Bibblewindi Multi-Lateral Pilot Expansion - Bibblewindi State Forest

Request for DGRs supporting documentation

Prepared by:

RPS AUSTRALIA EAST PTY LTD

Level 9, 17 York Street
Sydney NSW 2000

T: +61 2 8270 8300
F: +61 2 8270 8399
E: sydney@rpsgroup.com.au

Client Manager: Cassie Hay
Report Number: PR114272
Version / Date: Rev 0/March 2013

Prepared for:

SANTOS NSW (EASTERN) PTY LTD

Level 16
40 Creek Street
Brisbane, QLD, 4000

IMPORTANT NOTE

We have prepared this report for the sole purposes of Santos NSW (Eastern) Pty LTD ("**Client**") for the specific purpose only for which it is supplied ("**Purpose**"). This report is strictly limited to the purpose and the facts and matters stated in it and does not apply directly or indirectly and will not be used for any other application, purpose, use or matter. This report may be relied upon by the Minister for Planning (Minister) in the exercise of his functions under the Environmental Planning and Assessment Act 1979 (EP&A Act).

In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

This report is presented without the assumption of a duty of care to any other person (other than the Client and the Minister) ("**Third Party**"). The report may not contain sufficient information for the purposes of a Third Party or for other uses. Without the prior written consent of RPS Australia East Pty Ltd:

(a) this report may not be relied on by a Third Party; and

(b) RPS Australia East Pty Ltd will not be liable to a Third Party for any loss, damage, liability or claim arising out of or incidental to a Third Party publishing, using or relying on the facts, content, opinions or subject matter contained in this report.

If a Third Party uses or relies on the facts, content, opinions or subject matter contained in this report with or without the consent of RPS Australia East Pty Ltd, RPS Australia East Pty Ltd disclaims all risk and the Third Party assumes all risk and releases and indemnifies and agrees to keep indemnified RPS Australia East Pty Ltd from any loss, damage, claim or liability arising directly or indirectly from the use of or reliance on this report.

In this note, a reference to loss and damage includes past and prospective economic loss, loss of profits, damage to property, injury to any person (including death) costs and expenses incurred in taking measures to prevent, mitigate or rectify any harm, loss of opportunity, legal costs, compensation, interest and any other direct, indirect, consequential or financial or other loss.

Document Status

Version	Purpose of Document	Orig	Review	Review Date
Rev A	Draft for internal review	GS	RS	04 December 2012
Rev B	Second draft for client review	GS	CH	4 February 2013
Rev 0	Final	KB	CH	7 March 2013

Approval for Issue

Name	Signature	Date
Cassie Hay		7 March 2013

Contents

Tables

Figures

Plates

Executive summary

Background

Santos NSW (Eastern) Pty Ltd (a wholly owned subsidiary of Santos Limited) (Santos) is seeking consent to drill and operate two petroleum exploration (pilot) wells, known as Bibblewindi 31 and 32, within the Bibblewindi State Forest, approximately 40 kilometres south of Narrabri, NSW in Petroleum Assessment Lease (PAL) 2 (the project).

The two pilot wells are proposed to be located on existing well leases within an existing multi-lateral pilot well set (known as the Bibblewindi Multi-Lateral Pilot) which were developed by Eastern Star Gas Pty Ltd (ESG) as part of the Narrabri Gas Development Project in 2009.

Need for proposed development

The purpose of the proposed development is to further develop lateral well design and to investigate gas flow potential within PAL 2. The development of the gas industry in the region would bring capital investment and economic benefits, and has the potential to play a significant role in the delivery of reliable energy in a carbon constrained economy, provide security of supply for domestic gas and alleviate the state's reliance on imported gas.

Proposed development scope

The project will include:

- drilling one vertical (Bibblewindi 31) and one lateral (Bibblewindi 32) pilot well to target the Bohena coal seam
- installing infrastructure to connect the wells to the existing gas and water gathering system for the Bibblewindi Multi-Lateral Pilot
- operating the Bibblewindi 31 and Bibblewindi 32 pilot wells and the existing Bibblewindi Multi-Lateral Pilot as a combined pilot well set for the life of PAL 2 (including any extension of PAL 2) or until such time as sufficient data is collected
- managing the water and gas produced during operation of the combined Bibblewindi Multi-Lateral Pilot.

Planning and permissibility

The proposed development is deemed to be State Significant Development (SSD) under the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP). Schedule 1 of the SRD SEPP defines SSD as being development for the purpose of drilling or operating petroleum exploration wells, not including *'a set of 5 or fewer wells that is more than 3 kilometres from any other petroleum well (other than an abandoned petroleum well) in the same petroleum title.'*

The development of Bibblewindi 31 and 32 wells would create more than five wells within a three kilometre radius and is therefore deemed to be SSD under the State and Regional Development SEPP.

Preliminary environmental assessment

A preliminary environmental risk assessment was carried out for the proposed development to identify and prioritise issues requiring assessment in the Environmental Impact Statement (EIS). Potential impacts to groundwater and management of drilling and pilot testing by-products were identified as the key

environmental issues for the project. Detailed assessment of these issues will be carried out during preparation of the EIS. Other issues to be investigated and documented in the EIS include biodiversity, bushfire, surface water, air quality and greenhouse gas, noise and vibration, traffic and transport, natural resources, Aboriginal heritage and non-Indigenous heritage.

Next steps

A comprehensive EIS addressing the Director-General's Requirements (DGRs) issued by the Department of Planning and Infrastructure would be prepared and submitted to the Department. The EIS would assess the key environmental issues and other issues identified in the preliminary environmental assessment. A range of stakeholders would be consulted during preparation of the EIS.

Once submitted to the Department, the EIS would be placed on public exhibition for a minimum period of 30 days, during which time the Department would invite the public and government agencies to make submissions.

1.0 Introduction

1.1 Background

Santos NSW (Eastern) Pty Ltd as the CSG operator on behalf of the titleholders and operators for Petroleum Assessment Lease (PAL) 2, is seeking consent to drill and operate two petroleum exploration (pilot) wells, known as Bibblewindi 31 and 32, within the Bibblewindi State Forest, approximately 40 kilometres south of Narrabri, in north western NSW (the project).

The two pilot wells will be located on existing well leases within an existing multi-lateral pilot well set (known as the Bibblewindi Multi-Lateral Pilot) which was developed by Eastern Star Gas Pty Ltd (ESG) as part of the Narrabri Gas Development Project in 2009. Santos acquired the Narrabri Gas Development Project, including the Bibblewindi Multi-Lateral Pilot, from ESG in 2011.

The Bibblewindi Multi-Lateral Pilot was established in order to evaluate the technical feasibility of lateral well designs and to investigate the potential for commercial gas production in the area. Monitoring of the wells has determined that there is not enough dewatering of the coal seam to obtain peak gas rates and well gas and water profiles. Tighter well spacing is required to accelerate the results of the pilot and to progress critical design and commercial aspects of the Narrabri Gas Development Project.

Under clause 6 of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP), development for the purposes of petroleum exploration is permissible without consent. However, under clause 7(2) of the Mining SEPP, development consent is required for the purposes of drilling or operating petroleum exploration wells, not including a set of five or fewer wells that is more than three kilometres from any other petroleum well (other than an abandoned petroleum well) in the same petroleum title.

Section 89C(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) provides that a State environmental planning policy may declare any development or any class or description of development, to be State significant development (SSD). The State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) identifies development which is SSD for this purpose. Clause 6 of Schedule 1 of the SRD SEPP identifies 'Petroleum (oil and gas)' and classifies 'development for the purpose of drilling and operating petroleum exploration wells, not including… a set of five or fewer wells that is more than three kilometres from any other petroleum well (other than an abandoned petroleum well) in the same petroleum title' as SSD.

The project will result in more than five petroleum wells, other than abandoned wells, within a three kilometre radius within PAL 2 and is therefore SSD. The project will require assessment and development consent under Division 4.1 of Part 4 of the EP&A Act. A development application and Environmental Impact Statement (EIS) will need to be prepared for the project and submitted to the Department of Planning and Infrastructure.

1.2 Proponent

Santos NSW (Eastern) Pty Ltd (a wholly owned subsidiary of Santos Limited) (Santos) is the proponent for the proposed development as the CSG operator, on behalf of the titleholders of PAL 2, Santos NSW (Eastern) Pty Ltd and EnergyAustralia Narrabri Gas Pty Ltd.

1.3 Purpose of this report

This report has been prepared by RPS Australia East Pty Ltd (RPS) to support a request for Director-General Requirements (DGRs) for the project. The report:

- describes the site and local and regional context
- describes the proposed development
- discusses the strategic and statutory planning policies and instruments applicable to the proposed development
- provides a preliminary environmental impact assessment and outlines strategies to manage potential environmental issues
- outlines the justification for the proposed development, including why the proposed sites were selected;
- identifies consultation activities
- provides an estimated capital investment value for the proposed development.

2.0 Site and context

2.1 Location

Bibblewindi 31 and 32 will be located on existing well leases, Bibblewindi 14 and 19H respectively, within the Bibblewindi Multi-Lateral Pilot located on Little Tighes Road (refer to Figure 2-1). The approximate coordinates of the wells are identified in Table 2-1.

Table 2-1 Approximate well locations (MGA 94 Zone 55)

Well	Easting	Northing
Bibblewindi 31	754466.68	6603944.41
Bibblewindi 32	753637.23	6604983.47

Gas and water infrastructure for the wells will tie-in to the existing gathering system on the Bibblewindi 14 and 19H well leases. No disturbance beyond the existing well leases or access tracks will be required for the project.

The existing lease areas are shown in Figures 2-2 and 2-3.

2.2 Local and regional context

Little Tighes Road runs in a northwest-southeast direction and connects to Boundary Road and Self Camp Road north of the site, and Tighes Gully Road south of the site. Self Camp Road connects to Oil Well Road which links the site to the Newell Highway.

The site is located within the central portion of the Bibblewindi State Forest, which is bordered by the Pilliga State Forest to the east, west and south. The Bibblewindi State Forest is a 7,135 hectare area managed by the NSW Department of Primary Industries, Forests NSW. It forms part of a larger patch of remnant vegetation known as the Pilliga Scrub, which encompasses numerous protected areas including the Pilliga Nature Reserve, Pilliga East State Forest, Pilliga East State Conservation Area, Jacks Creek State Forest, Rutley State Forest, Kerringle State Forest and Willala Aboriginal Area (refer to Figure 2-4).

The nearest residences are located north of the Bibblewindi State Forest, outside of the forested area, over five kilometres from the site.

The nearest watercourses to the site include an unnamed ephemeral tributary of Cowallah Creek approximately 50 metres northeast of the Bibblewindi 19H lease area, and Mount Pleasant Creek approximately 500 metres to the west of the Bibblewindi 14 lease area.

2.3 CSG infrastructure

2.3.1 Existing infrastructure

The Bibblewindi Multi-Lateral Pilot consists of 12 pilot wells, including:

- four directional wells (Bibblewindi 18H, 19H, 21H and 28H)
- eight vertical wells (Bibblewindi 12, 13, 14, 15, 16, 17, 27 and 29).

The wells straddle Little Tighes Road and are connected via a series of access tracks branching off Little Tighes Road.

The wells are operational but have been temporarily shut in and are not currently pumping gas or water. There is also a core hole at Bibblewindi 11C which has been suspended.

Each well is situated on a lease area of approximately 0.8 hectares (100 by 80 metres) in size. The lease areas are fenced and have been partially rehabilitated. Surface infrastructure on each lease area generally includes a well head and gas separator.

Subsurface infrastructure includes a gas and water gathering system which follows the existing access tracks and collects at Bibblewindi 19H. From here, gas and water is transferred via a pipeline to a water handling and degassing facility currently located approximately three kilometres north of the Bibblewindi Multi-Lateral Pilot, known as the Bibblewindi Water Management Facility. Gas is then transferred to Wilga Park Power Station north of the Bibblewindi Water Management Facility via a 35 kilometre flowline.

The existing lease areas are shown in Plates 2-1 and 2-2.

Plate 2-1 Existing Bibblewindi 14 lease area

Plate 2-2 Existing Bibblewindi 19H

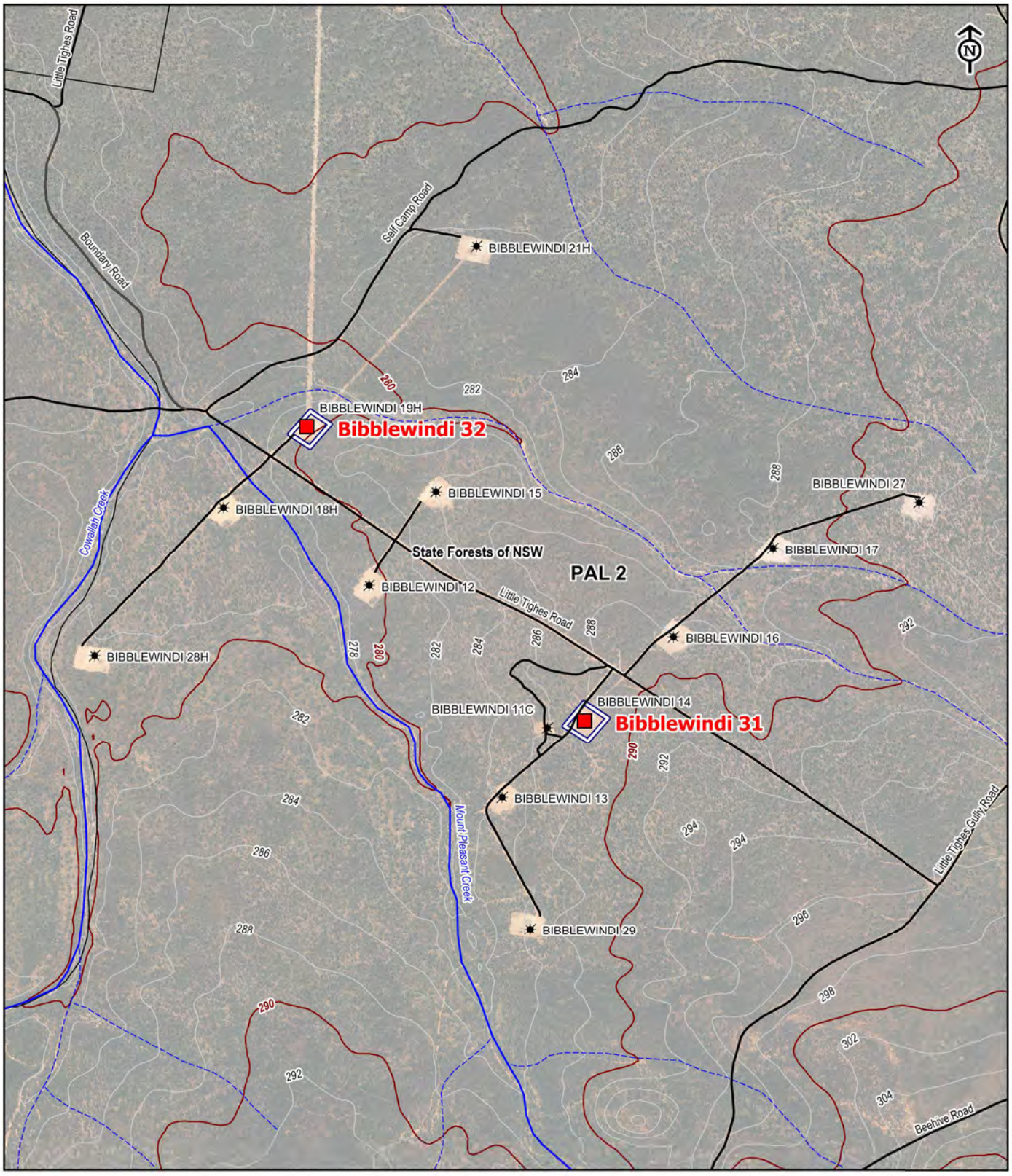
2.3.2 Future infrastructure

Santos intends to centralise its water handling and treatment operations outside of the Pilliga forest and plans to construct a new water management facility, known as the Leewood Produced Water and Brine Management Facility, on an agricultural property approximately 24 kilometres south of Narrabri. A 16 kilometre water flowline will be constructed between the Bibblewindi Water Management Facility and the Leewood Produced Water and Brine Management Facility (refer to Figure 2-5).

