




Review of Environmental Factors
Core Hole Drilling in PEL 450
Gunnedah Basin

Santos QNT Pty Ltd

ABN: 33 083 077 196

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Approvals

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Executive Summary

Santos QNT Pty Ltd (Santos QNT) has entered a Farmin Agreement with the holder of PEL 450, Gunnedah Gas Pty Ltd, which authorises Santos QNT to explore for petroleum (Section 7, Petroleum (Onshore) Act 1991). Santos QNT is the Operator under the Farmin Agreement.

Condition 1.0 of the PEL 450 licence instrument states that prior to carrying out any drilling activities a Review of Environmental Factors (REF) is required to be submitted to the Department of Primary Industries-Mineral Resources (DPI-MR) to enable a determination to be made under Part 5 of the Environmental Planning and Assessment Act 1979.

Drilling of up to 11 proposed core holes is the first step in evaluating the hydrocarbon potential of PEL 450. Discovery of gas resources in this area has the potential to increase the state's reserves and revenue from coal seam gas and underpin future exploration or production in the region. This REF covers this activity.

The Operator wishes to ensure that its activities have minimal impacts on landholders, and will contact affected landowners and seek to negotiate an agreement regarding land access, compensation and rehabilitation. This step will involve the conducting of various land enquiries and meetings with the landowners in question to address any concerns. Regular contact with landholders will be made as necessary.

It should be noted that an initial assessment of proposed locations has shown that all core holes should be located in cleared grazing land. A final scouting survey will be undertaken prior to drilling taking place to locate sites where minimal environment and landholder impact will occur. The proposed core hole sites will avoid any threatened species and critical habitat identified in the desktop assessment. Core hole sites can be moved to avoid any sensitive areas.

The proposed activities have associated potential environmental impacts, which are common to drilling activities such as those carried out elsewhere in the Gunnedah Basin. It is considered that the potential impacts can be successfully mitigated with the application of the management controls/measures outlined in this document. The controls/measures are consistent with the APPEA Code of Environmental Practice and are typical of good hydrocarbon field practice.

Section 5A of the Environmental Planning and Assessment Act 1979 lists seven factors to be considered, commonly referred to as the seven part test of significance. An assessment was made against the seven factors as provided in Section 2.2 and concluded that:

- There are no known threatened species that would be impacted by the planned activities. The size and nature of the proposal is unlikely to affect the life cycle of any viable populations of threatened flora/fauna if present.
- There are no known endangered populations that would be impacted by this proposal. The size and nature of the proposal is unlikely to affect the life cycle of any viable populations of endangered populations if present at the sites.
- There are no known endangered ecological communities or critically endangered communities that would be impacted by this proposal.

It is not proposed to clear any natural habitat and planned activities will not constitute a threatening process.

If the management strategies are effectively implemented, it is expected that:

- Impacts on landholders will be minimal;
- Impacts to air quality will be minor, localised and insignificant;
- Adverse effects on water resources will be minimal;
- Off-site impacts to soils will be avoided and on-site impacts will be minor and temporary;
- Noise impacts will be short term, and no threatened species or communities are likely to be impacted;
- There will be no significant use of, or impact to, natural resources including groundwater;
- Impacts on the community and visual amenity will be insignificant and short term, particularly as the core hole sites are in a sparsely populated area ;
- Impacts to heritage places or sites will be avoided;
- Disturbances to pastoral and cropping land use will be minor and short term and managed in consultation with affected landholder(s); and
- There will be no significant cumulative environmental impacts.

On completion of the activities, the sites will be rehabilitated to reflect the pre-existing land form and use and this will be undertaken in consultation with relevant landholders. All waste will be disposed of in an appropriate manner.

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1 Introduction

1.1 Background

This Review of Environmental Factors (REF) has been prepared for the drilling of up to fifteen core hole wells in the Gunnedah Basin, being explored under the conditions of Petroleum Exploration Licence no 1 (PEL 450) located in New South Wales (NSW). The licence for PEL 450 permits exploration for petroleum, including coal seam gas, by methods including the drilling of core hole wells.

Condition 1.0 of the PEL 450 licence instrument states that, prior to carrying out any drilling activities, a Review of Environmental Factors (REF) is required to be submitted to the Department of Primary Industries-Mineral Resources (DPI-MR) to enable a determination to be made under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

1.2 Proponent Contact Information

The correspondence address for the Operator is:

Santos QNT (ABN 33 083 077 196) on behalf of Gunnedah Gas Pty Ltd, (under a farmin Agreement dated 12/10/2007 and registered with the DPI).

Address: Level 14, Santos House, 60 Edward Street, Brisbane, Qld, 4000

Telephone Number: 07 3228 6666

Fax Number: 07 3228 6700

Email: reception.brisbane@Santos.com

Contact Person: Mr T Lonergan, Senior Staff Geologist Gunnedah Basin.

1.3 Structure

This REF consists of:

- Section 1: Introduction and company details
- Section 2: Summary of relevant regulations applicable to the activity;
- Section 3: Proposed activities including location and timing;
- Section 4: Description of the local environment including its physical, natural and socio-economic overview;
- Section 5: Outline of the potential environmental impacts and mitigation measures; and
- Section 6: Concluding comments on the likely impacts.

2 Legislation & Planning Framework

2.1 Planning Framework

2.1.1 Overview

The Environmental Planning & Assessment Act 1979 (EP&A Act) is the primary legislation regulating land use planning in NSW. It provides the framework for the development of state and local planning instruments which, through their hierarchy, determine the statutory process for environmental impact assessment. Under the EP&A Act there are three distinctive processes, which are:

- Part 3A, which regulates specific types of 'projects' and requires an Environmental Assessment report to be prepared and submitted to the Department of Planning for the Planning Minister's approval;
- Part 4, which regulates 'development' and requires a development application accompanied by a Statement of Environmental Effects to be submitted to council for development approval; and
- Part 5, which regulates 'activities' and requires a Review of Environmental Factors for determination by the determining authority.

The proposal satisfies the definition of an activity under Part 5 of the Environmental Planning and Assessment Act 1979, because the proposal:

- may be carried out without development consent;
- is not an exempt development; and
- will be approved by a determining authority.

A determining authority, for the purposes of this activity, is defined in Part 5 of the Environmental Planning and Assessment Act 1979 to include, but is not limited to a public authority. In relation to petroleum exploration licences the Department of Primary Industries is the determining authority for approving exploration activities and will, therefore be the determining authority for the activities covered by this Review of Environmental Factors. In determining the proposal and degree of impact, the Operator has considered s.111 of the EP&A Act and Clause 228 of the Environmental Planning Regulation.

2.1.2 Environmental planning instruments

The Environmental Planning Instruments (EPIs) regulate the permissibility to undertake an activity and the type of assessment process that is required. EPI is the generic term used to describe state environmental planning policies, regional environmental plans and local environmental plans. The EPI that applies to this activity being assessed under Part 5 of the EP&A Act and the circumstances in which it applies are outlined below.

