negative health impact and is a source of major social disruption to the local residents and the wider regional communities. Spraying produced water on the dirt roads has caused terrible skin reactions on the people of Tara (Qld) and there is no research on wildlife health.

- 3) The EIS conclusions that the proposed activity is relatively minor in scale to negatively impact on the psychological wellbeing of individuals may be too generalised and an independent assessment should be considered to provide reassurance of the applicant's assertions.

4.23.2 Response

- 1) The proposed activity and other activities as part of the E&A Program are not located within the Coonamble Shire LGA. Further, the proposed project area currently under investigation for the Narrabri Gas Project is also not within Coonamble Shire LGA.
- 2) Adverse health related issues are not anticipated.

The scale of the proposed activity is small and it is located well away from public facilities. The nearest residence is located 7.5 kilometres from the proposed activity. Due to these reasons, the air quality impact assessment (Appendix 5 of the EIS) determined that air quality issues during both construction and operation were negligible. Produced water will not be used for dust suppression during the proposed activity.

The drilling fluids do not contain petroleum oil or chemicals with BTEX constituents as ingredients. In accordance with the standard drilling process, wells are constructed with the aquifer systems isolated by casings and cement from the underlying target coal sequences. A surface casing (extending through any shallow aquifers) is established and cemented prior to advancement of drilling into the deeper coal units. This surface casing eliminates the potential for impact from constituents present within the coal during drilling or operation of the well.

Unlike conventional petroleum reservoirs, which contain heavier petroleum hydrocarbon fractions, CSG is primarily methane and does not contain heavier petroleum gases such as BTEX. Sampling and analysis of the CSG in the area has confirmed that the gas is dominated by methane (approximately 96 per cent by weight) and does not contain heavy petroleum gases.

Reference has been made in submissions to allegations of health impacts from CSG operations located near Tara in Queensland in respect of emissions and the use of produced water for dust suppression.

Queensland Health investigated these allegations and its report found no evidence of any link between CSG operations and claimed health impacts from residents. 'Based on the clinical and

environmental monitoring data available for this community risk assessment, a clear link cannot be drawn between health complaints by some residents of the Tara region and impacts of the local CSG industry on air, water and soil within the community' (Queensland Health, 2013). A copy of the report is available at <http://www.health.qld.gov.au/publications/csg/documents/report.pdf>.

An independent medical practitioner has also carried out an investigation with similar results. The report of the investigation noted 'CSG is also released during coal mining, thus coal miners have been and are regularly exposed to CSG in the course of their work. Despite regular monitoring of the health of coal miners both in Queensland and internationally, no health effect from potential exposure to methane has been recognised... The relationship between symptoms and potential exposure to chemicals involved in the production of CSG remains unclear' (Adam, 2013). A copy of the report is available at <http://www.health.qld.gov.au/publications/csg/documents/appx2.pdf>.

- 3) According to Carey (2012), mental health issues may arise when the basic needs of a community are not met due to the cumulative impacts of water and air pollution, degradation of agricultural land and loss of amenity and landscape. Mental health issues (anxiety, depression and paranoia) may also manifest when there is a lack of empowerment and people's environment change beyond their control.

The nature and scale of the proposed activity, and the broader E&A Program, as well as its location within the State forest ensures that potential cumulative impacts to the community are minimised. In addition, Santos will adopt best practice site environmental management measures during both construction and operation to minimise the likelihood of potential impacts to land and water resources, as outlined in the SoC within Table 20-1 of the EIS.

In terms of ensuring that landholders maintain a sense of empowerment, Santos has a long standing commitment to work in partnership with landholders, to ensure that CSG activities do not impact on their lifestyle or the sustainability of their land. Gas exploration or development activities are only undertaken on the property of landholders who agree to host the operations. A mutually agreeable land access agreement is put in place prior to carrying out any exploration work or developing well sites on a landholder's property.