The Leewood Produced Water and Brine Management Facility will be developed over two phases. The first phase will involve the construction and operation of produced water and brine ponds at Leewood and the water flowlines between Bibblewindi Water Management Facility and Leewood. Santos prepared a Review of Environmental Factors for phase 1 of the Leewood Produced Water and Brine Management Facility under Part 5 of the EP&A Act and submitted this to the NSW Department of Investment, Trade, Regional Infrastructure and Services in December 2012.

The second phase is proposed to involve the construction and operation of a reverse osmosis (RO) plant and brine treatment plant and will be subject to further environmental assessment and approvals.

It is anticipated that the phase 1 of the Leewood Produced Water and Brine Management Facility will be constructed prior to switching on Bibblewindi 31 and 32.



Site Location
Existing Well
Unsealed Road
Major Drainage
Minor Contour
Major Contour
Minor Contour
Tenure
Lease Area

Santos

PAL 2 - New South Wales

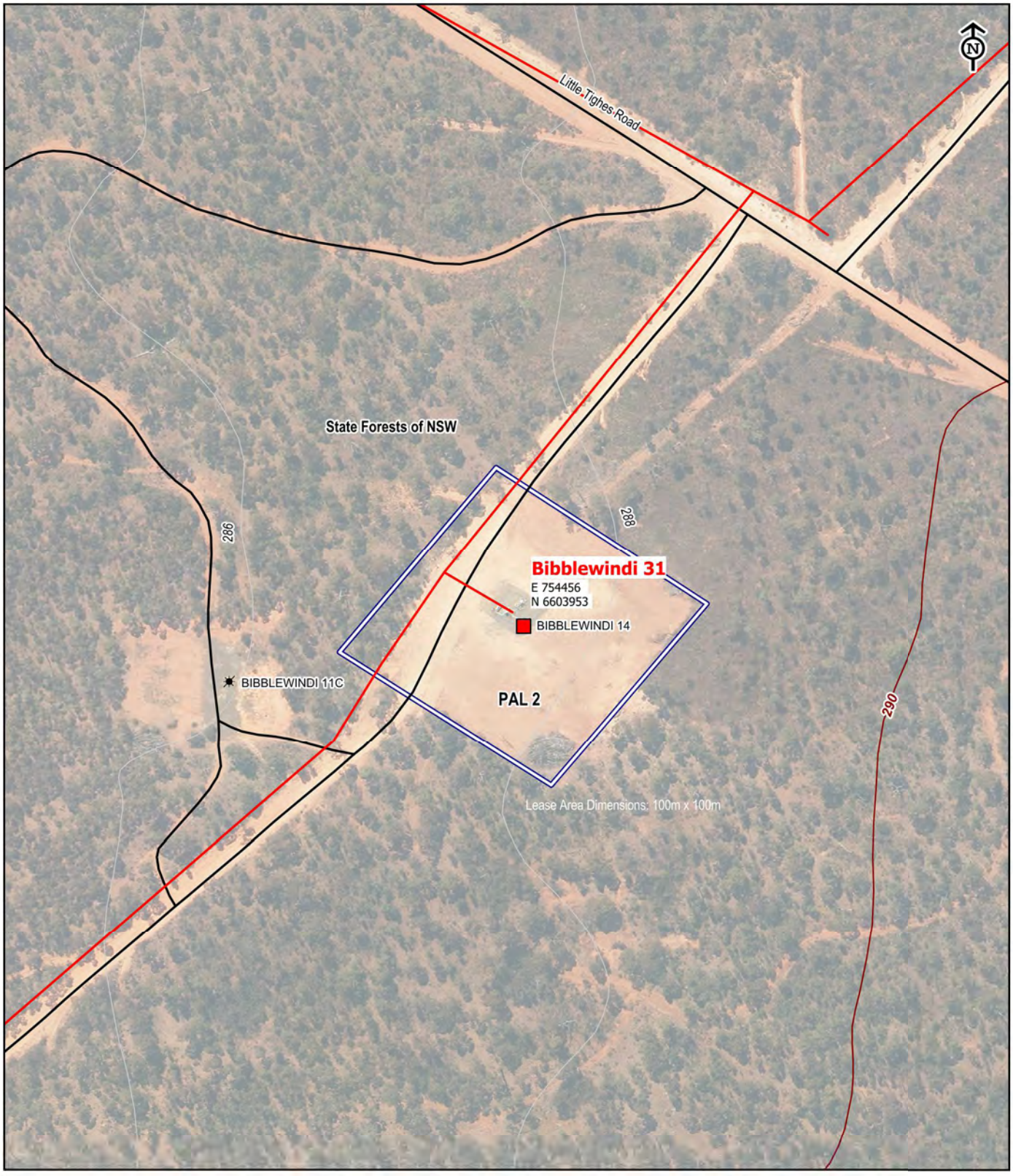
Bibblewindi 31/32 Multi-lateral Pilot and Proposed Well Locations

25 0 25 50 km

Figure: 2-1

Date: February 2013
File No: GUNNEDAH 293b

GDA



Site Location
Existing Well
Pipeline - Existing
Unsealed Road
Major Drainage
Minor Drainage
Major Contour
Minor Contour
Tenure
Well Lease

Santos

PAL 2 - New South Wales

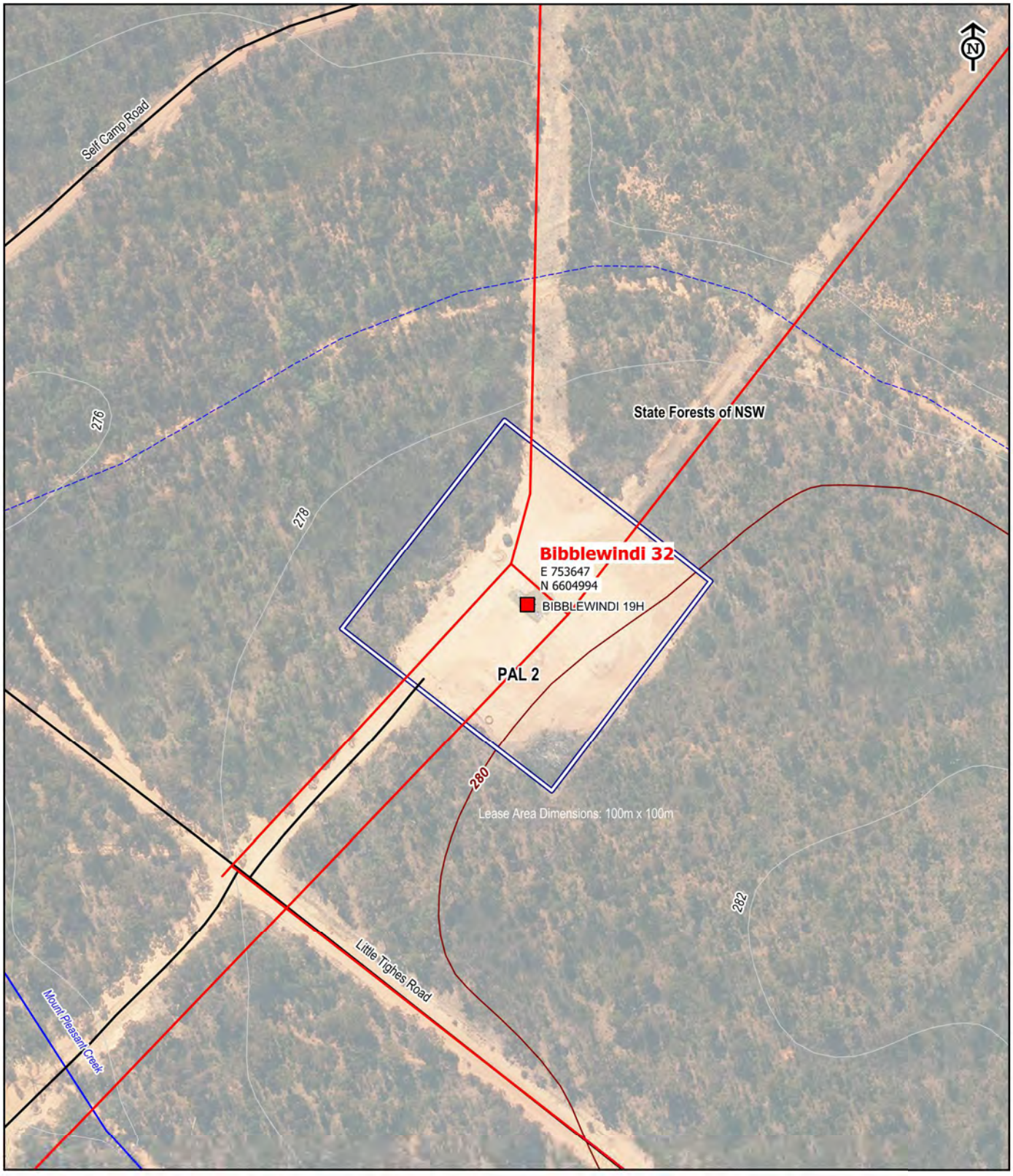
Bibblewindi 31 Lease Area

50 0 50 M

Figure: 2-2

Date: February 2013
File No. GUNNEDAH 293c

GDA



Site Location
Existing Well
Pipeline - Existing
Unsealed Road
Major Drainage
Minor Drainage
Major Contour
Minor Contour
Tenure
Well Lease