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

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (SEPP 2007) recognises the importance to New South Wales of mining, petroleum production and extractive industries. SEPP 2007 seeks to facilitate the orderly and economic use of land containing mineral, petroleum and extractive material resources, whilst encouraging ecologically sustainable development.

Subject to certain exemptions, SEPP 2007 allows development for the purposes of petroleum exploration to be carried out without consent. The definition of petroleum under SEPP 2007 includes any naturally occurring hydrocarbon, whether in gaseous, liquid or solid state.

2.1.3 Local environmental plans

Local environmental plans (LEPs) are developed by Councils (they become law only after Ministerial approval) and guide planning provisions for local government areas. According to the Department of Planning, through zoning and development controls, they allow councils to supervise the ways in which land is used. Council LEPs also list heritage items that are of local heritage significance.

The local environment plans covering the Warrumbungle (WSC), Coonamble (CSC) and Gilgandra (GSC) Shire Council areas apply to the area of interest covered in this REF. However, the application of SEPP 2007 overrides the need to consider zoning controls, as activities covered by SEPP 2007 are permissible without consent. Figure 2.1 shows the location of Warrumbungle (WSC), Coonamble and Gilgandra Shire Councils and relevant core hole sites.

2.2 Legislative Requirements, Petroleum Licenses and Approvals Required

Pursuant to Section 7 of the Petroleum (Onshore) Act 1991, it is an offence to explore for petroleum (which includes coal seam gas) without a Petroleum Title. Santos QNT has entered a Farming Agreement with the holder of PEL 450, Gunnedah Gas Pty Ltd, which grants the right to Santos QNT to explore for petroleum (Section 7, Petroleum (Onshore) Act 1991) subject to meeting landholder and legislative requirements.

Prior to any exploration on private land, an access arrangement must be agreed between the titleholder (or its agent) and the landowner (Petroleum (Onshore) Act 1991, Section 69). Compensation can be agreed to under the access arrangement or determined separately. The legislation specifies those issues that must be covered by an access arrangement, which include:

- periods during which access may be permitted;
- parts of the land on which exploration may be undertaken;
- conditions to be observed during exploration, and
- compensation to be paid to the landholder.

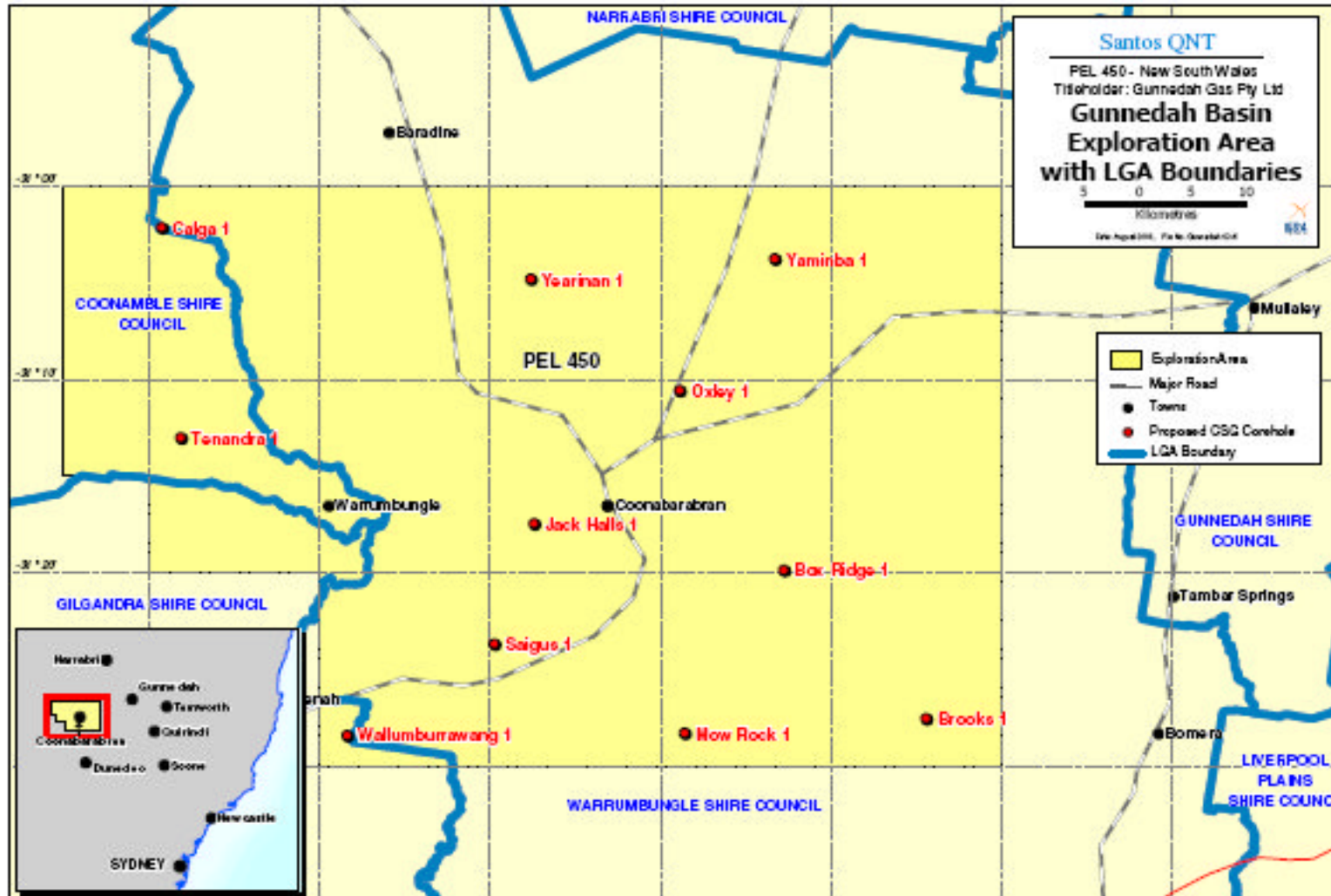
In preparing this REF the necessary considerations found at the DPI website at <http://www.dpi.nsw.gov.au/minerals/titles/landholders-rights> have been considered.

Whilst it is the Operator's intention to negotiate an acceptable arrangement with any affected landowner, the above legislation also details the mechanisms by which an access and compensation arrangement can be sought if a voluntary arrangement cannot be obtained.

Operations must not affect any road or track unless with the prior written approval of the Director-General and subject to any conditions he may stipulate. The operator is required to pay to the relevant authority (local council or Roads and Traffic Authority) any costs incurred in fixing any damage to roads caused by its operations.

Santos QNT, on behalf of Gunnedah Gas, must also obtain an approval under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act) from the DPI-MR prior to carrying out core hole drilling activities.