Santos has developed a community engagement and consultation framework to specifically target the different needs and requirements of stakeholders and the community to inform and consult on the E&A Program and the CSG industry more broadly. Santos is committed to undertaking ongoing community engagement and consultation, including a presence in the local community in the form of a project information centre at 125 Maitland Street, Narrabri, which members of the community can visit and request information about the E&A Program.

5.0 Revised Statement of Commitments

The EIS for the Bibbiewindi Gas Exploration Pilot Expansion identified a range of environmental outcomes and management measures that would be required to avoid or reduce the environmental impacts of the proposed activity.

After consideration of the issues raised in the public submissions, the draft Statement of Commitments for the project (refer to Chapter 20 of the EIS) has been revised. Should the proposed activity be approved, the revised commitments will guide the subsequent phases of the associated works.

The revised Statement of Commitments, including commitments relating to the key issues described in the Director-General's Requirements is provided in Table 4. Modified commitments are shown in **bold** and *italics*.

Table 4 Statement of Commitments

Item	Commitment
Activity type	The Bibblewindi Gas Exploration Pilot Expansion (proposed activity) includes the construction and drilling of Bibblewindi 31 and 32 on the existing Bibblewindi 14 and Bibblewindi 19H well leases respectively, installation of surface infrastructure to connect the two wells to the existing Bibblewindi Multi-Lateral Pilot and operation of the Bibblewindi 31 and 32 wells as part of the Bibblewindi Multi-Lateral Pilot.
Location	The proposed activity is within PAL2, within the Bibblewindi State Forest.
Hours of operation	Hours of operation will be up to 24 hours a day, seven days a week.
Activity duration	Approximately 15 weeks construction and up to 3 years for operation of the wells.
Proposed commencement date	Works are scheduled to commence in Q2 2014.
Maximum area of disturbance	Nil. The activity includes the construction and drilling of Bibblewindi 31 and 32 on the existing Bibblewindi 14 and Bibblewindi 19H well leases and access tracks.
Rehabilitation commitments and timeframes	Pilot well decommissioning and rehabilitation of the well lease areas and access tracks will occur within 6 months of abandonment. Pilot wells and ancillary infrastructure would be decommissioned and lease areas rehabilitated as outlined in Section 4.5.1 of the EIS.
Stakeholder consultation	- Community consultation will be undertaken in accordance with Chapter 5 of the EIS. - Advice will be provided to relevant landholders that may be impacted by the activity 14 days prior to the proposed activity commencing. - Narrabri Shire Council will be consulted on a monthly basis where appropriate. - Updates on the proposed activity will be provided to the Narrabri Community Consultation Committee. - Advertisements will be placed in the local media of the upcoming exploration and drilling activities. - The local police will be notified of the proposed drilling activities and provided with a road traffic plan specifying the route, time and location of the drilling rig 14 days prior to the drilling rig mobilising to site.
Land resources	Construction - Excess topsoil and subsoil generated during site preparation activities will be stockpiled onsite and used as backfill following completion of drilling. - Erosion and sediment controls will be implemented where necessary during site preparation activities, in accordance with the guidelines, principles and recommended minimum design standards contained in Managing Urban Stormwater: Soils and Construction – Volume 1 (the Blue Book). These controls will be maintained until disturbed areas of the site are stabilised. - The quantity of chemicals, fuels and oils stored onsite will be minimised, where practicable. - All additives, chemicals, fuels and oils stored onsite will be kept in an appropriately secured, bunded storage shed in accordance with the relevant Safety Data Sheet (SDS). - Where there is a risk of contamination pits will be lined or material will be stored in surface tanks or metal bins. - An SDS register of all chemicals used or stored onsite will be maintained. - Maintenance of vehicles, plant and equipment will occur offsite at an appropriately licensed facility unless deemed necessary and appropriate to conduct such maintenance onsite.