Santos

PAL 2 - New South Wales

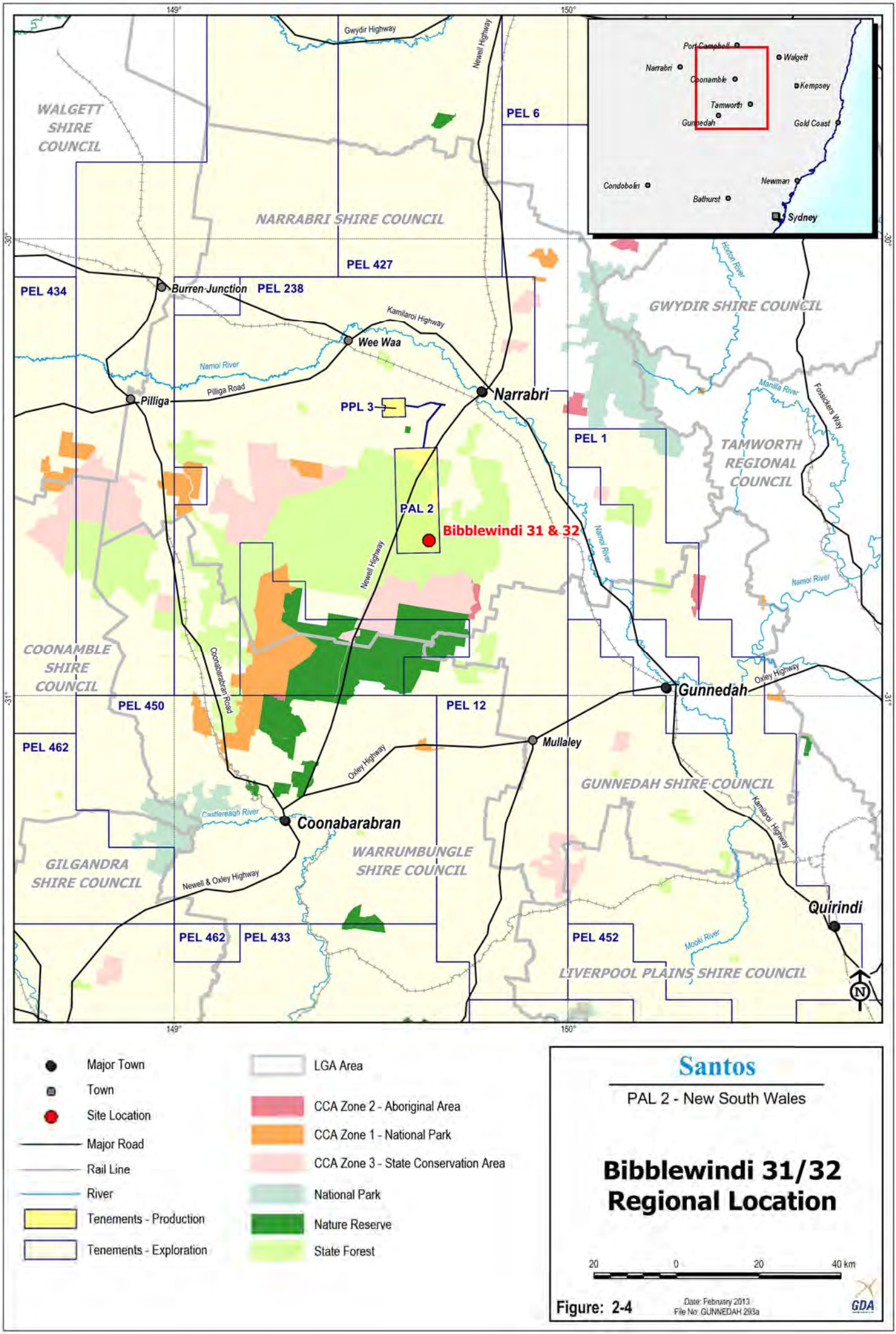
Bibblewindi 32 Lease Area

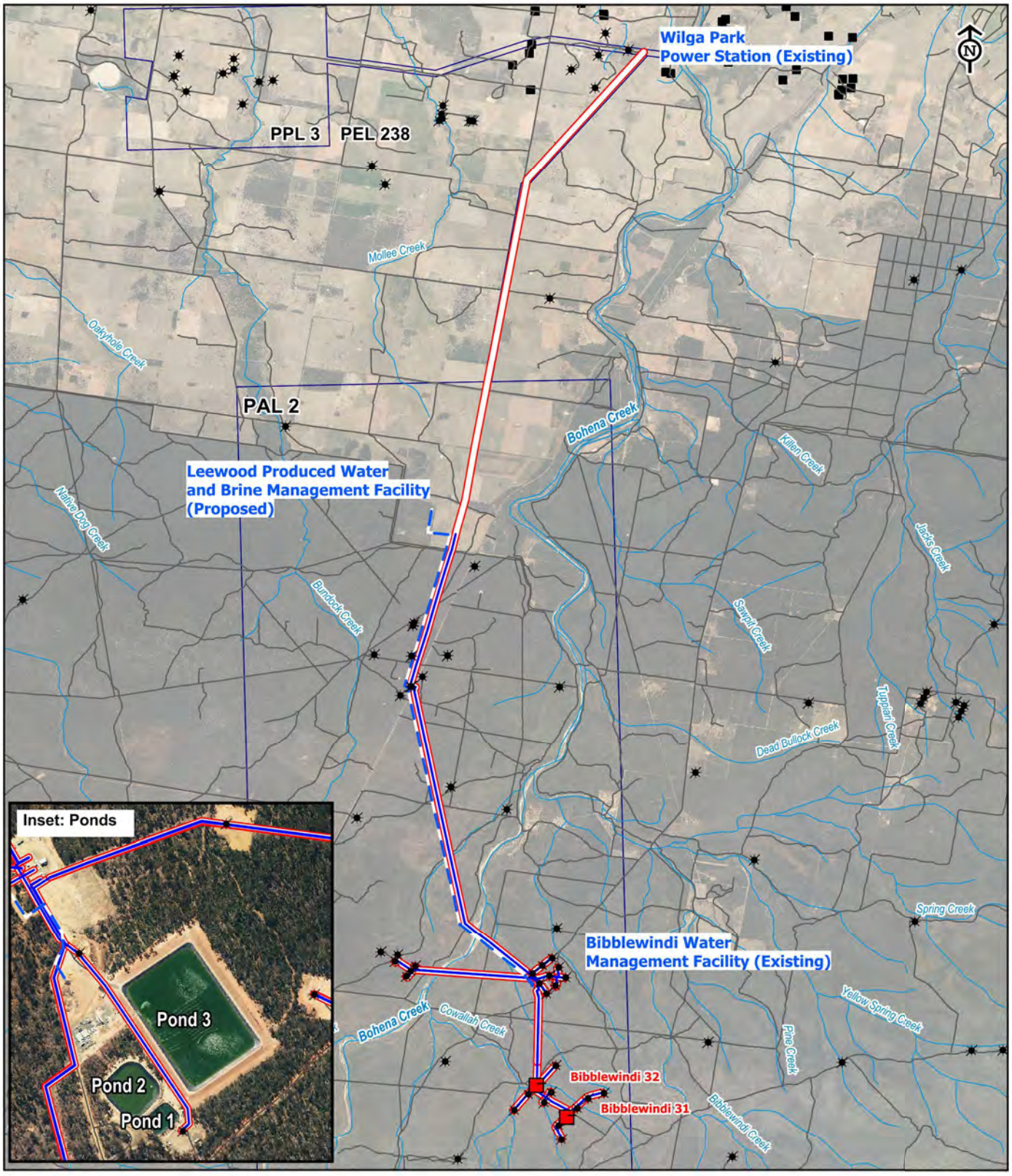
50 0 50 M

Figure: 2-3

Date: February 2013
File No: GUNNEDAH 293rd

GDA


149°
150°
30°
31°
Gwydir Highway
Newell Highway
WALGETT SHIRE COUNCIL
NARRABRI SHIRE COUNCIL
PEL 6
PEL 427
PEL 434
Burren Junction
PEL 238
Kamilaroi Highway
Wee Waa
Namoi River
Pilliga Road
Pilliga
Narrabri
PPL 3
PEL 1
PAL 2
Bibblewindi 31 & 32
Horton River
GWYDIR SHIRE COUNCIL
Manilla River
Fossickers Way
TAMWORTH REGIONAL COUNCIL
Namoi River
Namoi River
COONAMBLE SHIRE COUNCIL
Coonabarabran Road
Oxley Highway
Gunnedah
PEL 450
PEL 12
PEL 462
Mullaley
Oxley Highway
GUNNEDAH SHIRE COUNCIL
Castlereagh River
Coonabarabran
WARRUMBUNGLE SHIRE COUNCIL
Kamilaroi Highway
GILGANDRA SHIRE COUNCIL
Newell & Oxley Highway
Quirindi
PEL 462
PEL 433
PEL 452
Mooki River
LIVERPOOL PLAINS SHIRE COUNCIL
N
Port Campbell
Walgett
Narrabri
Coonamble
Kempsey
Tamworth
Gunnedah
Gold Coast
Condobolin
Newman
Bathurst
Sydney
Major Town
Town
Site Location
Major Road
Rail Line
River
Tenements - Production
Tenements - Exploration
LGA Area
CCA Zone 2 - Aboriginal Area
CCA Zone 1 - National Park
CCA Zone 3 - State Conservation Area
National Park
Nature Reserve
State Forest
Santos
PAL 2 - New South Wales
Bibblewindi 31/32
Regional Location
20
0
20
40 km
Figure: 2-4
Date: February 2013
File No: GUNNEDAH 293a
GDA



Site Location
Existing Well
Leewood Flowline
Gas Flowline
Water Flowline
Unsealed Road
Drainage
Tenure
Lease Area

Santos

PAL 2 - New South Wales

Bibblewindi 31/32 Multi-lateral Pilot and Surrounding CSG Infrastructure

2.5 0 2.5 5 km

Figure: 2-5

Date: February 2013
File No: GUNNEDAH 293e

GDA

3.0 Project description

3.1 Overview

Santos is seeking approval to drill and operate two additional pilot wells within the existing Bibblewindi Multi-Lateral Pilot and operate the combined multi-lateral pilot set. The project will include:

- drilling one vertical (Bibblewindi 31) and one lateral (Bibblewindi 32) pilot well to target the Bohena coal seam
- installing infrastructure to connect the wells to the existing gas and water gathering system for Bibblewindi Multi-Lateral Pilot
- operating the Bibblewindi 31 and Bibblewindi 32 pilot wells and the existing Bibblewindi Multi-Lateral Pilot as a combined pilot well set for the life of PAL 2 (including any extension of PAL 2) or until such time as sufficient data is collected
- managing the water and gas produced during operation of the combined Bibblewindi Multi-Lateral Pilot utilising the Leewood Produced Water and Brine Management Facility.

Santos plans to recommence operation of the existing wells within the Bibblewindi Multi-Lateral Pilot in mid to late 2013. These wells need to be worked over in order to recommence operation. Working over is a standard well maintenance activity.

The former NSW Department of Primary Industries (DPI) approved drilling and operation of Bibblewindi 18H, 12, 13, 14, 19H, 15, 16 and 17 on 8 August 2008 and Bibblewindi 21H, 27, 28H and 29 on 20 July 2009. These activities were approved under Part 5 of the EP&A Act prior to amendments to the Mining SEPP which required that development consent be obtained for exploration activities involving more than five petroleum wells within a three kilometre radius, within the one tenement.

The project can be described in terms of three key stages, including:

- Construction: this includes site preparation activities, well drilling, installation of surface infrastructure and connection to the existing gas and water gathering system.
- Operation: this includes commissioning the wells, pilot testing, water and gas management, partial rehabilitation of the lease areas and ongoing maintenance activities.
- Post operation: this will include decommissioning the wells and ancillary infrastructure, and completely rehabilitating the lease area. If the pilot confirms that the CSG resource is commercially viable, Santos may seek approval to go to production. In this case, the wells and infrastructure would not be decommissioned. Any production project would be subject to further environmental assessment and government approvals.

3.2 Construction

3.2.1 Site preparation

The proposed wells will be drilled on existing leases established for Bibblewindi 14 and 19H. Minor works will be required to prepare both of the existing leases for drilling, including:

- compacting a level drill pad
- constructing a lined environmental pit as a secondary containment system in the event of a spill
- excavating a rectangular cellar pit in the drilling location

- installing and cementing a steel conductor casing ahead of the rig arriving on site
- setting up portable amenities, plant, equipment and temporary buildings on site.

The primary plant, equipment and temporary buildings to be used during drilling activities will include:

- drilling rig and supporting equipment (such as pipe handler and mud pump)
- surface drilling mud tanks
- metal bins, baskets, skids and sea containers to house equipment
- mechanical vibrating screens
- power generator
- lighting towers
- satellite communication trailers
- containers and sheds
- vent tank.

The vent tank would be installed to capture fluids and gas from the well if required. This tank is a re-enforced steel container, approximately 10 by three metres in size, with internal baffles and piping to allow for the separation of gas and liquids. The tank will be designed to contain any fluids vented. This captured and contained fluid will be removed, as required, and disposed of by a licensed waste disposal company. Minor volumes of methane (CH_4) and carbon dioxide (CO_2) may be emitted from the vent tank from time to time.

Other equipment will be required on site during the course of the drilling activities, including wireline trucks, cementing trucks and service company vehicles.

3.2.2 Drilling, casing and completion

3.2.2.1 Well design

Bibblewindi 31 is a vertical well with a True Vertical Depth of approximately 1100 metres and a measured depth of approximately 1146 metres. The measured depth is slightly longer than the True Vertical Depth as the bottom of the well has a slight incline.

Bibblewindi 32 is a single-lateral well and will have a True Vertical Depth of approximately 930–990 metres and a measured depth of approximately 2100 metres. The ‘build zone’, where the initially vertically drilled well is inclined to penetrate the coal seam laterally, will be between 940 and 985 metres True Vertical Depth. From here, the well will continue laterally in-seam for a distance of approximately 900 metres, where it will intercept Bibblewindi 31, and then will continue for a further 100 metres or so.

The single-lateral well arrangement is shown in Figure 3-1.

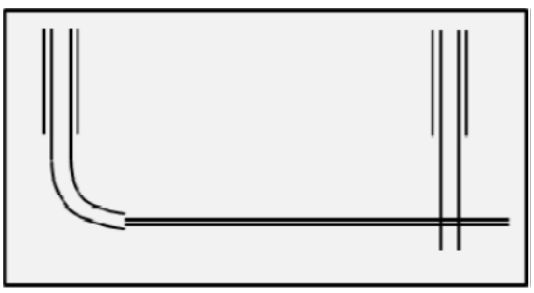


Figure 3-1 Single-lateral well arrangement

3.2.2.2 Drilling activities

Bibblewindi 31 will be drilled first followed by Bibblewindi 32. Drilling and construction of the two wells will involve:

- Drilling an open hole with an approximate diameter of 12 1/4" through alluvial and/or weathered rock material into competent rock (Upper Napperby Formation).
- Installing 9 5/8" steel casing and cementing in place back to surface. The surface casing would be set 260 to 280 metres below ground level.
- Installing a blow out preventer (BOP) on top of the casing.
- Drilling out the casing shoe using an 8 1/2" rotary drilling assembly and drilling to the planned depth.
- Installing production casing to the planned total depth just above the Bohena coal seam.
- Bibblewindi 32 will have a +/- 6" lateral well drilled in the Bohena coal seam to intercept Bibblewindi 31.

3.2.2.3 Drilling mud and additives

During the rotary drilling process, water-based drilling mud will be used to:

- clear rock fragments and other solids (drill cuttings) from the bore hole and bring them to the surface
- apply enough pressure against subsurface formations to prevent fluids and gases from flowing into the well
- prevent clays from swelling and keep the bore hole open until casing has been cemented in place
- cool and lubricate the drilling equipment.

Chemicals may be added to the drilling mud, or held as a contingency on site, to facilitate safe and efficient drilling of the core holes. The primary additives that may be used are potassium-sulphate and potassium-formate to help control swelling clays. In the event that potassium-sulphate and potassium formate are not effective, potassium chloride, a proven and more conventional additive, may be used. Other chemical additives may be used as weighting agents, viscosifiers or polymers. The Material Safety Data Sheets (MSDS) for these chemicals are provided on the Santos website: http://www.santos.com/exploration-acreage/nsw-csg/reports-and-publications.aspx.

The drilling mud will be transported to the site in a trailer prior to the commencement of drilling and stored in surface tanks on site. During operations, the drilling mud will mix with naturally occurring rock and soil and return these to the surface. The drilling mud will pass through mechanical vibrating screens to separate out drill cuttings. The liquid component of the drilling mud will flow into the surface tanks for recirculation throughout the drilling process. The drill cuttings will be transferred to metal bins or a lined pit and stored on site until drilling is completed.

Losing drilling fluid is undesirable as it is the primary means of controlling the core hole. In the event that losses are detected, a lost circulation material (LCM) will be mixed into the mud to prevent further losses. LCM is made of cellulose or other natural material and works by blocking the pores in the permeable/fractured rock.