Figure 2-1: Local Government Areas



Under Section 5A of the EP&A Act, the DPI-MR is required to consider whether the activity is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats. Section 5A lists seven factors to be considered, commonly referred to the 'seven part' test of significance. These are as follows:

- a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;
- b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;
- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
 - i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or
 - ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;
- d) in relation to the habitat of a threatened species, population or ecological community:
 - i. the extent to which habitat is likely to be removed or modified as a result of the action proposed; and
 - ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and
 - iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species population or ecological community in the locality.
- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);
- f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and
- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

Under the Protection of the Environment Operations Act 1997, pollution incidents causing or threatening material harm must be notified. Under Section 147 material harm means:

- harm to the environment is material if:
 - a) it involves actual or potential harm to the health or safety of human beings or to ecosystems that is not trivial; or
 - b) it results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding \$10,000 (or such other amount as is prescribed by the regulations), and loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment.

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It does not matter that harm to the environment is caused only in the premises where the pollution incident occurs.

The National Parks and Wildlife Act 1974, protects Aboriginal objects and places (under Part 6) and threatened species, populations and ecological communities, their habitats and critical habitats (Part 8A). Under Section 5A of the EP & A Act, the DPI-MR is required to consider whether the activity is likely to have any impact on these matters.

The Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth) protects matters of national significance. As outlined in section 4.6.4 the Operator does not consider that this proposal will trigger this Act, and do not intend to lodge a referral to the Commonwealth Department of Environment, Water, Heritage and Arts.

Under the regulations of the Water Management Act 2000 there is an exemption (regulation 18 (e)) for the need of an access licence if the water is required for petroleum activities.

The relevant State Acts are summarised in Table 2.1 below.

Table 2-1: PEL 450 Licence Conditions and Applicable Legislation

Legislation	Requirements of Schedule 2 Licence Conditions	Administering Authority
<i>Petroleum (Onshore) Act 1991</i>	The activities do not cause other than minimal/nil impact on features listed in Section 75 (i.e. of Aboriginal, Architectural, archaeological, historical or geological interest). Where these are present, an exploration protocol acceptable to the Department must be completed prior to exploration commencing to ensure that exploration activities will not have an adverse impact on these features. Full rehabilitation in accordance with Department guidelines/standards is carried out after completion of the exploration activities.	Department of Primary Industries – Mineral Resources
<i>Environmental Planning and Assessment Act 1979</i>	Obtain an approval under Part 5 of the Environmental Planning and Assessment Act 1979 (EP & A Act) from the DPI-MP prior to carrying out core hole drilling activities.	Department of Primary Industries – Mineral Resources
<i>Threatened Species Conservation Act 1995</i>	The Licence holder is required to consult the register of Critical Habitat kept by the Director-General, and consider the significance of any notations in respect of the area of any proposed exploration activity	Department of Environment and Climate Change
<i>Fisheries Management Act 1994</i>	Consult the register of critical habitat kept under this Act	Department of Primary Industries – Fisheries
<i>National Parks and Wildlife Act 1974</i>	The activities do not contravene Part 6 (Aboriginal objects and Aboriginal places) of this Act	National Parks and Wildlife Service
<i>Native Vegetation Conservation Act 1997(now 2003)</i>	The licence holder must not cut, destroy, ringbark or remove any timber or other vegetative cover on any land subject of the licence except such as directly obstructs or prevents the carrying on of operations. Any clearing not authorised under the Petroleum (onshore) Act 1991, must comply with the provisions of this Act.	Department of Environment and Climate Change

Legislation	Requirements of Schedule 2 Licence Conditions	Administering Authority
<i>Rural Fires Act 1997</i>	The operator must take all precautions against causing an outbreak of fire and must comply with the provisions and regulations of the Act and must not burn off any grass, foliage or herbage with out the current consent of the owner or occupier and the local fire authority.	NSW Rural Fires Service

2.3 Zoning

Proposed core holes will be located in Warrumbungle Shire Council (WSC) (11 core holes), Coonamble Shire Council (3 core holes) and Gilgandra Shire Council (GSC) (1 core hole). Further details are presented in Table 3.1 and Figure 3.1.

The proposed core holes fall within Zone No 1 (a) (General Rural) or equivalent in the three Shire Council areas. However, as noted in Section 2.1.3 above, the application of SEPP 2007 overrides the need to consider zoning controls, as activities covered by SEPP 2007 are permissible without consent.

2.4 Stakeholder Consultation

Key stakeholders relevant to the proposed core holes during the exploration phase include:

- State regulatory agencies (DPI-MR, Department of Water and Energy);
- Local governments;
- Landowners/occupiers;
- Aboriginal Groups/ Local Aboriginal Land Councils;
- Community, business and special interest groups, and
- Utilities operators.

The Operator has commenced (April 2008) a program of community and stakeholder consultation in the region of the proposed coal seam gas (CSG) exploration. This has involved briefings and discussions with a broad range of stakeholders to inform them of the operator and its proposed exploration activities in the Gunnedah Basin.

Groups consulted initially have included the local governments areas relevant to the activities proposed in this REF, relevant Members of Federal and State Parliament, Local Aboriginal Land Councils, senior representatives of relevant government agencies and various business, community and special interest groups (e.g. Gunnedah District Development Board, Liverpool Plains Land Management Committee, NSW Farmers Association, Caroon Coal Action Group, Caroon Coal Community Consultation Committee).

Fact sheets on the proposed activities and a map of the areas to be explored are presented on the Operator's website at:

http://www.Santos.com/library/Santos_Gunnedah_Basin_Project_Overview.pdf.

Observations from this first phase of consultation indicate that little is known in the community about coal seam gas and the differences between the petroleum exploration legislation and the mining legislation, with which the community is generally more familiar. Future activities will therefore be aimed at increasing the community understanding of the proposed coal seam gas exploration activities.

The Operator will also contact and seek to negotiate an access arrangement with affected landowners in respect to land access, compensation and rehabilitation once the proposed sites have been finally selected. This step will involve the conducting of various land enquiries and meetings with the relevant landowners. A notice of intended entry will be provided to each affected landowner. A formal land access arrangement will also be made between the operator and the affected landowners. Contact with landholders will be made as necessary.

Consultation activities will be ongoing through the exploration program. Further consultation with other groups such as any local environmental groups, will occur if the proposed core holes indicate a potentially commercially operation that will trigger a follow-up program. Progression to commercial production would necessitate drilling additional wells and infrastructure. Progress of the project beyond the core hole drilling stage will necessitate additional application to DPI-MR and further consideration of any additional potential environmental impacts.