Item	Commitment
	▪ Refuelling of plant and equipment will occur in a designated, bunded area, at least 40 metres from the nearest waterway. ▪ Any spills or leaks will be contained and cleaned up immediately using the spill kit. Contaminated material (such as contaminated soil or absorbent materials) will be placed in a bag and removed from site for disposal at a licensed waste facility. ▪ Plant and equipment will be inspected daily to ensure these are properly maintained. Operation ▪ Ongoing management and maintenance of remaining infrastructure onsite will occur, including water transfer area and well heads. ▪ The gathering system water pressure will be monitored. Should line failure occur between the wells to the transfer tank at Bibbiewindi Water Transfer Facility, operation of the well will be suspended until the problem is rectified. ▪ The site will be rehabilitated in accordance with Section 4.5.1 of the EIS.
Groundwater	Construction ▪ The wells will be designed and constructed in accordance with the <i>NSW Coal Seam Gas Code of Practice Well Integrity</i> (DTIRIS, 2012). ▪ Drilling and installation operations, well control, waste management and abandonment procedures for the pilot wells will be in accordance with accepted industry practices and in accordance with the processes outlined in the EIS. ▪ A driller that holds the relevant qualifications as defined by the NSW Office of Water will be onsite during drilling of the top hole until the surface casing is set, cemented, and pressure tested. During this time, there will be 24 hour coverage by one person working the day shift and on call at site during the night. This will ensure that the appropriate knowledge of water legislation and regulation in NSW and technical skills are employed to avoid impacts to surface and groundwater sources. ▪ Excessive drilling fluid losses will be cured by loss circulation material (cellulose material such as sawdust or other benign naturally occurring substances, as required) to ensure most fluids return to the surface. ▪ Santos will make reasonable endeavours to seek permission (from landowners) to access registered groundwater bores within 2 km of the site to undertake groundwater monitoring prior to drilling, to establish baseline conditions, and on completion of drilling, to determine if there are any impacts. Where access to bores is granted (and the bore is functioning), monitoring will include water level measurements and water quality observations in the field, and sampling for analysis by an accredited laboratory. Operation ▪ The volume of water extracted from the pilot wells will be monitored. ▪ Pressure gauges will be fitted to the pilot wells and monitored remotely through a Supervisory Control and Data Acquisition (SCADA) system. Should pressure change due to a leak, the pilot wells will be shut down immediately and the affected area investigated. ▪ The groundwater monitoring program will be implemented. ▪ In line with monitoring during drilling, Santos will make reasonable endeavours to seek permission (from landowners) to continue monitoring of registered groundwater bores within 2 km of the site to determine if there are any impacts to aquifers. ▪ The wells will be decommissioned as soon as they are no longer required.

Item	Commitment
Surface water	Construction - Water will not be extracted from nearby watercourses, including Cowallah Creek or Mount Pleasant Creek. - The existing diversion bund will be maintained on the up-slope side of the lease areas to divert clean water around the work area. - Drilling fluids will be contained in surface tanks which will be regularly inspected and maintained. - Water that drains to the cellar pit will be circulated with the drilling fluid throughout the drilling process. - Should any formation fluid rise through the well, it will be captured in the waste fluid tank and will be removed to a licensed waste facility that is able to accept liquid waste for disposal or treatment. - Drilling fluids will be transported to and from site by an appropriately licensed contractor. - Fuel and lubricants will be stored onsite only when necessary and maintained offsite whenever possible. - Wastewater generated through general site activities will be removed by an appropriately licensed contractor for disposal at a licensed facility or treated to an appropriate quality prior to discharging. - All areas storing or handling fuel, fuel using equipment, and chemicals will be banded in accordance with <i>Australian Standard 1940-2004; The Storage and Handling of Flammable and Combustible Liquids</i> or other relevant guidelines. - Weather forecast will be monitored and in the event that prolonged, severe wet weather or flooding is predicted, works will cease and plant, machinery and any chemicals will be secured and banded. - A minimum freeboard of 300 mm will be maintained for any tanks or pits containing liquid waste. Operation - The surface infrastructure at the lease areas will be regularly inspected. - The surface water monitoring program will be implemented.
Biodiversity	- The site boundary will be clearly demarcated to ensure that plant and vehicles keep within the approved area of disturbance. - The site will be rehabilitated in accordance with Section 4.5 of the EIS. - Construction and operational vehicles/plant will only travel on the designated access tracks. Site speed limits will be imposed to reduce the potential of fauna strike and to reduce dust generation. - Weed management measures will be undertaken, including wash down of all plant and machinery (including vehicles) in accordance with legislative requirements to prevent the spread of weeds and pathogens. - Weed monitoring will occur throughout all phases of the proposed activity. Weed removal will be carried out as necessary.
Air quality	- Dust will be suppressed as required by spraying water along the access tracks and lease areas. - Site speed limits will be imposed to minimise dust generated by vehicle movements. - Vehicles, plant and equipment will be regularly maintained to ensure they are in good operating condition. - Vehicles, plant and machinery will be turned off when not in use rather than left idling. - Rehabilitation works, including landform establishment, will occur within 6 months of abandonment.