Once drilling is complete, drilling mud will be transported to an approved treatment and processing facility so it can be reused in future drilling.

3.2.2.4 Cementing

Casing strings will be cemented in accordance with the *Coal Seam Gas Code of Practice (Well Integrity)* (DTIRIS 2012) by a recognised professional cementing company. Pressure tested steel lines will connect the cementing unit to the well to allow fluids to be pumped to the well and these fluids will be positioned in the well following correctly formulated engineering design and good oilfield practice.

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.

3.2.2.5 Casing

Once each well has reached the total depth, geophysical wire-line logs would be run over the entire length of the hole to identify major stratigraphic units, intersected coal seam depth and seam thickness. Further well testing may follow after completion of logging. In the vertical well, Bibblewindi 31, a combination of steel and fiber glass casing would be run in the hole and pressure cemented ensuring total isolation of the well bore to the surrounding coal seams and any potential aquifers. The combination casing design allows fiberglass to be placed over potential future mineable coal seams whereas steel casing isolates all other non-target rock types in the upper section of the well. The horizontal hole drilled from Bibblewindi 32 will intercept the fiberglass casing in the vertical well over the target coal sequences.

In Bibblewindi 32, steel casing will be run in the 8-1/2” hole section to total depth at approximately 1100 metres measured depth. Steel casing will be used over the coal seams.

3.2.2.6 Well completion

The wells will be completed using a smaller work over rig. This involves installing the downhole pump assembly and hydraulic drive head (wellhead) with additional support equipment.

Completions will require several days to install the pumping equipment and approximately one day per well to install the pressure monitoring equipment.

3.2.3 Surface equipment and tie-in to gathering system

A wellhead separator and metering skids with associated power generation equipment (gas and diesel), motor control centre, pump and telemetry units will be installed at each pilot well. The wellhead separator at each pilot will be connected to the existing gas and water gathering system for the Bibblewindi Multi-Lateral Pilot. The tie-in point to the existing buried gathering system will be on the existing Bibblewindi 14 and 19H lease areas to avoid clearing of any vegetation.

A typical wellhead separator is shown in Plate 3-1.

Plate 3-1 Typical wellhead separator

3.2.4 Construction staff and hours

Approximately 24 employees and contractors may be present on site each day. Drilling and construction activities may occur 24 hours per day, seven days per week to maximise efficiencies and use of a remote work force.

3.2.5 Construction schedule

Drilling of Bibblewindi 31 and 32 is planned to commence in mid to late 2013, subject to approval. Construction, including site preparation, drilling and installation of ancillary infrastructure, is expected to take approximately six months.

3.3 Operation

3.3.1 Pilot testing

Operation of the combined Bibblewindi Multi-Lateral Pilot is expected to commence in late 2013. The wells will initially operate for a period of up to three years.

During the pilot test, pressures, water volumes, water levels, compositions and gas rates will be monitored. These will be reported in accordance with regulatory obligations.

Data collected on site from the well head and gathering system will be transmitted via a Remote Telemetry Unit (RTU) through the Next G network to Santos offices to enable operations personnel to remotely monitor and control the surface facilities. Security measures will also be installed.

The pilot wells will have automated shutdown systems that are triggered by preset operating envelopes if exceeded which are designed to prevent environmental, health or safety risk.

3.3.2 Gas and water management

At the surface, each pilot well will be connected to a small separator, operating at low pressure to separate any coal seam gas from the incidental water. Both the gas and water will be collected from each well and transferred to the gathering system.

3.3.2.1 Gas

Recovered coal seam methane gas will flow up the well annulus separate to the water with the gas stream entering the wellhead separator to remove any entrained water. A portion of the produced gas will be diverted to the local fuel gas skid for conditioning prior to being used within the well site power generators.

The balance of gas will flow into the gas gathering lines to a central point on the Bibblewindi 19H lease area before being transferred via an existing pipeline to the Wilga Park Power Station.

3.3.2.2 Water

For the vertical well (Bibblewindi 31) a progressive cavity pump (PCP) will be installed just above the coal seam and transfer water to the surface through the well tubing. For the directional well (Bibblewindi 32), an electrical submersible pump (ESP) will be located at the depth of the target coal seams.

The produced water flowing from the wellhead separator will be mixed with the produced water from the PCP/ESP tubing flowline. The combined water stream from the Bibblewindi Multi-Lateral Pilot will then enter the gathering system and be pumped to facilities at Bibblewindi 19H. From here it will be transferred via an existing pipeline to the Bibblewindi Water Management Facility and then to the Leewood Produced Water and Brine Management Facility. It is proposed to use the Leewood Produce Water and Brine Management Facility for management of the water produced by the combined Bibblewindi Multi-Lateral Pilot.

3.3.3 Partial rehabilitation of lease areas

Once the drilling activities are complete, any surplus lease area is proposed to be rehabilitated to an area of approximately five by five metres around each well head with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

3.3.4 Maintenance activities

Work over operations using a smaller rig will be required on the pilot wells from time to time for corrosion monitoring, mechanical repairs or other interventions as required.

3.4 Post operation

The results of the pilot test will be used to determine whether commercial CSG production is viable or whether the wells will be decommissioned and the lease areas rehabilitated.

If the decision is made to decommission and rehabilitate the pilot wells post-operation, well abandonment and rehabilitation procedures would be undertaken prior to the expiration of PAL 2 (or any renewal).

The wells would be cemented, plugged and abandoned in accordance with DTIRIS requirements. This would include:

- sealing the wells from bottom to top by plugging with cement in approximately 200 metre increments
- pressure testing the cement plug across the surface casing shoe to ensure the wells are sealed
- removing the well head sat a depth of greater than 1.5 metres below surface and burying.

Buried surface infrastructure would be flushed, capped at each end and left in-situ.

The lease areas would be fully rehabilitated within approximately six months of well abandonment where practicable and considering external factors such as the weather and availability of resources.

If the decision is made to proceed to commercial production, additional environmental assessment would be carried out and government approvals sought.

4.0 Planning and permissibility

4.1 Commonwealth legislation

4.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) provides for the protection of certain Matters of National Environmental Significance (MNES) listed under the Act, which include:

- World Heritage Areas
- National Heritage Places
- Ramsar wetlands of international importance
- Commonwealth listed threatened species and ecological communities
- listed migratory species
- Commonwealth marine areas
- Great Barrier Reef Marine Park
- nuclear actions.

Under the EPBC Act, Commonwealth approval is required from the Minister of Sustainability, Environment, Water, Population and Communities (Minister) for any action that will have or is likely to have a significant impact on a MNES, or on the environment of Commonwealth land or on the environment if the action is proposed to be taken by a Commonwealth agency (known as a 'controlled action').

A person proposing to take a controlled action must refer the proposed development to the Minister for determination. A person proposing to take an action that the person thinks is not a controlled action may refer the proposed development to the Minister for the Minister's decision whether or not the action is a controlled action.

An EPBC Act Protected Matters Search Report was generated for a 10 kilometre radius surrounding the site. The results of the search are outlined in Table 4-1. An assessment of the proposed development against MNES would be undertaken during preparation of the environmental impact statement.

Table 4-1 Matters of National Environmental Significance

MNES	Overview
World Heritage Properties	No World Heritage Properties are located within 10 km of the sites.
National Heritage Places	No National Heritage Places are located within 10 km of the sites.
Wetlands of international importance (RAMSAR wetlands)	No wetlands of international importance are located within 10 km of the sites.
Nationally listed threatened species and ecological communities:	Four Threatened Ecological Communities, listed under the EPBC Act were identified as having the potential to occur within 10km of the site, including: ▪ Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions, listed as endangered ▪ Grey Box Grassy Woodlands and Derived Native Grasslands of South-eastern Australia, listed as endangered ▪ Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland, listed as critically endangered ▪ Weeping Myall Woodlands, listed as endangered.

MNES	Overview
	Twenty threatened species listed under the EPBC Act were identified as having the potential to occur within 10 km of the sites.
Migratory species	Thirteen migratory bird species listed under the EPBC Act were identified as having the potential to occur within 10 km of the sites.
Commonwealth marine areas	No Commonwealth marine areas are located within 10 km of the sites.
Great Barrier Reef Marine Park	The sites are not located within 10 km of the Great Barrier Reef Marine Park.
All nuclear actions	The proposed development does not involve a nuclear activity.

4.1.2 Native Title Act 1993

The objectives of the *Native Title Act 1993* (Native Title Act) are to:

- Recognise native title rights and sets down basic principles in relation to native title in Australia.
- Provide for the validation of past acts which may be invalid because of the existence of native title.
- Provide for a future act regime in which native title rights are protected and conditions imposed on acts affecting native title land and waters.
- Provide a process by which native title rights can be established and compensation determined.
- Provide processes for negotiations and determinations about whether future acts, including grants and activities carried out under those grants, can be done over native title land and waters.
- Provides for a range of other matters, including the establishment of a National Aboriginal and Torres Strait Islander Land Fund.

In the area of PAL 2 the relevant native title claimant is the Gomeroi People (NSD2308/2011). PAL 2 was granted in 2007 and no further native title process is required for activities authorised under PAL 2. Should Santos apply for a production lease in the area of PAL 2, Santos understands that the Native Title Act requires completing the right to negotiate process under Subdivision P of Division 3 of Part 2 of the Act or concluding an Indigenous Land Use Agreement with the Gomeroi People.

4.2 NSW legislation and policy

4.2.1 Petroleum (Onshore) Act 1991

The *Petroleum (Onshore) Act 1991* (Petroleum Act) regulates the onshore exploration for and production of petroleum. Under the Petroleum Act, petroleum means:

> *(a) any naturally occurring hydrocarbon, whether in a gaseous, liquid or solid state, or*
>
> *(b) any naturally occurring mixture of hydrocarbons, whether in a gaseous, liquid or solid state, or*
>
> *(c) any naturally occurring mixture of one or more hydrocarbons, whether in a gaseous, liquid or solid state, and one or more of the following, that is to say, hydrogen sulphide, nitrogen, helium, carbon dioxide and water,*
>
> *and includes any substance referred to in paragraph (a), (b) or (c) that has been returned to a natural reservoir, but does not include coal or oil shale or any substance prescribed to be a mineral for the purposes of the Mining Act 1992.*

The holder of a petroleum assessment lease has the right to prospect for, and to assess any, petroleum on the land within the lease area. If approved, the project would be undertaken within PAL 2 granted under the Petroleum Act. Activities allowed under PAL 2 are identified in a Petroleum Operations Plan (POP) that has been approved by the Director-General of NSW Trade & Investment (or delegated authority).

The proposed activities are allowed under the POP, but as identified in section 4.2.2, the activity is deemed to be SSD and would require development consent under Part 4, Division 4.1, of the EP&A Act.

4.2.2 Environmental Planning and Assessment Act 1979

4.2.2.1 Overview

Under clause 6 of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP), development for the purposes of petroleum exploration is permissible without consent. However, under clause 7(2) of the Mining SEPP, development consent is required for the purposes of drilling or operating a set of more than five wells that is more than three kilometres from any other petroleum well (other than an abandoned petroleum well) in the same petroleum title.

Section 89C(2) of the EP&A Act provides that a State environmental planning policy may declare any development or any class or description of development, to be SSD. The State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) identifies development which is SSD for this purpose. Clause 6 of Schedule 1 of the SRD SEPP identifies 'Petroleum (oil and gas)' and classifies 'development for the purpose of drilling and operating petroleum exploration wells, not including… a set of five or fewer wells that is more than three kilometres from any other petroleum well (other than an abandoned petroleum well) in the same petroleum title' as SSD.

The project will result in more than five petroleum wells, other than abandoned wells, within a three kilometre radius within PAL 2 and is therefore SSD. Under section 89D of the EP&A Act, the Minister for Planning and Infrastructure is the consent authority for SSD.

Section 78(8A) of the EP&A Act requires an environmental impact statement (EIS) assessing the project to be submitted. Before preparing an EIS, Part 2, clause 3(1) of the *Environmental Planning and Assessment Regulation* 2000 (Regulation) requires a written application to be made to the Director-General for the environmental assessment requirements with respect to the proposed EIS. This document has been prepared for the purpose of obtaining the environmental assessment requirements.

The development assessment process under Division 4.1 of the EP&A Act is shown in Figure 4-1.

4.2.2.2 Section 79C requirements

Section 79C of the EP&A Act applies to the determination of State significant development and requires the consent authority to take into consideration the matters identified in Table 4-2. The EIS would address these matters for consideration.

Table 4-2 Matters for consideration under section 79C of EP&A Act

Matters for consideration	Response
(a) the provisions of:	
(i) any environmental planning instrument	The primary environmental planning instruments of relevance to the proposed development are discussed in section 4.2.2. The EIS would consider all relevant matters within applicable environmental planning instruments.
(ii) any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority	Draft amendments to the Mining SEPP were exhibited during November and December of 2012. These amendments will establish the Gateway process for State significant mining and petroleum projects located on Biophysical Strategic Agricultural Land (SAL) under the *Strategic Regional Land Use Policy* (DoP&I 2012). While the project is not located on SAL, under the draft amendments to the Mining SEPP, Santos will need to apply for a site verification certificate prior to submitting the development application for the project.
(iii) any development control plan	In accordance with section 11 of the State and Regional Development SEPP, development control plans do not apply to State significant development.
(iiia) any planning agreement that has been entered into under section 93F, or any draft planning agreement that a developer has offered to enter into under section 93F	Any planning agreements or draft planning agreements would be addressed in the EIS.
(iv) the regulations	There are no relevant matters prescribed by the regulations.
(v) any coastal zone management plan (within the meaning of the Coastal Protection Act 1979), that apply to the land to which the development application relates	There are no coastal zone management plans relevant to the site.
(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality	Section 5 provides preliminary consideration of the potential impacts of the proposed development. The EIS would provide further detailed assessment of the potential impacts of the proposed development.
(c) the suitability of the site for the development	Justification for selecting the proposed site is provided in section 6. Further assessment of the site's suitability for the proposed development will be provided in the EIS.
(d) any submissions made in accordance with this Act or the regulations	Any submissions received during the statutory exhibition period would be considered by the Department of Planning and Infrastructure prior to determination of the application.
(e) the public interest.	The public interest would be served through the application of all relevant planning controls and objectives.