3 Project Description

3.1 Location and Tenure

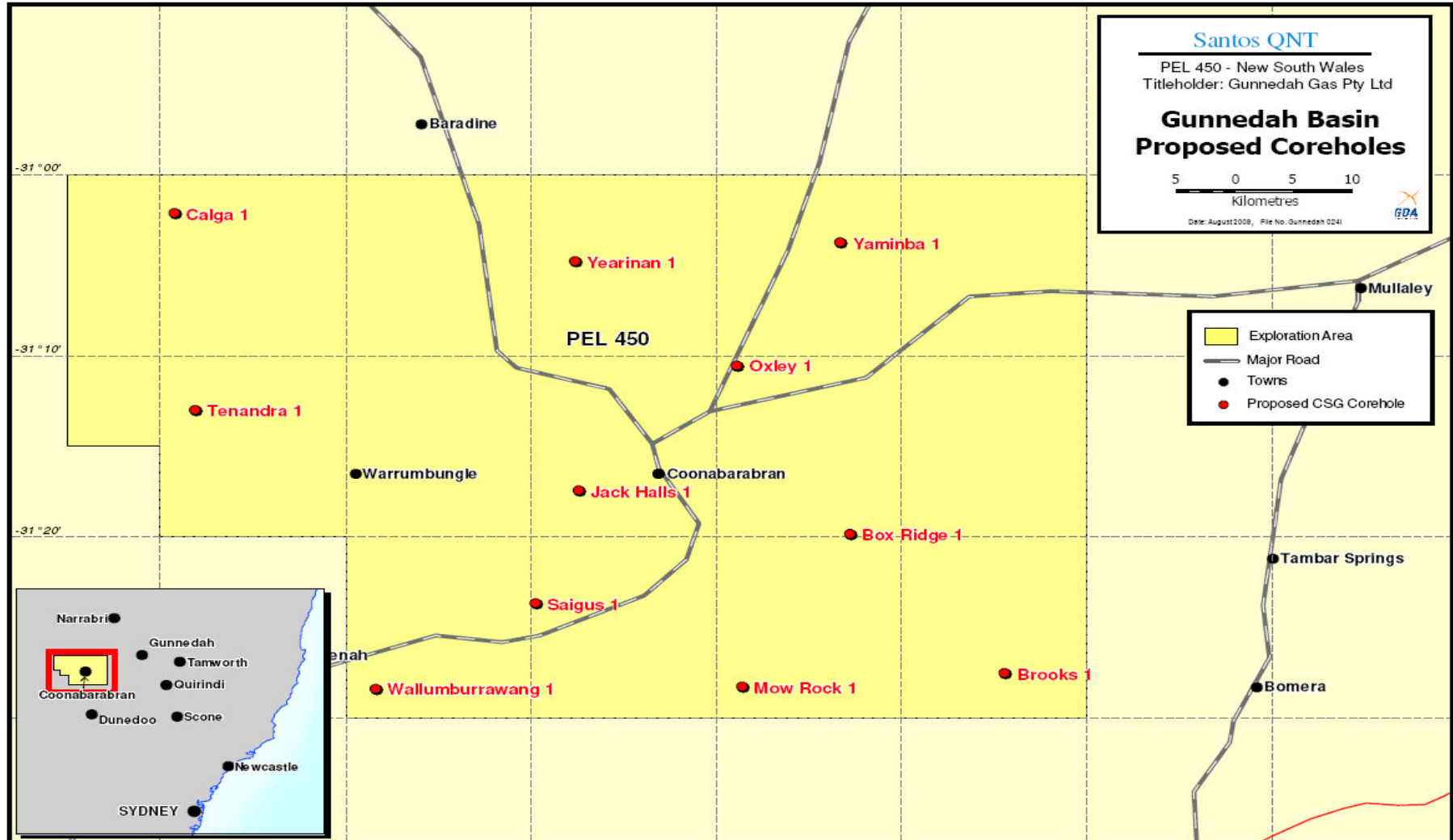
3.1.1 Location

Santos QNT has entered into a Farmin Agreement with the titleholder of Petroleum Exploration Licence No 1 (PEL 450), Gunnedah Gas Pty Ltd. The aim of the project described below in Section 3.2 is to explore the underlying area within PEL 450 by drilling up to eleven core holes. The co-ordinates of the eleven core hole sites are shown in Table 3.1 below. Figure 3.1 shows the location of the permit and core hole sites on freehold land. The core holes are expected to range from about 295-970m deep.

Table 3-1: Co-ordinates of Proposed Core Hole Sites (GDA-Zone 56)

Core Hole Node*	Longitude	Latitude	Local Government Area	Nearest Town
Calga 1	148.846571	-31.03619	Coonamble	Warrumbungle
Yearinan 1	149.207048	-31.080608	Warrumbungle	Baradine
Yaminba 1	149.445903	-31.0631	Warrumbungle S	Coonabarabran
Oxley 1	149.353135	-31.176699	Warrumbungle	Coonabarabran
Tenandra 1	148.865282	-31.217176	Coonamble	Warrumbungle
Jack Halls 1	149.210704	-31.91323	Warrumbungle	Coonabarabran
Box Ridge 1	149.454423	-31.331203	Warrumbungle S	Coonabarabran
Wallumburrawang 1	149.027712	-31.473601	Gilgandra	Tooraweenah
Mow Rock 1	149.357601	-31.471651	Warrumbungle	Coonabarabran
Brooks 1	149.593813	-31.459159	Warrumbungle	Bomera
Salgus 1	149.171736	-31.395035	Warrumbungle	Coonabarabran

Figure 3-1: Well Locations



The environmental information in this document is based upon NSW database searches for flora and fauna covering the three local government areas within which the core holes will be drilled. The Commonwealth EPBC database searches were based on a 4 km radius around each proposed core hole location. If there are technical constraints at any particular core hole then the site will be relocated, subject to the necessary landholder approvals, in a similar environmental setting.

The core hole sites proposed in this REF are located on freehold land.

As required to be stated (based on the DPI Guidelines for preparing a REF-see Mineral Resources Division, 2006), the proposed core hole sites are not located in the following areas:

- An area reserved or dedicated under the National Parks and Wildlife Act 1974;
- Land reserved or dedicated within the meaning of the Crown Lands Act 1989 for preservation of other environmental protection purposes;
- A World Heritage Area;
- Environmental Protection Zones in environmental planning instruments;
- Lands protected under SEPP 14 – Coastal Wetlands;
- Lands protected under SEPP 26 – Littoral Rainforests;
- Land identified as wilderness under the Wilderness Act 1987 or declared as wilderness under the National Parks and Wildlife Act 1974;
- Aquatic reserves dedicated under the Fisheries Management Act 1994;
- Wetland areas dedicated under the Ramsar Wetlands Convention;
- Land subject to a conservation agreement under the National Parks and Wildlife Act 1974;
- Western Lands Lease;
- Land identified as State Forest under the Forestry Act 1916; and
- Crown Land.