Item	Commitment
Greenhouse Gases	Construction - Energy efficient equipment and processes will be used where possible. - Water based drilling fluid will be used. - Appropriate monitoring of emissions and consumables will be undertaken for legislative reporting requirements (such as to inform National Greenhouse Energy Reporting Scheme (NGERS) calculations). Operation - Regular monitoring and maintenance of equipment and pipes to minimise fugitive emissions. - A fugitive emissions monitoring program will be implemented in the Energy NSW CSG Exploration and Appraisal Program (E&A Program) area, incorporating a leak detection and repair program using the Picarro Cavity Ring Down Spectrometer. - Appropriate monitoring of emissions and consumables will be undertaken for legislative reporting requirements (such as to inform NGERS calculations).
Noise	- Forestry Corporation of NSW (Forestry NSW) to be notified prior to the proposed activity commencing. This will include details of the timing and duration of noise generating activities. - In the event of a noise complaint, the source of the noise will be investigated. Where necessary, Santos will offer to conduct noise monitoring from the proposed activity at the affected receiver. If it is determined that noise levels are unacceptable, further feasible and reasonable work practices or mitigation measures will be implemented.
Traffic and Transport	- Vehicles within the forest will not travel at speeds greater than 80 kilometres per hour unless otherwise signed. - An in-vehicle monitoring system (IVMS) will be fitted to all Santos vehicles. - Construction vehicle movements will be restricted to designated routes to/ from site via the Newell Highway. - Construction vehicle activity will be managed and controlled in the vicinity of the site. - Any damage to roads caused by construction activities would be repaired at Santos cost in accordance with the Permit to Occupy. Access to the pilot shall primarily be via the intersection of X-Line Road and the Newell Highway.
Waste	- Management of waste, including its transport, will comply with the <i>Protection of the Environment Operations Act 1997</i> (POEO Act) and <i>Protection of the Environment Operations (Waste) Regulation 2005</i>. - A Waste Management Plan will be implemented, that will be based on the waste reduction hierarchy of avoid, reduce, reuse, recycle, recover, treat and dispose. - General site waste will be segregated according to their classifications under the Waste Classification Guidelines (DECCW, 2009) and stored in bins or skips within a designated waste transfer point within the lease area prior to transportation for disposal. - Drill cuttings will be used for backfilling or site shaping during rehabilitation of the site, to reduce material which may otherwise go to landfill - Regulated waste will be collected by licensed contractors for offsite disposal. General and recyclable waste will be transported to local council landfill and recycling facilities. - Following completion of cementing, excess fluids and cement slurries will be segregated in steel waste tanks and removed and disposed of by a licensed waste disposal company.