Development consent may not be granted if the development is wholly prohibited by an environmental planning instrument. The project is not prohibited by any environmental planning instruments.

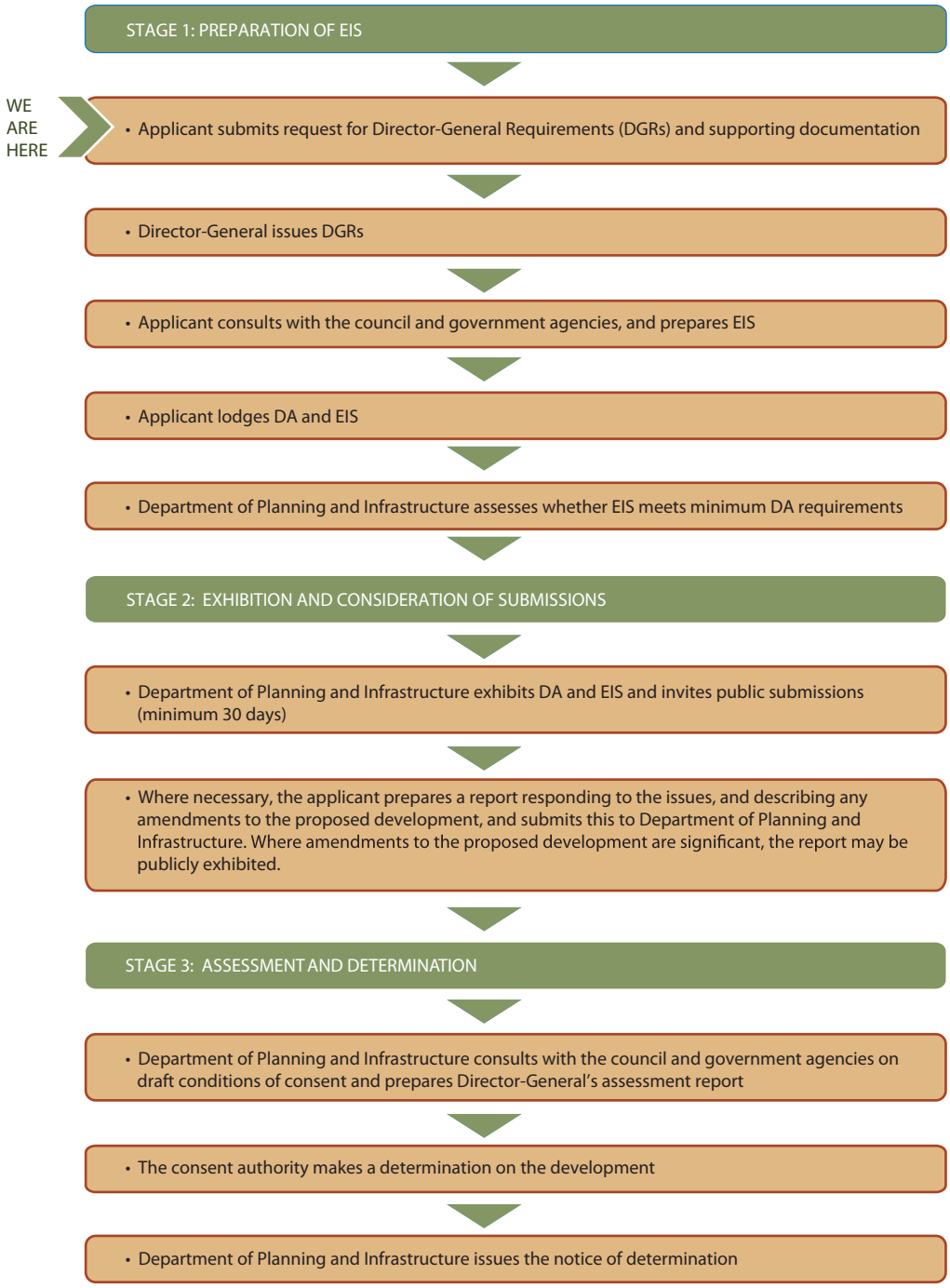


Figure 4-1 The development assessment process

4.2.3 Strategic Regional Land Use Policy

The *Strategic Regional Land Use Policy* identifies and protects more than two million hectares of strategic agricultural land, protects valuable water resources, and provides greater certainty for companies wanting to invest in mining and coal seam gas projects in regional NSW.

The project is not located on or within two kilometres of strategic agricultural land (SAL) or a Critical Industry Cluster mapped under the *Strategic Regional Land Use Plan New England North West Region* and is unlikely to impact on agricultural resources. However, under draft amendments to the Mining SEPP, a Site Verification Certificate will likely be required for submission with the development application to verify whether the site is or is not biophysical SAL.

On 19 February 2013 the NSW Government announced that a two kilometre exclusion zone will be imposed around residential zones to prevent new CSG exploration, assessment and production activities. The project is located within the Bibblewindi State Forest and is not located within two kilometres of a residential zone.

4.2.4 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The Mining SEPP recognises the importance of mining, petroleum production and extractive industries within NSW.

Clause 6 identifies development that can be carried out without development consent under Part 5 of the EP&A Act and includes development for the purposes of '*petroleum exploration*'. However, as outlined in above, the proposed development is classified as SSD and requires development consent under Part 4, Division 4.1, of the EP&A Act.

4.2.5 Narrabri Local Environmental Plan 2012

The site is located within land RU3 Forestry under the Narrabri Local Environmental Plan 2012 (Narrabri LEP). Under the LEP, uses authorised under the *Forestry Act 2012* or for the purposes of roads are permitted without consent within the RU3 Forestry zone and all other uses. The project is for the purposes of petroleum exploration.

Under section 60 of the *Forestry Act 2012*, the land manager of a forestry area may issue a forest permit authorising the holder of the permit to use the forestry area for such purposes (including recreational, sporting or commercial activities) as are specified in the permit. Santos holds an occupation permit issued by Forests NSW under the *Forestry Act 1916* (which was replaced by the *Forestry Act 2012*) for the area of the Bibblewindi State Forest and Pilliga State Forest within the boundaries of PEL 238 or PAL 2. The occupation permit allows activities authorised under the Petroleum Act or a petroleum title within this area and is valid for a period of 30 years, commencing in 2011.

As discussed in section 4.2.1, the Mining SEPP has the effect that the project is permissible with development consent despite the provisions of the Narrabri LEP and the project is SSD.

4.2.6 Water Management Act 2000

4.2.6.1 Water sharing plans

Water sharing plans (WSPs) are designed to provide long-term environmental protection and sustainability of the surface water and groundwater resources as well as directing how water will be allocated and shared among the various water users. WSPs apply the goals and principles of the *NSW State Groundwater Policy* at a local and regional level.

The *Water Management Act 2000* (WMA) provides for a system of assessment and licensing and approvals relating to the equitable take of water from water sources, in addition to works and activities occurring within or affecting these water sources. Each WSP sets out Water Sharing Rules and Management Rules for aquifer interference activities within each water source that operate under these water management principles.

The following WSPs apply to water sources beneath or in the vicinity of the site:

- NSW Great Artesian Basin (GAB) Groundwater Sources WSP
- NSW Murray-Darling Basin (MDB) Porous Rock Groundwater WSP
- NSW MDB Fractured Rock Groundwater WSP
- NSW Upper and Lower Namoi Groundwater Sources WSP
- NSW GAB Shallow Groundwater Sources WSP
- Upper Namoi and Lower Namoi Regulated River WSP.

The project will need to comply with the rules developed for the affected water sources within the relevant WSPs outlined above.

4.2.6.2 Water access licences

Under Part 2 of Chapter 3 of the WMA, it is an offence to take water from a source regulated by the WMA unless in accordance with a water access licence (WAL).

Water used for the construction and operation of the proposed activity will be sourced from Narrabri or Gunnedah's town water supply or local industrial licensed water bores and trucked to the site. Alternatively, production water from pilot wells will be used when available for the preparation of drilling mud.

A WAL is also required for the taking of groundwater, whether for consumption or incidentally, unless an exemption applies. Any new mining and petroleum exploration activities that take more than three megalitres per year from groundwater sources will need to hold a WAL.

The volume of water to be abstracted during operation of Bibblewindi 31 and 32 is estimated to be approximately 62 megalitres over three years. Santos will need to obtain a WAL to account for this water take.

4.2.6.3 Aquifer interference approvals

Under section 91F of the WMA, it is an offence to carry out an aquifer interference activity without an aquifer interference approval. Aquifer interference activities include any of the following:

- the penetration of an aquifer
- the interference with water in an aquifer
- the obstruction of the flow of water in an aquifer
- the taking of water from an aquifer in the course of carrying out mining, or any other activity prescribed by the regulations
- the disposal of water taken from an aquifer.

However, section 91F of the WMA does not currently apply. Section 88A provides that Part 3 of Chapter 3 (including section 91F) applies to each part of the State or each water source and each type or kind of approval that relates to that part of the State or that water source that is declared by proclamation.

At the time of this REF, no proclamation has been made declaring that Part 3 of Chapter 3 of the Act applies in relation to aquifer interference approvals.

Accordingly, an aquifer interference approval will not be required for the project.

4.2.6.4 Aquifer interference policy

The *NSW Aquifer Interference Policy* (AIP) was released in September 2012 to clarify the requirements for obtaining water licences and approvals for aquifer interference activities. The AIP establishes and objectively defines minimal impact considerations for groundwater sources, connected water sources, and their dependent ecosystems, culturally significant sites and water users.

The AIP specifies that the volume of water taken from a water source(s) as a result of an activity is required to be predicted prior to project approval and that approval will not be granted unless the Minister is satisfied that adequate arrangements are in force to ensure that no more than minimal harm will be done to an aquifer or its dependent ecosystems.

Minimal harm criteria are specified in the Policy for highly productive and less productive groundwater sources.

4.2.7 Protection of the Environment Operations Act 1997

One of the primary objectives of the *Protection of the Environment Operations Act 1997* (NSW) (POEO Act) is to 'protect, restore and enhance the quality of the environment in New South Wales, having regard to the need to maintain ecologically sustainable development'. The POEO Act requires environmental protection licences (EPLs) be obtained for the carrying out of 'scheduled activities'.

On 19 February 2013 the NSW Government announced that all CSG exploration, assessment and production titles and activities will be required to hold an EPL. Further details of this announcement have not yet been released. If required, Santos will need to obtain an EPL for the project.

4.3 Other NSW legislation

Other NSW legislation that will be addressed in the EIS includes:

- Brigalow and Nandewar Community Conservation Area Act 2005
- Contaminated Land Management Act 1997
- Dangerous Goods (Road and Rail Transport) Act 2008
- Fisheries Management Act 1994
- Forestry Act 2012
- Heritage Act 1977
- National Parks and Wildlife Act 1974
- Native Title (New South Wales) Act 1994
- Native Vegetation Act 2003
- Work Health and Safety Act 2011
- Roads Act 1993
- Threatened Species Conservation Act 1995
- Water Act 1912.

Section 89J of the EP&A Act overrides the need to obtain certain approvals and authorisations under various acts of legislation (including some of those listed above) for State significant development for which a development consent has been granted. The EIS would identify the additional approvals and authorisations required for the proposed development.

5.0 Preliminary environmental assessment

5.1 Environmental risk analysis

A preliminary environmental risk assessment of the project was undertaken to identify and prioritise issues requiring further assessment in the EIS. Potential environmental issues associated with the project were identified based on desktop investigations, preliminary ecological and archaeological field investigations, knowledge of the statutory planning and regulatory requirements, and considering the nature and scale of the project.

The risk assessment was conducted by a multi-disciplinary project team. Environmental risks were identified for each environmental aspect during key stages of the project. Each risk was given an inherent risk ranking based on the likelihood and potential consequences of the risk without any mitigation measures being applied.

Potential issues with a risk rating of four or greater are considered key environmental issues for the project, and require further detailed environmental assessment and/or specific mitigation strategies to be developed. Potential issues with a risk rating equal to or less than three are considered other environmental issues for the project and can be managed through standard mitigation measures.

The proposed wells have been located on existing well leases within the Bibblewindi Multi-Lateral Pilot to avoid the need for further vegetation clearing or disturbance. Impacts associated with establishing the Bibblewindi 14 and 19H well leases were assessed by Eastern Star Gas in a REF titled *2008 Narrabri Coal Seam Gas Lateral Program, Lateral Production Pilot A, Petroleum Assessment Lease 2, Gunnedah Basin, New South Wales* (ESG 2008). This REF was approved by the former DPI on 8 August 2008.

The risk assessment identified potential impacts on biodiversity, hazard and risk (including bushfire risk) and waste as being key issues for the project.

5.2 Key environmental issue

5.2.1 Groundwater

5.2.1.1 Existing environment

PAL 2 is located in the central portion of the Gunnedah Basin where Jurassic and Cretaceous Surat Basin sediments unconformably overlie Permo Triassic Gunnedah Basin sediments. The Gunnedah Basin, covers an area of more than 15,000 square kilometres and is defined in structural terms as being bounded to the east by the Hunter-Mooki Thrust Fault System and the New England Fold Belt, and to the west by the Lachlan Fold Belt onto which the Gunnedah Basin sediments gradually onlap. The Gunnedah Surat Basin stratigraphy is shown in Figure 5-1.

The Early Permian (Bohena) coal seam of the Maules Creek Formation is the target CSG bearing formation for the project. The Maules Creek Formation is overlain by strata belonging to the Middle Permian Porcupine and Watermark Formations of the Millie Group, successively overlain by the Late Permian Black Jack Group strata and the Triassic Digby, Napperby and Deriah Formations (refer to Figure 5-1).

The main groundwater sources underlying the site include:

- Upper and Lower Namoi Alluvium, covered by the NSW Upper and Lower Namoi Alluvium Groundwater Sources WSP.
- Southern recharge groundwater sources of the GAB, covered by the NSW GAB Groundwater Sources WSP.
- Gunnedah Basin MDB buried groundwater source, covered by the NSW Murray-Darling Basin (MDB) Porous Rock Groundwater Source WSP.

The Upper and Lower Namoi Alluvium groundwater sources and the southern recharge groundwater source of the GAB are considered to be 'Highly Productive' in the context of the AIP. The Gunnedah Basin MDB porous rock groundwater source, covered by the NSW MDB Porous Rock Groundwater WSP, is considered to be a 'Less Productive' groundwater source in the context of the AIP.