3.2 Planned Activities

To assess the coal seam gas potential of the underlying resources of PEL 450 it is proposed to drill eleven HQ (96 mm) diameter core holes to obtain information on coal depths, seam sizes, continuity and quality. These core holes will also provide data on gas content, gas type, and the porosity and permeability of the coal seams. In addition, tests for desorption isotherm behaviour will be undertaken on selected coal samples recovered during drilling operations to assess the potential flow of gas out of the coal seams.

The Operator proposes to carry out the drilling activities in accordance with the activities described below.

Firstly, the Operator will contact and negotiate with affected landowners in respect to land access, compensation and rehabilitation. This step will involve meetings with the affected landowners and developing an understanding of the nature of the land and activities undertaken at each site. Only after landowner access arrangements have been entered into, site preparation and drilling will commence.

Existing access tracks will be used where possible. New tracks required for core hole sites will avoid remnant trees and shrubs. There will be some soil disturbance as a level drilling pad will need to be constructed. Tracks on slopes will have drains cut at regular intervals to reduce the risk of gullying and soil erosion. Vehicular activity will be minimised when the ground is soft after rain. The surface will be rehabilitated.

The major equipment to be used will be a drilling rig. A temporary building will be located at the site. The areas to be disturbed for drilling activities will be approximately 45 by 60 metres for each core hole site plus necessary access track. However, only approximately 30% of the core hole site will be a hard stand area. Associated sumps and flare pit will also be constructed on site.

Each corehole will have a specific well design developed, compliant with the relevant legislation. In general, an open hole of nominal 200mm diameter will be drilled through any alluvial and/or weathered material into competent rock and a Blow Out Preventer casing cemented in place, which will have a blow out preventer installed on top of it. The hole will be drilled using open hole rotary drilling to the depth at which core drilling will commence (core point). Depending on the local stratigraphy and objectives of the proposed well, casing may be run or the hole left open. Drilling will then carry on using continuous HQ diameter coring techniques for the purposes of recovering core and conducting open hole testing and geophysical logging.

A water-based drilling fluid will be used, which may include calcium carbonate, potassium chloride and/or sodium chloride as weighting agents. As it is possible that some water-reactive clays may be found, potassium chloride may be added to the drilling fluid to control swelling clays and increase the stability of the formations intersected. There will also be a need to add polymers while drilling the core hole. None of these additives are considered harmful to the immediate environment. Water will be generally sourced from nearby dams/bores, in agreement with land owners and/or from local authorities.

A selection of the potential production horizons may be tested for permeability by Drill Stem Test (DST).

In the event that a partially drilled core hole is abandoned a new nearby location will be selected where the alternative core hole can be completed. This will be subject to obtaining the necessary approval of the land holder. This will be within a radius of less than 4 km from the existing core hole site (i.e. within the database search areas already undertaken as part of this REF).

The number of employees present at each site is expected to be in the range up to ten persons. The hours of operation will be as negotiated with the landowner and approved by DPI-MR. If well-sites are less than 1 km from a residence this will be highlighted and noted in the landowner agreements. It is proposed to commence these operations in late 2008 or early 2009.

Core hole drilling activities are temporary and will not have any long term impact on the visual amenity of the area. A typical drilling rig on a location is shown in Figure 3-2.

3.3 Abandonment

In the event that it would be worthwhile to undertake on-going monitoring at a selected core hole location acceptance by the landholder and regulatory authority will be sought. Core holes not used for temporary monitoring purposes (e.g. standing water levels) will be abandoned and the area rehabilitated in line with legislative, landowner and licence requirements. Cement plugs will be set to fill the core hole from total depth to the surface, the casing will be cut back and an abandonment plaque placed on the nearest fence line. The area will then be rehabilitated in consultation with the landowner and DPI-MR. The core hole sites will be monitored during this rehabilitation period.

Figure 3-2: Typical Drilling Rig



3.4 Justification of the Activity

Drilling of the proposed core holes is an essential step in the exploration and evaluation of the hydrocarbon potential in PEL 450 which to date has undergone little petroleum exploration. Discovery of coal seam gas resources in the area has the potential to increase the state's reserves and revenue from gas, and underpin future exploration or production in the region.

The proposed program consists of drilling core holes, geologically logging and sampling cores for gas content etc, conducting drill stem tests, and wireline geophysical logging in each core hole. All these procedures are required to define and identify commercially useful reserves of coal seam gas.

Santos QNT is committed to undertake this work as part its obligations under the NSW petroleum legislation and its obligations contained in the Farm-in Agreement entered into with Gunnedah Gas.

3.5 Evaluation of Alternatives

There are no reasonable industry alternatives to the drilling method proposed in Section 3.3 if commercially useful amounts of coal seam gas are to be located and assessed. There is little previous drilling in this area of the Gunnedah Basin that is sufficiently deep for the purposes of petroleum exploration. Geophysical methods available (e.g. seismic), which could be applied to exploration would show the structure of the basin but would not provide the ability to sample and analyse the stratigraphy of Gunnedah Basin that underlies PEL 450 to quantify coal and coal seam gas potential.