Item	Commitment
	▪ Sewage waste will be removed from site by a licensed contractor for treatment and disposal, as required. ▪ Appropriate waste receptacles will be provided onsite including covered rubbish bins for disposal of domestic wastes. These will remain during drilling activities. ▪ The type and volume of all waste removed from site will be recorded. ▪ All staff and contractors will be made aware of waste management procedures during site induction and through toolbox talks. ▪ Chemical, fuel and oil containers will be managed according to the SDS or manufacturers' directions to avoid potential impacts to the environment or human health.
Hazards	Construction ▪ Site safety protocols, incident management and emergency procedures will be implemented during the construction and drilling works. ▪ The site will be kept in a clean and tidy manner during site preparation, drilling activities and operation of the pilot wells. ▪ Chemicals and potentially hazardous substances will be used and stored according to regulatory requirements including the <i>Work Health and Safety Act 2011</i>. ▪ Any dangerous goods will be transported according to regulatory requirements under the <i>Dangerous Goods (Road and Rail Transport) Act 2008</i>. ▪ Chemical, fuel and oil containers will be managed according to the SDS or manufacturers' directions to avoid potential impacts to the environment or human health. Operation ▪ Where feasible best practice bushfire risk management will be implemented. ▪ All statutory obligations for bushfire management will be met. ▪ An education program for staff and contractors regarding the risks from bushfires in consultation and collaboration with the NSW Rural Fire Service, Fire & Rescue NSW and Forestry NSW will be implemented.
Social and Economic	▪ Consultation activities will occur in accordance with Chapter 5 of the EIS. ▪ <i>Ongoing contributions will be made to the local sponsorship program throughout the E&A Program.</i> ▪ <i>Santos will continue to rent properties in Narrabri for the use of project workers throughout the E&A Program.</i>

Item	Commitment
Other	▪ Project staff and contractors will be made aware of their statutory obligations to protect Aboriginal cultural heritage objects under the <i>National Parks and Wildlife Act 1974</i> (NPW Act), through site induction and toolbox talks. ▪ All works will be undertaken to comply with Part 6 of the NPW Act. ▪ If any previously unidentified Aboriginal cultural heritage objects are identified during works, then such in the immediate area will cease, the area will be cordoned off and the NSW Office of Environment and Heritage (NSW OEH) Enviroline 131 555 will be contacted. A suitably qualified archaeologist will be contacted so that the site can be assessed and managed in accordance with relevant legislative and policy requirements. ▪ In the event that skeletal remains are uncovered, then works in the immediate area will cease, the area will be cordoned off and the NSW Police will be contacted. Should the NSW Police determine that the material is not recent, the OEH Enviroline 131 555 and relevant Aboriginal stakeholders will be contacted to determine an action plan for the management of the skeletal remains prior to works re-commencing. ▪ If any previously unidentified potential non-Aboriginal cultural heritage material is identified during construction or drilling, then works in the immediate area will cease, the area will be cordoned off and the OEH Heritage Branch will be contacted. A suitably qualified archaeologist will be contacted so that the site can be assessed and managed.

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7.0 Terms and abbreviations

ABS	Australian Bureau of Statistics
AHIMS	Aboriginal Heritage Information Management System
AIP	Aquifer Interference Policy
AIS	Agricultural Impact Statement
ASC	Australian Soils Classification
BNCCA Act	<i>Brigalow and Nandewar Community Conservation Area Act 2005 (NSW)</i>
BSAL	Biophysical Strategic Agricultural Land
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CAP	<i>Namoi Catchment Action Plan 2010-2020 (NCMA, 2011)</i>
CCA	Community Conservation Area
CEEC	Critically Endangered Ecological Communities
CIC	Critical Industry Cluster
CO	Carbon monoxide
CO ₂	Carbon dioxide
CO ₂ ^e	Carbon dioxide equivalent
CSG	Coal seam gas
CUCCLG	Coonabarabran and Upper Castlereagh Catchment and Landcare Group
DA	Development application
DAMB	Deep aquifer monitoring bore
DCCEE	Commonwealth Department of Climate Change and Energy Efficiency
DECC	NSW Department of Environment and Climate Change
DECCW	NSW Department of Environment, Climate Change and Water
DGRs	Director-General's Requirements
DoE	Commonwealth Department of the Environment
DP&I	NSW Department of Planning and Infrastructure
ds/cm	Decisiemens per centimetre
ds/m	Decisiemens per metre
DST	Drill stem test
DTIRIS	NSW Department of Trade and Investment, Regional Infrastructure and Services
E&A Program	Energy NSW CSG Exploration and Appraisal Program
EC	Electrical conductivity
EIS	Environmental Impact Statement
EFT	Equivalent Full Time
ELA	Eco Logical Australia
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>
EPL	Environment Protection Licence
ESG	Eastern Star Gas
Forestry NSW	Forestry Corporation of New South Wales
FTF	Fluids treatment facility
GAB	Great Artesian Basin