Groundwater in the Namoi catchment supports the irrigation industry and also provides the water supply for many towns and intensive industries. There are a total of 700 license holders in the Namoi catchment (NOW, 2011).

There are three registered groundwater bores located within approximately five kilometres of the Bibblewindi Multi-Lateral Pilot (NSW Government, 2013). These bores are located north of the site and have the following details:

- GW021998 (maximum depth 73.76 metres) – authorised purpose is oil exploration (water bearing zone is located within Pilliga sandstone at depth 38.8 to 69.7 metres).
- GW967923 (maximum depth 90.0 metres) – authorised purpose is industrial (water bearing zone is located within Pilliga sandstone at depth 65.0 to 90.0 metres).
- GW970010 (maximum depth 47.0 metres) – authorised purpose is as a test bore (water bearing zone is located within Pilliga sandstone at depth 33.0 to 47.0 metres).

The Pilliga sandstone in this area belongs to the southern recharge groundwater source of the GAB covered by the NSW GAB Groundwater Sources WSP and is a 'Highly Productive' groundwater source in the context of the AIP.

Eather Spring and Hardy's Spring are groundwater dependent ecosystems (GDEs) located approximately 15 kilometres from the site. These GDEs are recharge rejection springs associated with the junction of the unconfined Pilliga Sandstone and the underlying Purlawaugh Formation. The Purlawaugh Formation acts as a barrier to further percolation of groundwater within the Pilliga sandstone, which causes groundwater to discharge (Halcrow 2012).

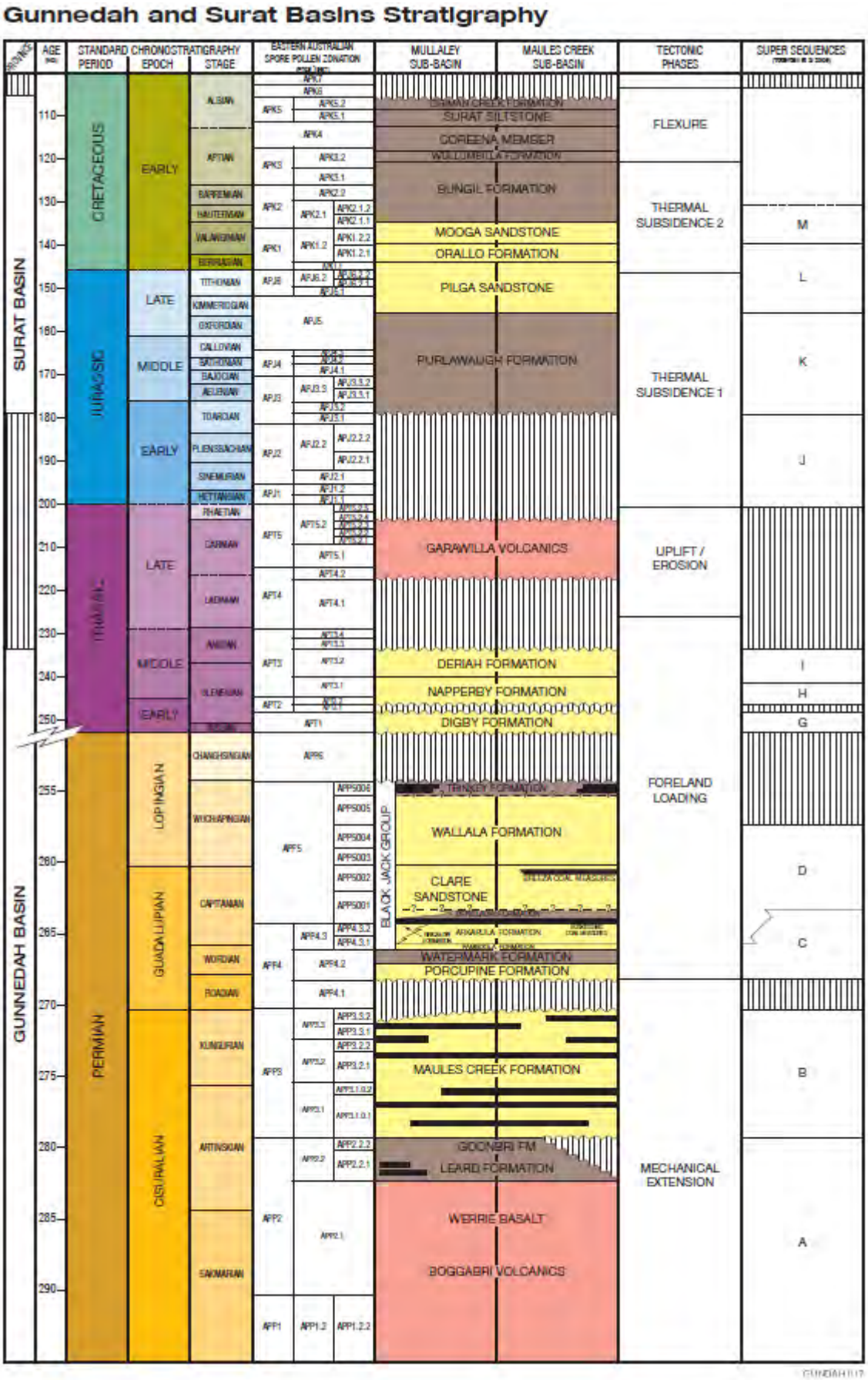


Figure 5-1 Gunnedah-Surat Basin stratigraphy

5.2.1.2 Consideration of potential issues

Impacts to groundwater have greatest potential to occur during operation of the wells but may also occur during drilling. During drilling groundwater aquifers will be intersected, however these will be cased and cemented in accordance with the *Code of Practice Coal Seam Gas Well Integrity* (DTIRIS 2012) to isolate any water transfer between aquifers.

Drilling mud and chemical additives would also be used during drilling to control the well and bring solids to surface. There is little risk of contamination of aquifers from this process due to the well casing.

During operation, CSG will be extracted from the Bohena seam of the Maules Creek Formation. This formation is part of the porous rock groundwater source of the Gunnedah Basin (NSW MDB Porous Rock groundwater source WSP), a 'Less Productive' groundwater source in the context of the AIP. In order to release CSG from the coal seam, the coal seam needs to be depressurised by extracting water from the formation. It is estimated that Bibblewindi 31 and 32 will extract approximately 62 megalitres of water over the three year pilot testing duration, which averages approximately 55,000 litres per day.

Preliminary groundwater modeling carried out by Halcrow Australasia Pty Limited (Halcrow 2012) indicates that drawdown as a result of this extraction will occur within the Gunnedah Basin MDB porous rock groundwater source but will be limited to target seam within the Maules Creek Formation and the overlying Porcupine and Watermark Formations. The water extraction would be unlikely to result in aquifer interference to alluvial groundwater sources of the Upper and Lower Namoi Alluvium or to the Pilliga Sandstone, and is not expected to impact the GDEs, Eather Spring and Hardy's Spring, east of the site.

The existing pilot wells with the Bibblewindi Multi-Lateral Pilot will re-commence pumping during operation of the proposed new wells. There may be cumulative impacts on groundwater associated with operation of Bibblewindi 31 and 32 and the existing pilot wells.

5.2.1.3 Strategy to address potential issues

The proposed drilling and well construction and completion method would significantly reduce the risk of impacts to groundwater sources during drilling.

A groundwater impact assessment, including detailed groundwater modeling will be undertaken during preparation of the EIS. As part of this assessment:

- The volume of water to be extracted from the target coal seam by the proposed wells will be estimated as well as water extracted by the existing surrounding pilot wells.
- The potential water level drawdown in strata overlying the coal seam targets will be calculated.
- The potential flux of water induced between various formations will be calculated.
- Resultant impacts to existing groundwater users and GDEs in the area will be assessed.

5.2.2 Management of waste and by-products

5.2.2.1 Consideration of potential issues

The proposed development would generate the following waste streams:

- drilling mud and cuttings
- chemical, fuel and oil containers
- general site waste such as packaging materials and scrap metal

- domestic wastes (such as food scraps and rubbish)
- sewage waste
- cement slurry.

Potential impacts associated with the generation, management and disposal of these wastes include:

- leaching of chemicals or other pollutants into groundwater, soils or surface water
- pollution or contamination of land or water due to illegal dumping of waste, lack of suitable containment of waste or improper management of produced formation water
- littering of the sites, surrounding properties or surface waters due to lack of suitable containment of waste
- odours caused by improper storage or treatment of putrescible waste.

Approximately 62 megalitres of formation water would be produced over the life of the project. This water would be transferred via pipeline to the proposed Leewood Water and Brine Management Facility for treatment, to be assessed and approved as a separate project. No produced formation water would be stored on the site.

5.2.2.2 Strategy to address potential issues

Waste would be managed in accordance with the resource management hierarchy principles of the *Waste Avoidance and Resources Recovery Act 2001*. The EIS would identify and quantify wastes and provide a waste management strategy for the project following these principles.

At the completion of drilling, drilling mud would be removed from the site, by an appropriately licensed contractor, to a licensed fluids batching and reuse facility for treatment and reuse in future drilling activities. Drill cuttings would be sampled to determine whether they qualify as excavated natural material under the excavated natural material exemption. Where drill cuttings qualify as excavated natural material, these would be mixed with spoil and used during rehabilitation of the lease area. The EIS would provide a detailed management strategy for drilling muds and fluids.

An operational water management plan would be prepared prior to pumping water from the pilot wells.

5.3 Other environmental issues

5.3.1 Biodiversity

Potential impacts to biodiversity from development of the Bibblewindi 14 and 19H well leases were assessed in the REF prepared by ESG in 2008. This REF included a seven-part test under section 5A of the EP&A Act and determined that development of the well leases would be unlikely to significantly impact on any threatened species, populations, ecological communities or their habitats, or on critical habitat.

An additional ecological inspection of the well leases and surrounding area was carried out by RPS on 27 November 2012. The findings of this inspection are discussed in the following sections.

5.3.1.1 Existing environment

Flora

The Bibblewindi 14 and 19H lease areas were previously cleared during development of the Bibblewindi Multi-Lateral Pilot and are completely devoid of vegetation. Vegetation surrounding the lease areas is dense and consists of Ironbark Shrubby Woodlands of the Pilliga area, Brigalow Belt South. This vegetation type is

common and is not commensurate with any threatened ecological community listed under the TSC Act or EPBC Act.

Areas around each of the well sites have been recently burnt which has resulted in significant regeneration of the mid and over-stories and a general paucity of mature hollow bearing trees.

Four threatened flora species were identified as having the potential to occur near the site based on a review of available literature, including *Cyperus conicus, Philotheca ericifolia, Polygala linariifolia* (Native Milkwort) and *Rulingia procumbens*. Targeted searches were carried out for these species in the area around the existing lease areas; however, none were identified.

Five Weeds of National Significance (WoNS) have been identified as having the potential to occur near the site, including African Boxthorn (*Lycium ferocissimum*), Radiata Pine (*Pinus radiata*), Blackberry (*Rubus fruticosus aggregate*), Willows (*Salix spp.*) and Athel Pine (*Tamarix aphylla*). No WoNS were identified during the site inspection.

Fauna

The habitat surrounding the existing leases provides a range of resources for native fauna species. Old stockpiles resulting from tree felling provide breeding and roosting habitat for a range of reptile and mammal species. The dense Acacia under-storey provides cover that favours cryptic and shy species.

Fauna observed near the site during the inspection included Striated Pardalote (*Pardalotus striatus*), Emu (*Dromaius novaehollandiae*), Willy Wagtail (*Rhipidura leucophrys*) and the Eastern Grey Kangaroo (*Macropus giganteus*). Wallaby and goat scats were observed during the site inspection.

Vegetation surrounding the site provides suitable habitat for a range of threatened fauna species as identified in Table 5-1.

Table 5-1 Threatened fauna species likely to occur within the sites

Common name	Scientific name	TSC Act listed	EPBC Act listed
Swift Parrot	*Lathamus discolour*	E	E
Superb Parrot	*Polytelis swainsonii*	V	V
Koala	*Phascolarctos cinereus*	V	V
Pilliga Mouse	*Pseudomys pilligaensis*	V	V
Border Thick-tailed Gecko	*Uvidicolus sphyrurus*	V	V
Speckled Warbler	*Chthonicola sagittata*	V	-
Turquoise Parrot	*Neophema pulchella*	V	-
Grey-crowned Babbler	*Pomatostomus temporalis temporalis*	V	-
Regent Honeyeater	*Anthochaera phrygia*	E	E
Spotted-tailed Quoll	*Dasyurus maculates*	V	E
Large-eared Pied Bat, Large Pied Bat	*Chalinolobus dwyeri*	V	V
Malleefowl	*Leipoa ocellata*	E	V
South-eastern Long-eared Bat/Corben's Lond-eared Bat	*Nyctophilus corbeni*	V	V
Regent Honeyeater	*Anthochaera Phrygia*	E	E
Glossy Black-Cockatoo	*Calyptorhynchus*	V	-

Common name	Scientific name	TSC Act listed	EPBC Act listed
	lathami		
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	-
Varied Sittella	*Daphoenositta chrysoptera*	V	-
Little Lorikeet	*Glossopsitta pusilla*	V	-
Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	-
Eastern Pygmy-possum	*Cercartetus nanus*	V	-
Little Pied Bat	*Chalinolobus picatus*	V	-

Table note: 1. E = endangered, V = vulnerable

No threatened fauna species were recorded during the site inspection though no targeted surveys or trapping was carried out.

Two migratory species listed under the EPBC Act have the potential to occur at the sites, based on the presence of suitable habitat and known species distribution, including:

- Australian Painted Snipe (*Rostratula australis*)
- Regent Honeyeater (*Xanthomyza phrygia*).

Neither species was observed during the site inspection.

Groundwater Dependant Ecosystems

The nearest recorded GDE's to the site are Hardy's Spring and Eather Spring, located approximately 15 kilometres east of the site, outside of PAL 2.

5.3.1.2 Consideration of potential issues

The proposed wells and ancillary infrastructure will be located entirely within the existing cleared lease areas. No vegetation clearing will be required for the project and the project is not likely to significantly impact any threatened species, populations or ecological communities, or their habitats.