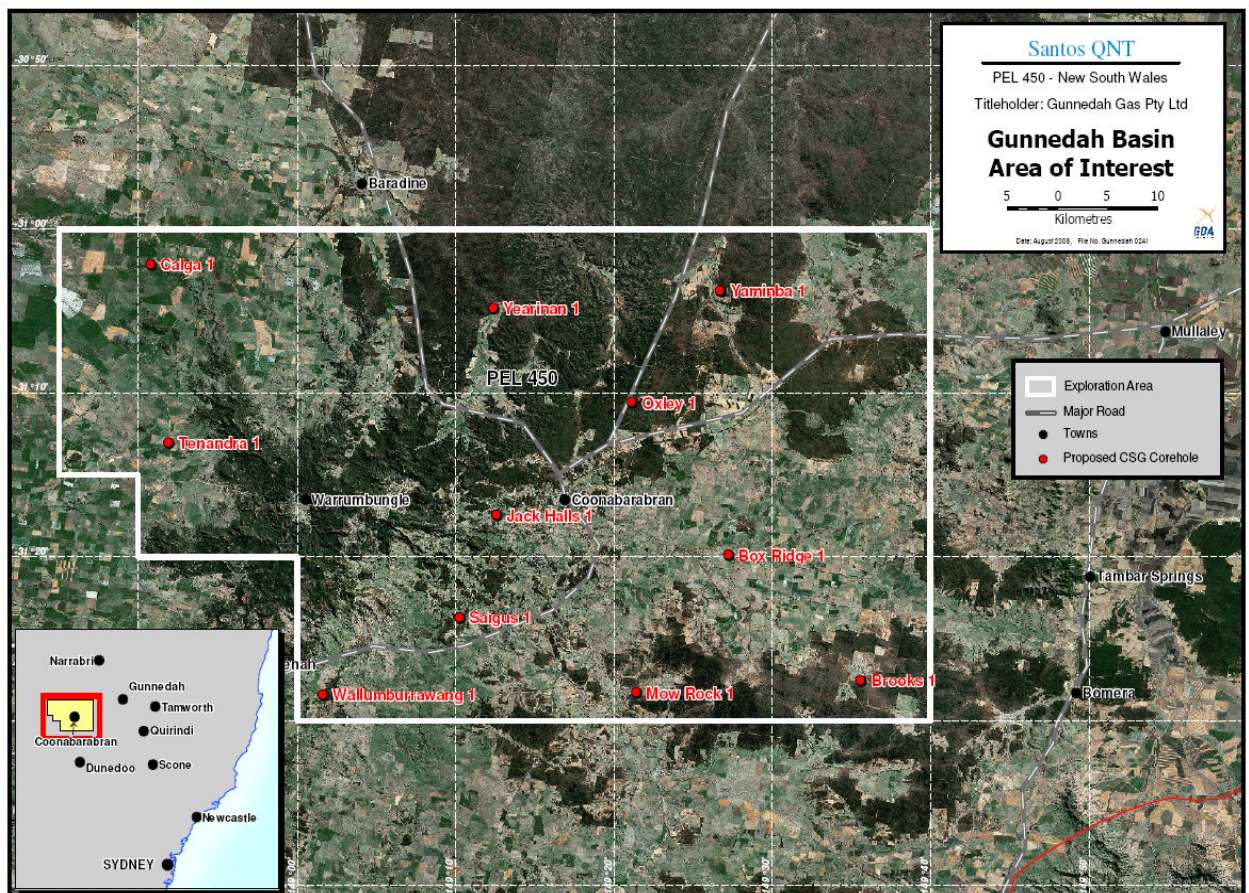
4 Regional Description

Unless otherwise stated the major source reference for this section is as follows:

NSW National Parks and Wildlife Service, 2003, The Bioregions of New South Wales: their biodiversity, conservation and history, at <http://www.environment.nsw.gov.au/bioregions/BrigalowBeltSouthBioregion.htm>

The proposed core hole sites are located within the red box shown in Figure 4.1 below.

Figure 4-1: Regional Map



4.1 Bioregion

PEL 450 falls within the Brigalow Belt South Bioregion which extends from south of Dubbo in central-western NSW to mid-Queensland coast, of which about 20% is located in NSW. The towns of Baradine, Binnaway, Coonabarabran, Dubbo, Gunnedah, Merriwa, Moree and Narrabri occur within this bioregion. The largest town within PEL 450 is Coonabarabran with the core holes located within a 45km radius from this centre.

4.2 Geology

4.2.1 Regional Geology

The geological setting of PEL 450 contains three major structural elements which include:

- Western edge of the Mullaley Sub Basin of the Gunnedah Basin outcrops in the east of the licence area;
- Rocky Glen Ridge which is essentially made up of folded metamorphic rocks of the Lachlan Fold Belt; and
- Tooraweenah Trough which contains Permo-Triassic sediment. This sub-basin has to date been poorly defined due to lack of exploration activity. However, a number of elongate Permian outliers, west of the township of Mudgee and the presence of Permian outcrops associated with gravity lows with centres in the south and southwest of the Warrumbungle Ranges do indicate that a condensed Permian sedimentary section being present within the Tooraweenah trough.

The Gunnedah Basin contains up to 1200m of marine and non-marine Permo-Triassic sediments resting unconformably upon Late Carboniferous to Early Permian mafic and silicic volcanics which forms the effective basement. Overlying basement are lacustrine environments of the Leard and Goonbri Formations. This unit was followed by low energy fluvial conditions in which the coal measures of the Maules Creek Formation were deposited. An Early Permian transgression then inundated the area and deposited shallow marine para-conglomerate, sandstone and siltstone of the Porcupine and lower Watermark Formations, culminating in the deposition of the upper Watermark Formation marine claystone.

The Late Permian Black Jack Formation was deposited in a major delta system with a dominantly northeast sediment source from the New England region. The probable uplift within the Lachlan Fold Belt to the west had a minor influence on the deposition of medium to coarse-grained quartz rich sandstones within the Black Jack Formation. Deposition of the western derived quartzose sandstones was followed by very widespread coal swamp conditions depositing the thick Hoskissons Coal seam that is readily correlated across the Gunnedah Basin. Late Permian volcanic activity and tectonism to the east resulted in renewed deposition of more lithic sediments with an easterly provenance. A period of tectonism, uplift and erosion of variable intensity throughout the Gunnedah Basin followed Late Permian deposition. The end of the Permian is marked by a major unconformity along the crest of uplifted areas, including many anticlines.

The Triassic Digby Formation is marked by a basal conglomerate that has been derived from the New England Fold Belt. Deposition continued with the formation of fluvial, deltaic and lacustrine sediments (conglomerates, sandstones and mudstones) sourced from rivers flowing predominantly from the New England Fold Belt.

Volcanic activity in the Late Triassic/Early Jurassic resulted in outpouring of the Garrawilla Volcanics which overlie the Triassic Napperby Formation. A major period of uplift and erosion during the Late Triassic ended Gunnedah Basin deposition.

Deposition of the Surat Basin sequence commenced during the Early Jurassic, preceded by lava flows, pyroclastics with intercalated claystones of the Garrawilla Volcanics (Nandewar Range). During the Tertiary period of tectonism, the Liverpool and Warrumbungle Ranges were formed by massive extrusions of basalts representing the last major depositional episode in the Gunnedah Basin.

Figure 4-2: Stratigraphy of the Gunnedah Basin

STRATIGRAPHIC TABLE

AGE	BIOSTRAT ZONE	ROCK UNIT	LITHOLOGY	ENVIRONMENT OF DEPOSITION	MAX THICKNESS (M)	RESERVOIR POTENTIAL	SOURCE POTENTIAL	BASIN		
									POOR	EXCELLENT
MESOZOIC	CR.	F. WONTHAGGIENSIS	BUNGIL FM		PARALIC	15	EXCELLENT	SURAT BASIN		
		C. AUSTRALIENSIS	MOOGA FM		FLUVIAL					
			ORALLO FM		FLOOD PLAIN MEANDERING FLUVIAL					
		LATE	UJ5-6	PILLIGA SANDSTONE					BRAIDED STREAM	213
			LJ5-6							
			J4	PURLAWAUGH FORMATION					FLOOD PLAIN OVERBANK & MEANDERING STREAM	
	MIDDLE	J3				76				
		J2								
		J1			FLAWS & PYROCLASTICS					
			GARRAWILLA VOLCANICS							
	EARLY	Tr3c-d			REGRESSIVE DELTAIC	215				
		Tr3a-b	NAPPERBY FORMATION		LACUSTRINE ?					
		Tr2	DIGBY FORMATION		ALLUVIAL FAN					
		Tr1b								
		Tr1a								
		U5c	BLACK JACK FM		FLUVIO-LACUSTRINE					
	LATE	U5b				460				
		U5a								
L5c		HOSKISSONS COAL MEMBER WESTERN SANDS ARKARULA SST MBR		PEAT SWAMP FLUVIAL SHALLOW MARINE DELTA PLAIN DELTA FRONT						
L5b				PRO DELTA						
L5a		WATERMARK AND PORCUPINE FORMATIONS		MARINE SHELF						
U4b										
U4a										
L4		MAULES CREEK FORMATION		ALLUVIAL PLAIN						
3b		LEARD/GOONBRI FORMATIONS		LACUSTRINE						
3a		BOGGABRI VOLCANICS/ WERRIE BASALT								
PALAEOZOIC	EARLY				380					
	LATE					100				
EARLY					127					

4.2.2 Soils

The soils across the region vary depending on the local sediment source.