GDE	Groundwater Dependent Ecosystem
GHG	Greenhouse gas
GJ	Gigajoule
GMMP	Groundwater Monitoring and Modelling Plan
GWP	Global warming potential
HIA	Health Impact Assessment
HSU	Hydrostratigraphic Unit
IECA	International Erosion Control Association
IESC	Independent Expert Scientific Committee
IVMS	In vehicle monitoring system
LGA	Local government area
LSC Class	Land and soil capability class
LSTU	Less significant transmissive unit
MNES	Matter of National Environmental Significance
Namoi CMA	Namoi Catchment Management Authority
Narrabri CCC	Narrabri Community Consultation Committee
Narrabri LALC	Narrabri Local Aboriginal Land Council
NGA Factors	<i>National Greenhouse Accounts Factors</i> (DCCEE, 2012)
NGERS	National Greenhouse Energy Reporting Scheme
NICE	Northern Inland Council for the Environment
NOW	NSW Office of Water
NO ₂	Nitrogen dioxide
NPA	National Parks Association
NPW Act	<i>National Parks and Wildlife Act 1974</i> (NSW)
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NSW EPA	NSW Environment Protection Authority
NSW Health	NSW Health – Hunter New England Local Health District
NSW OCSG	NSW Office of Coal Seam Gas
NSW OEH	NSW Office of Environment and Heritage
NTU	Negligibly transmissive unit
PAC	Planning Assessment Committee
PAH	Polycyclic aromatic hydrocarbons
PAL	Petroleum Assessment Lease
PBT	Persistence, bioaccumulation and toxicity
PEA	Preliminary environmental assessment
PEL	Petroleum Exploration Licence
PIN	Penalty infringement notice
PNTU	Probable negligibly transmissive unit
POEO Act	<i>Protection of the Environment Operations Act 1997</i> (NSW)
POP	Petroleum Operations Plan
PPL	Petroleum Production Licence
PWMP	Produced Water Management Plan

REF	Review of Environmental Factors
RFS	NSW Rural Fire Service
RO	Reverse osmosis
RPS	RPS Australia East Pty Ltd
SAMB	Shallow aquifer monitoring bore
Santos	Santos NSW (Eastern) Pty Ltd
SCADA	Supervisory control and data acquisition
SCS	Soil Conservation Service
SDS	Safety Data Sheet
SIS	Species Impact Statement
SoC	Statement of Commitments
SRD SEPP	<i>State Environmental Planning Policy (State and Regional Development) 2011</i>
SRLUP	Strategic Regional Land Use Policy
SSD	State Significant Development
STU	Significant transmissive unit
TSC Act	<i>Threatened Species Conservation Act 1995 (NSW)</i>
VOCs	Volatile organic compounds
WAD	Works Authorisation Deed
WAL	Water access licence
Wall cake	Low permeability 'skin' around the wall of the hole.

Appendix I

List of submissions received

Appendix 2

Bibbiewindi Gas Exploration Pilot Baseline Surface and Groundwater Data Report

Appendix 3

Energy NSW CSG Exploration and Appraisal Program – Impact Assessment under the EPBC Act

Appendix 4

PEL 238 – TSC Act Cumulative Impact Assessment

Appendix 5

Pilliga Stygofauna Review – Santos Energy NSW CSG Exploration and Extraction Activities