There is some potential for weeds to be introduced or spread during construction and drilling activities. However, this could be managed through implementation of standard weed management practices such as vehicle washing.

During construction, noise generated by vehicles, machinery and drilling may deter native fauna from the site or surrounding areas, which may affect the migration and dispersal ability of native fauna. The breeding cycle, roosting, sheltering and foraging behaviour of some fauna species may be impacted by noise, lighting and vehicle traffic. These impacts would likely only affect individuals for the duration of construction and drilling activities.

During operation, noise will be emitted from the generator and pumps; however, noise levels are expected to be significantly lower than during drilling activities and are not anticipated to result in significant impacts to native fauna.

During operation, groundwater will be extracted from the Bohena coal seam. This is not expected to impact on the GDEs, Hardy's Spring and Eather Spring, located east of the site as preliminary advice from Halcrow

indicates that groundwater fluctuations within strata underlying the Purlawaugh Formation are unlikely to be able to influence the characteristics of flow in these GDEs.

5.3.1.3 Strategy to address potential issues

The project will be located entirely within the existing cleared lease areas and will not require any vegetation or habitat removal. Potential impacts to GDEs as a result of the project will be investigated as part of the detailed groundwater assessment as described in section 5.2.1.3. No further assessment of potential impacts to biodiversity is proposed.

5.3.2 Bushfire

5.3.2.1 Existing environment

Fire plays a major role in the ecology of the Pilliga scrub, with many plant species depending on fire to regenerate. In unfavourable conditions fire can be extremely intense, destroy entire ecosystems, spread very quickly and threaten nearby properties. The critical wildfire season generally occurs during November and December (NPWS & OEH 2012).

The magnitude of historical Pilliga bushfires correlates with the El Nino Southern Oscillation phenomena, with El Nino (dry) years having the most severe fires (NPWS 2006). During El Nino periods, the critical wildfire season can extend from September to January (NPWS & OEH 2012).

In 1997 a major fire burned almost half the Pilliga scrub, while an extremely dry winter and spring in 2006 saw a number of large fires develop (NPWS 2006). Areas of the Pilliga Nature Reserve to the south of the site were threatened by fire in January 2013.

5.3.2.2 Potential issues

Construction and operation of the proposed pilot wells may increase the risk of bushfire in the region.

Construction activities would increase the risk through the use of hot works and the operation of machinery in a hot and fuel-laden environment. The lease areas are cleared of vegetation which would reduce the risk of ignition occurring.

During operation, gas will not be flared but will be transferred via a pipeline to Wilga Park Power Station. There may be an increased risk of fire in the event of a blow out at the well head. However, the risk of a blow out would be minimal as both wells will have BOPs installed.

5.3.2.3 Strategy to address potential issues

The risk of bushfire would be assessed as part of the EIS and measures to reduce the risk, such as use of blue chip metal around the well head, would be implemented.

5.3.3 Soils and land stability

5.3.3.1 Existing environment

The soil landscape underlying the site and surrounds is designated as ‘Cubbo Uplands’ according to the NSW (Mitchell) Landscapes (DECC 2002). The Cubbo Uplands soil landscape is characterised by:

- thin discontinuous soils with stony, sandy profiles and low nutrients on sandstone ridge tops
- texture-contrast soils with harsh clay subsoils down slope

- deep sands with yellow earthy profiles, harsh grey clays, or more texture-contrast soils with a greater concentration of soluble salts in the valley floors.

According to the *Draft Inherent Soil Fertility mapping of the New England – North West region* (OEH 2012), the inherent soil fertility of the site is moderately low.

5.3.3.2 Consideration of potential issues

The existing lease areas are already largely exposed. Minor earthworks may be required to prepare these lease areas for the new wells. These works have the potential to cause soil erosion, loss of topsoil and sedimentation of waterways. However, on completing of drilling activities, the lease areas will be partially rehabilitated to the minimum area necessary for ongoing operation. This would result in reduced potential for erosion in the long term.

The project could result in soil contamination as a result of spilled or leaked chemicals (such as drilling fluid additives), fuel or oil. Spills or leaks could occur during handling, use, storage or transit of chemicals, fuels and oils. Spills or leaks may also occur during refuelling or maintenance of plant or equipment.

There is minimal risk of soil contamination occurring due to the use of drilling mud as this would be water-based and would contain non-toxic additives. Drilling mud and cuttings are therefore unlikely to be contaminated.

5.3.3.3 Strategy to address potential issues

The EIS would investigate and identify appropriate measures to address soil erosion and sedimentation issues and reduce the risk of contamination due to accidental spills or leaks or other site activities. The lease areas would be partially rehabilitated on completion of drilling activities.

5.3.4 Surface water

5.3.4.1 Existing environment

The site is located within the Namoi River catchment which covers an area of approximately 42,000 square kilometres stretching from Woolbrook in the east to Walgett in the west. The catchment is bounded by the Great Dividing Range in the east, the Liverpool Ranges and Warrumbungle Ranges in the south and the Nandewar Ranges and Mount Kaputar to the north. Its main tributaries are the Manilla and Peel rivers, joining the Namoi upstream of Boggabri, and Coxs, Pian, Narrabri, Baradine and Bohena creeks joining below Boggabri (NCMA, 2012).

The site is located within the Bohena Creek sub-catchment of the Namoi River catchment. The Bohena Creek sub-catchment stretches for a distance of approximately 50 kilometres and covers an area of approximately 830 square kilometres. The main tributaries within the sub-catchment include Bohena, Cowallah and Bibblewindi Creeks (NCMA, 2012). This sub-catchment forms the Bohena Creek Water Source under the Water Sharing Plan for the Namoi Unregulated and Alluvial Water Sources.

Figure 5-2 shows the drainage in the vicinity of the site. The closest watercourse to Bibblewindi 32 is an unnamed ephemeral tributary of Cowallah Creek located approximately 50 metres east of the lease area (refer to Plate 5-1). The closest watercourse to Bibblewindi 31 is an ephemeral creek called Mount Pleasant Creek, located approximately 500 metres to the west.

Plate 5-1 An unnamed ephemeral creek 50 metres north west of Bibblewindi 32

5.3.4.2 Consideration of potential issues

As discussed in section 5.3.3.2, earthworks and stockpiling activities would increase the erosion potential of the sites. This may result in increased sediment loads in surface runoff, which could increase turbidity and suspended sediment loads within local drainage lines. Runoff is not expected to be significant given the flat nature of the site and moderate average rainfall.

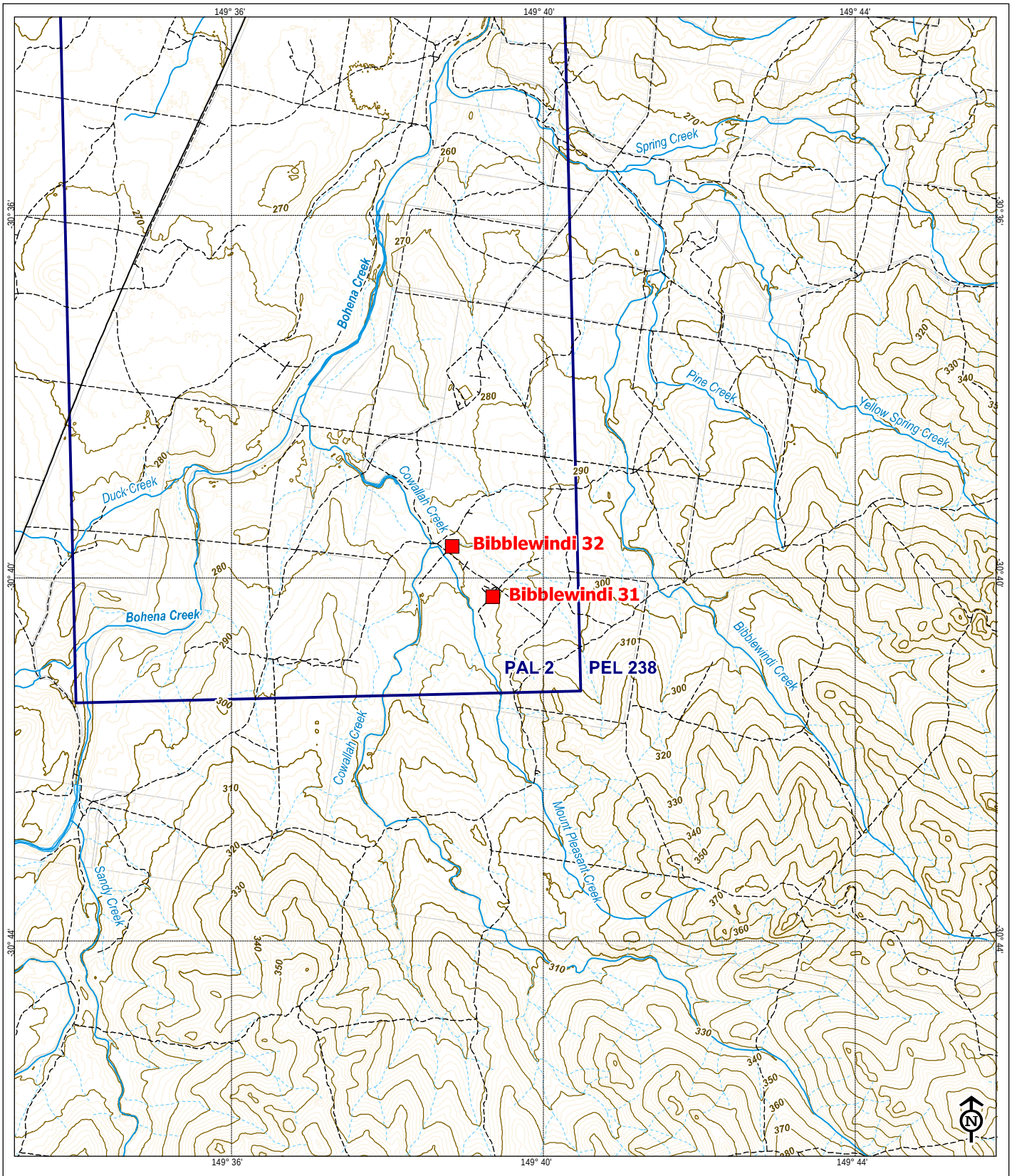
There is potential for drilling mud to be spilled due to overflow of surface tanks as a result of heavy rain or tank failure, during the drilling process or during transit to and from the sites. This could result in pollution of waterways with sediment and other contaminants.

There is potential for pollutants such as chemicals, fuels, oils or litter to enter drainage lines or waterways and degrade local water quality during construction or operation.

5.3.4.3 Strategy to address potential issues

During construction and drilling activities, stockpile areas, surface tanks and fuel/chemical storage areas would be appropriately contained and/or bunded.

Potential impacts to surface waters, and in particular to the unnamed drainage lines within the vicinity of the site, would be assessed in the EIS. The EIS would investigate and identify appropriate measures to reduce erosion and sedimentation issues and other impacts to surface waters. Such measures would include installing best practice erosion and sediment control measures prior to site disturbance, limiting the area of disturbance and maintaining a spill kit on site.



Site Location
Sealed Road
Unsealed Road
Major Contour
Minor Contour
Major Drainage (Line)
Minor Drainage
Major Drainage (Region)
Tenure Boundary
Santos Tenement

Santos

PAL 2 - New South Wales

Bibblewindi 31/32 Regional Drainage Plan

2.5 0 2.5 Km

Figure: 5-2

Date: February 2013
File No: GUNNEDAH 293g

GDA

5.3.5 Air quality and greenhouse gases

5.3.5.1 Existing environment

The nearest sensitive air receivers to the lease areas are estimated to be approximately five kilometres away. Regional air quality would be influenced by mining activities, grazing, land clearing and soil preparation, sowing and harvesting of crops, vehicle and heavy machinery movements, bushfires, burn-offs and use of combustion heaters.

5.3.5.2 Consideration of potential issues

Potential air emissions from the project would include:

- dust generated during establishment of the well lease, including excavation and core hole drilling
- exhaust emissions from vehicle movements to and from the site
- exhaust emissions from plant and machinery operations on site
- venting of methane (CH_4) and carbon dioxide (CO_2) during drilling.

Dust levels generated by the proposed development would vary depending on weather conditions.

The main air pollutants associated with vehicle, plant and machinery exhaust emissions include fine particulates ($PM_{2.5}$), carbon monoxide, oxides of nitrogen, carbon dioxide and hydrocarbons. These pollutants generally dissipate with distance from the source and are therefore unlikely to affect nearest sensitive receptors given the distance to these receptors.

Direct greenhouse gas emissions from the proposed development would include:

- exhaust from plant and machinery
- small quantities of CH_4 and CO_2 release during drilling and venting
- fugitive emissions of CH_4 and CO_2 from the well head or joins in the gathering system during operation.

5.3.5.3 Strategy to address potential issues

The EIS would investigate and identify appropriate measures to reduce dust and other air emissions from the proposed development. These would include such measures as minimising the area of disturbance, imposing site speed limits and turning of plant and vehicles when not in use.

Direct greenhouse gas emissions associated with the proposed development would be identified and the quantities estimated as CO_2 equivalent. Estimated greenhouse gas emissions would be compared to NSW and national greenhouse gas emissions.

5.3.6 Noise and vibration

5.3.6.1 Existing environment

The nearest sensitive noise receivers to the site are estimated to be approximately five kilometres away. Background noise monitoring has not been undertaken at the site. However, the existing noise environment is expected to be typical of rural areas with background noise levels being influenced by birds, insects wind through trees.

5.3.6.2 Potential issues

Noise and vibration would be generated during site preparation, drilling and cementing activities. The greatest noise and vibration impacts have the potential to occur during the drilling activities, which may occur 24 hours a day, seven days per week. Noise generated by the proposed development is unlikely to be audible at any residential receivers due to its remote location. Users of the Bibblewindi State Forest may be temporarily affected by the noise generated during these works. Noise during operation of the pilots is not expected to be audible at any sensitive receiver.

5.3.6.3 Strategy to address potential issues

The EIS would assess potential noise and vibration impacts of the proposed development in accordance with the *Interim Construction Noise Guideline* (DECCW 2009) and the *NSW Road Noise Policy* (DECCW 2011). The assessment would:

- identify all potentially affected sensitive receivers
- predict noise and vibration impacts at these receivers
- identify mitigation and management measures to reduce noise and vibration impacts of the proposed development.