The majority of the core holes are located within the central west catchment management area. The soils within this area are described below (CMA, 2008):

- The soils on the tablelands have lower nutrients and poorer soil types. Generally, the geology of this area is dominated by coarse grained, acidic rocks resulting in sandy textured soils that are susceptible to erosion. Soils have mainly developed in-situ;
- The slopes are characterised by variable geology with soils developed by colluvial and alluvial activity. Generally, the soil types are less fragile and have higher nutrient levels. A lot of these soils have naturally high salt stores in their profile, therefore increasing the risk of land degradation due to salinity; and
- The plains are dominated by alluvial and aeolian soil development. These soil types have higher fertility, cation exchange capacities and clay contents. The soils have a high shrink/swell potential and are susceptible to compaction problems. Acidity has not been an issue in the past due to lower total rainfall, but intensive agriculture is causing the acidity hazard to increase.

This is reflected within the Warrumbungle Shire area which includes the rich basaltic soils in the central and southern areas of the shire, fertile river flats in the Coolah Valley and poorer, acidic soils in the Pilliga area (WSC, 2007).

4.3 Climate

Based on the Bureau of Meteorology records¹, the town of Coonabaraban, which is representative of the area, has mean maximum temperatures ranging from 31.7 degrees Celsius in January to 14.8 degrees Celsius in July. Mean minimum temperatures range from 15.0 degrees Celsius in January to 0.0 degrees Celsius in July.

The mean annual rainfall totals 746.5 mm with the wettest month being January with rainfall of 90.4 mm.

4.4 Hydrology

4.4.1 Surface Water

The permit PEL 450 overlies both the Namoi River and Central West catchment management areas.

The Central West catchment includes the Castlereagh, Bogan and Macquarie River valleys and covers an area of approximately 92,000 km².

The majority of core holes will be drilled within the Castlereagh Valley catchment where the Castlereagh River rises in the Warrumbungle Range at an elevation of about 850 metres and flows eastwards to the town of Coonabarabran. The river then enters hilly country and flows in a southerly direction to the town of Binnaway. Downstream of Binnaway the river begins a sweeping change in direction to the northwest. In the extreme northern section of the valley the floodplain between the Barwon and

¹ BOM, Climate Statistics downloaded on 11th September 2008, from http://www.bom.gov.au/climate/averages/tables/cw_064008.shtml

Core Hole Drilling: PEL 450

Castlereagh Rivers is intersected by Womat and Wanourie Creeks, which carry flows from the Barwon to the Castlereagh River during major floods. The upper reaches of the Castlereagh River are largely unregulated.

Timor Dam on the Castlereagh River is the primary water supply for Coonabarabran, but has experienced algal bloom problems in recent years. The Castlereagh River immediately below the Coonabarabran offtake weir has been classified as "stressed" (DEC, 2006).

The Namoi Basin can be divided into the following four natural subdivisions (EPA, 1995):

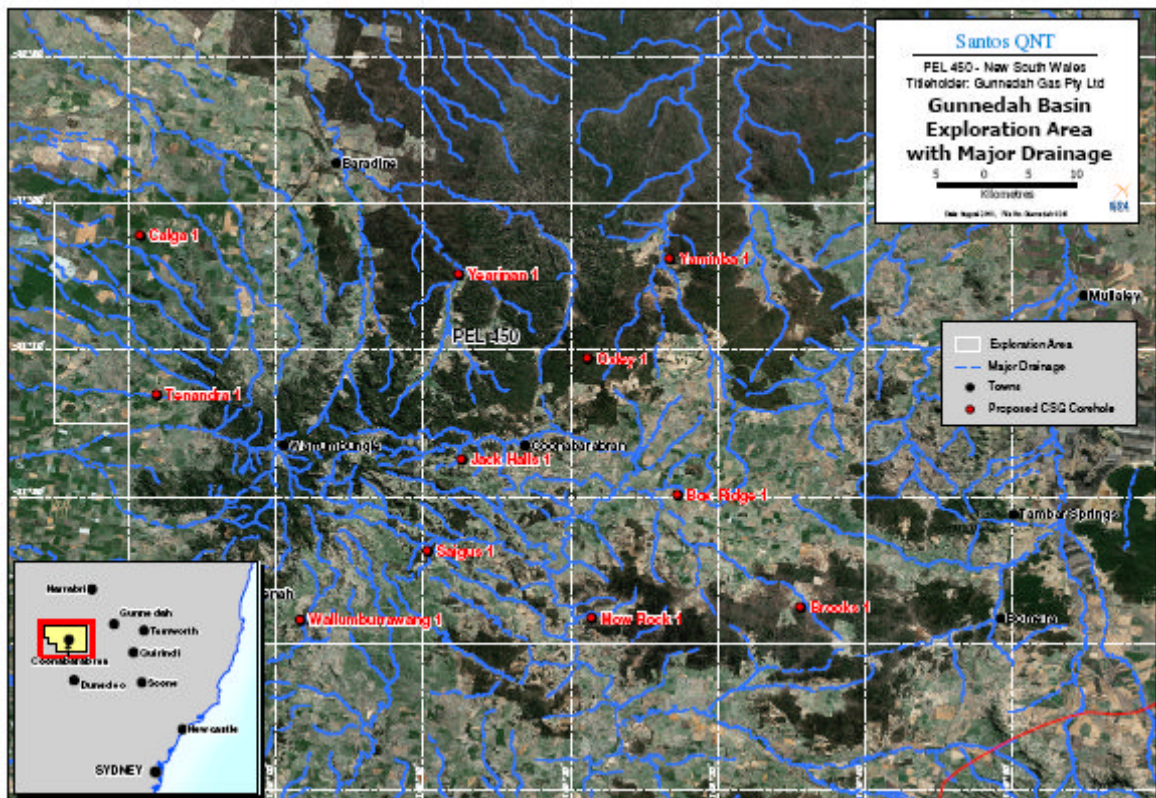
- Upper Catchment - runs north-west from Nundle to Barraba including parts of the Liverpool and Nandewar Ranges; steep to rugged; originally savannah woodland, now cleared;
- Liverpool Plains - mainly the Mooki and Coxs River catchments; flat with slopes rarely exceeding 3°; cracking clays or clay loams with red clay subsoils; naturally a treeless plain dominated by grasses with patches of savannah woodland, now cleared;
- Riverine Zone - follows the Namoi River; extensive flood plains; heavy clay soils and loams; naturally dominated by grassland. Stream banks, anabranches and natural wetlands were originally lined with natural vegetation communities (such as river red gums) but have since been cleared; the river now assumes characteristics of an inland delta; and
- Pilliga - south-west; flat; predominantly State Forest with extensive woodlands dominated by cypress pine and ironbark associations; intermittent streams, only flowing with significant rainfall or heavy falls in the Warrumbungle Ranges. Part of PEL 450 is located in this area.