5.3.7 Traffic and transport

5.3.7.1 Existing environment

Access to the site would be provided via X line Road, Boundary Road and Little Tighes Road, which are unsealed roads. X Line Road connects with Newell Highway approximately 40 kilometres south of Narrabri. Existing traffic volumes on these roads are very low.

5.3.7.2 Consideration of potential issues

The project is expected to result in increases in traffic along the above mentioned roads throughout the construction and operation of the project. It is anticipated that the existing road network could accommodate this level of traffic, though degradation of the road surface may accelerate, particularly during wet weather.

5.3.7.3 Strategy to address potential issues

The EIS would identify construction traffic volumes associated with the proposed development. The EIS would investigate and identify traffic controls measures to be employed during site preparation and drilling to minimise traffic disruptions or road safety issues along X Line, Boundary and Little Tighes Roads.

5.3.8 Natural resources

5.3.8.1 Consideration of potential issues

The site is located within the Bibblewindi State Forest. However, the proposed wells would be located entirely within existing established petroleum well leases and would not require any additional land or vegetation to be cleared within the state forest.

The site is not particularly suited to agricultural production and is not located on, or within two kilometres of, lands mapped as biophysical strategic agricultural land or a Critical Industry Cluster under the *Strategic Regional Land Use Plan New England – North West* DoP&I, 2012).

The site is not located within an existing mining title.

Natural resources required for the project during construction include diesel and petroleum fuels for operation of plant and machinery and water for drilling and general site activities. Quantities of fuel and water are not expected to be significant.

During operation, the pilot wells will extract significant volumes of groundwater (approximately 62 megalitres over three years). Preliminary groundwater modeling has indicated that this is not expected to impact on any registered groundwater users.

5.3.8.2 Strategy to address potential issues

Potential impacts to groundwater users would be assessed as part of the detailed groundwater impact assessment, as detailed in section 5.2.1.3. The appropriate water licenses would be obtained prior to taking any water for drilling or other purposes.

5.3.9 Aboriginal cultural heritage

The ESG REF included an assessment of risks to Aboriginal cultural heritage during establishment of the Bibblewindi 14 and 19H lease areas. The assessment included desktop searches of the Aboriginal Heritage Information Management System (AHIMS) maintained by OEH and the Aboriginal site register maintained by the Pilliga Forest Aboriginal Management Committee (PFAMC) and NSW Forestry, and the results of previous surveys of the broader PAL 2 area by PFAMC cultural heritage advisors. The assessment indicated that there was little risk of direct impacts to Aboriginal sites of significance as a result of the Bibblewindi Multi-Lateral Pilot. To further minimise risks, ESG proposed that PFAMC heritage advisors survey each lease area prior to commencing works.

An additional search of the AHIMS register and an archaeological inspection of the well leases and surrounding area were undertaken by RPS for due diligence purposes. The AHIMS search was undertaken on 15 October 2012. The archaeological survey was carried out by one archaeologist walking 5.0-10 metre wide transects on 27 November 2012. The findings of this inspection are discussed in the following sections.

5.3.9.1 Existing environment

The Bibblewindi 14 and 19H well leases have been completely cleared of vegetation and topsoil. 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. No Aboriginal objects or places recorded on the AHIMS were identified within 10 kilometres of the site. 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.

5.3.9.2 Consideration of potential issues

The proposed wells and ancillary infrastructure would be located entirely within the existing established Bibblewindi 14 and 19H well leases and would not impact on any previously identified Aboriginal cultural heritage sites or objects. There is very low potential for any previously unidentified Aboriginal sites or objects to be impacted.

5.3.9.3 Strategy to address potential issues

While potential impacts to Aboriginal cultural heritage are considered extremely unlikely, Santos will undertake further Aboriginal cultural assessment, including consultation with local Aboriginal representatives, as part of the EIS. ‘Stop work’ procedures would be implemented in the event that a potential site or item is uncovered during construction/drilling activities to ensure compliance with Part 6 of the *National Parks and Wildlife Act 1974*.

5.3.10 Non-Indigenous cultural heritage impacts

5.3.10.1 Existing environment

Database searches of the World Heritage List register, Australian Heritage Database and the NSW State Heritage Inventory indicated that there are no listed items of National, State or Local heritage significance within the site or surrounding area. No heritage sites, relics or places of non-Indigenous cultural heritage value, or vegetation with natural heritage values, were recorded on the site during the archaeological survey undertaken by RPS on 27 November 2012.

5.3.10.2 Consideration of potential issues

The project would not impact on any listed non-Indigenous cultural or natural heritage. There is limited potential for previously unidentified non-Indigenous cultural heritage items or relics to be impacted during the works.

5.3.10.3 Strategy to address potential issues

As potential impacts to non-Indigenous cultural heritage are extremely unlikely, no further assessment is proposed to be carried out as part of the EIS. ‘Stop work’ procedures would be implemented in the event that a potential site or item is uncovered during construction/drilling activities.

6.0 Justification

6.1 Need and benefits

The previous targeted drilling in this area (Bibblewindi 14 and 19H) was unable to gain sufficient drawdown to determine peak water and gas flow rates. Further refinement and development of lateral drilling in the area is required to fully determine the gas flow rates within this area of PAL 2.

The lateral well technique involves drilling down to, and turning into a coal seam, then drilling horizontally through the coal and intersecting nearby vertical wells. It is anticipated that the proposed pilot wells would allow further opening up of the coal seam, create well pressure drawdown and promote gas flow. Gas volumes from the wells would be recorded and would help determine the effectiveness of the lateral well design.

Discovery of coal seam gas resources in the area has the potential to increase NSW's gas reserves and revenue from gas, and underpin future exploration and production in the region. Not undertaking the proposed development would limit the evaluation of the potential resource.

The proposed development is consistent with the SRLUP, which recognises the region’s potential for CSG production and identifies the sites and surrounding land as having high coal seam gas resources. The SRLUP states that development of the gas industry in the region would bring capital investment and economic benefits, and has the potential to play a significant role in the delivery of reliable energy in a carbon strained economy, provide security of supply for domestic gas and alleviate the state’s reliance on imported gas.

6.2 Site selection

Bibblewindi 31 and 32 must be located within the existing Bibblewindi Multi-Lateral Pilot to increase drawdown and allow adequate assessment of peak water and gas flow rates. The proposed wells and ancillary infrastructure have been located on the existing Bibblewindi 14 and 19H well leases to avoid further surface disturbance within this area of the Bibblewindi State Forest. The only alternate option was to site the pilot wells on adjacent undisturbed area, which would create unnecessary vegetation and surface disturbance.

7.0 Consultation

The proposed activity is located entirely on land managed by Forestry Corporation of New South Wales (Forestry NSW). Santos holds a Permit to Occupy from Forestry NSW and the State of NSW. The permit to occupy outlines a range of environmental mitigation strategies that Santos must comply with.

As part of consultation with Forestry NSW, Santos' Narrabri Operations Manager holds regular meetings with a representative of Forestry NSW. A schedule of upcoming activities is provided to Forestry NSW, which is updated on a monthly basis. The schedule includes activities at the Bibblewindi Multi-Lateral Pilot.

In addition, the following stakeholders would also be consulted during preparation of the EIS and throughout all stages of the proposed development:

- the local Community Conservation Advisory Committee
- Office of Environment and Heritage
- NSW Office of Water
- Narrabri Shire Council
- NSW Rural Fire Service
- Narrabri Local Aboriginal Land Council
- the Gomeroi People.

Division 6 of Part 6 of the *Environmental Planning and Assessment Regulation 2000* also prescribes minimum requirements for public participation for State significant development including publication of the notice of the development application within a local newspaper and a minimum 30 day exhibition period. The activities would be undertaken by the Department of Planning and Infrastructure once the EIS is submitted and accepted by the Department.

8.0 Capital investment value

The estimated capital investment value of the proposed development is approximately $3.95 million.

9.0 Conclusion and next steps

The proposed development is State significant development and requires assessment and development consent by the Minister under Part 4 of the EP&A Act. An EIS assessing the proposed development would be prepared. This report supports Santos' request for DGRs for the EIS.

A preliminary environmental assessment of the proposed development has been undertaken and has identified potential impacts to groundwater and management of drilling and pilot testing by-products as the key issues for the project. The EIS will assess all issues identified in the preliminary environmental assessment and will address the DGRs. A range of stakeholders will be consulted during preparation of the EIS.

Once submitted to the Department, the EIS will be placed on public exhibition for a minimum period of 30 days, during which time the Department will invite the public and government agencies to make submissions.

10.0 References

Department of Environment & Climate Change (DECC), 2007, *Threatened Species Assessment Guidelines: The assessment of significance*

Department of Environment & Climate Change (DECC), 2002, *Descriptions for NSW (Mitchell) Landscapes – Version 2 (2002)*

Department of Environment Water Heritage and the Arts (DEWHA), 2009, *EPBC Act Policy Statement 1.1 Significant Impact Guidelines*

Department of Planning and Infrastructure (DoP&I), 2012, Strategic Regional Land Use Plan New England – North West.

Department of Trade, Investment, Regional Infrastructure and Services (DTIRIS), 2012a, *NSW Code of Practice for Coal Seam Gas Well Integrity*

Department of Trade, Investment, Regional Infrastructure and Services (DTIRIS), 2012b, *ESG2: Environmental Impact Assessment Guidelines: For exploration, mining and petroleum production activities subject to Part 5 of the Environmental Planning and Assessment Act 1979*

Great Artesian Basin Consultative Council GABCC, 1998, Great Artesian Basin Resource Study, Canberra, ACT

Halcrow Australiasia Pty Ltd (December 2012) *Bibblewindi 31-32 Pilot, Narrabri Gas Project, Santos Ltd, 18 December 2012*

Landcom, 2004, *Managing Urban Stormwater: Soils and Construction, 4th Edition*

Naomi Catchment Management Authority (NCMA), 2012, Naomi Catchment Management Area, accessed on 16 October 2012: http://www.namoi.cma.nsw.gov.au/

Namoi Catchment Management Authority (NCMA) (2009), *State of the Environment Report 2008-2009 Namoi Region*, available online: http://www.namoi.cma.nsw.gov.au/namoi_soe_2008_09__final_1.pdf

Namoi Catchment Management Authority (NCMA), no date, *RVC 33 Iron bark shrubby woodlands of the Pilliga Area, Brigalow Belt South,* available online: http://www.namoi.cma.nsw.gov.au/033_ironbark_shrubby_woodlands_of_the_pilliga_area__brigalow.pdf

Namoi Catchment Management Authority (NCMA), no date, *RVC 20 Rough-barked Apple – Blakely's Red Gum Riparian Grassy Woodlands, Brigalow Belt South and Nandewar*, available online: http://www.namoi.cma.nsw.gov.au/020_rough_barked_apple___blakely_s_red_gum_riparian_grassy_w_1.pdf

Norris, E 1996, A Study of the Soil and Vegetation Patterns Within Part of the Pilliga Forests and an Evaluation of the Impact of European Settlement on the Vegetation, MSC Submission, Macquarie University, Ryde.

NSW Government, 2012, NSW Natural Resource Atlas website, accessed on 1 February 2013: http://www.nratlas.nsw.gov.au

NSW Office of Water (NOW), 2012a, *Water Sharing Plan for the Murray-Darling Basin Fractured Rock Groundwater Sources – Background document*

NSW Office of Water (NOW), 2012b, *Water Sharing Plan for the Murray-Darling Basin Porous Rock Groundwater Sources – Background document.*

NSW Office of Water (NOW), 2011, *Water resources and management overview: Namoi catchment*

NPWS, 2012, *Pilliga East State Conservation Area,* accessed on 16 October 2012: http://www.environment.nsw.gov.au/nationalparks/parkHome.aspx?id=N1090

NPWS, 2006, *Pilliga Nature Reserve – Fire Management Strategy*. NSW National Parks and Wildlife Service, Northern Plains Region

Office of Environment and Heritage (OEH), 2012, *Draft Inherent Soil Fertility Mapping, Upper Hunter and New England North West Strategic Regional Landuse Areas*. State of New South Wales

Schlumberger Water Services (Australia) Pty Ltd, 2012, *Namoi Catchment Water Study Independent Expert Final Study Report*, Perth

Standards Australia, 2008, *AS1141–2008 Methods of Sampling and testing Aggregate*

11.0 Terms and abbreviations

Term/abbreviation	Meaning
Abandonment	Decommissioning the well. A process which involves shutting down the well and rehabilitating the site.
AHIMS	Aboriginal Heritage Information Management System
Annulus	The space between the wellbore and surrounding pipe.
Blow out preventer	One of several valves installed in a wellhead to prevent the escape of pressure either in the annular space between the casing and the drill pipe or in the open hole during drilling, completion and work over operations.
BOP	Blow out preventer
Cementing	The application of a liquid slurry of cement and water to various points inside and outside the casing.
CH_4	Methane
CO_2	Carbon Dioxide
Coring	Process of cutting a vertical, cylindrical sample of the formations.
CSG	Coal Seam Gas
Drill fluid/mud	Circulating fluid that can lift cuttings from the wellbore to the surface and to cool down the drill bit.
DTIRIS	Department of Investment, Trade, Regional Infrastructure and Services
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
LGA	Local government area
MMscf/d	Million cubic feet of produced gas per day
MNES	Matter of National Environmental Significance
MSDS	Materials Safety Data Sheets
NV Act	Native Vegetation Act 2003
NOW	NSW Office of Water
OEH	Office of Environment and Heritage
PEL	Petroleum Exploration Licence
Plug	Any object or device that blocks a hole or passageway.
POEO	*Protection of the Environment Operations Act 1997*
SCA	State Conservation Area
SEPP	State Environmental Planning Policy
TSC Act	*Threatened Species Conservation Act 1995*
Surface casing	A drilled and cemented pipe used to provide blow-out protection, to seal off water/hydrocarbon sands and prevent the loss of circulation. Also used to seal off water sands, weak formations and/or lost circulation zones. In some cases surface and intermediate casing requirements are provided by the same string.
Wall cake	Low permeability ‘skin’ around the wall of the hole.
WMA	*Water Management Act 2000*
Wellhead	The system of spools, valves and associated adapters that provide pressure control for production.