The streams or creeks located nearby the various core hole sites are summarised in Table 4.1 below. All water bodies will be no closer than 200m from the various core hole sites.

Table 4-1: Nearest Water Courses to the Core Hole Sites

Core Hole Node	Water course
Calga 1	Unnamed minor intermittent creek
Yearinan 1	Unnamed minor intermittent creek
Yaminba 1	Unnamed minor intermittent creek
Oxley 1	Unnamed minor intermittent creek
Tenandra 1	Unnamed minor intermittent creek
Jack Halls 1	Unnamed minor intermittent creek
Box Ridge 1	Terrawinda Creek
Wallumburrawang 1	Wallumburrawang Creek
Mow Rock 1	Unnamed minor intermittent creek
Brooks 1	Unnamed minor intermittent creek
Salgus 1	Unnamed minor intermittent creek

Figure 4-3: Major Drainage



4.4.2 Groundwater

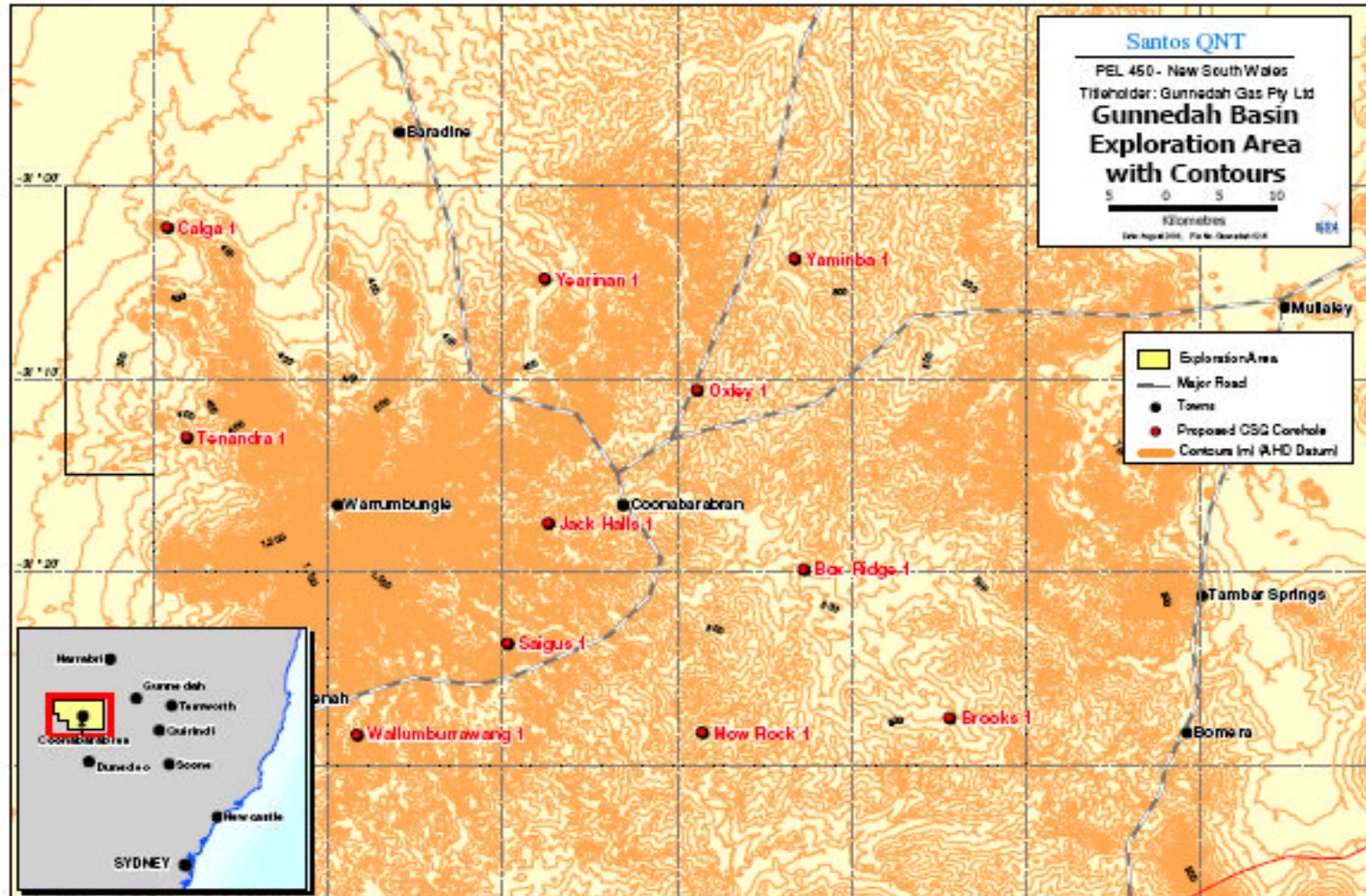
Groundwater in the region is managed under the *Water Sharing Plan for the NSW Great Artesian Basin Groundwater Sources 2008 Order* under the NSW Water Management Act, 2000. The area where PEL 450 is located falls within the Southern Recharge Groundwater source for the Great Artesian Basin which is adjacent to the Surat Groundwater Source division of the Basin. The long term annual net recharge is estimated to be 42,400 ML/year for the Southern Groundwater Source with domestic and stock rights of 3,000 ML/year.

4.5 Topography

Warrumbungle Shire is located between the Liverpool Ranges in the east and the Warrumbungle Ranges in the south and west. The landscape ranges from extensive plains in the north-west, to undulating hills in the central and southern areas, to the high basaltic plateau of Coolah Tops in the east and the rugged mountainous peaks of extinct volcanoes in the Warrumbungle Ranges and Mt Nombi area to the west and north-east (WSC, 2007).

The core holes will occur on flat to undulating areas as shown in Figure 4.4 below.

Figure 4-4: Local Topography within the Vicinity of the Core Hole Sites



4.6 Flora and Fauna

The information presented below is based on a desktop assessment which included searching various published literature, databases and an examination of aerial photographs of the area of interest. It should be noted that an initial assessment of proposed locations has shown that all core holes should be located in cleared grazing land.

The NSW Department of Environment and Climate Change Atlas of NSW Wildlife On-line database was searched for records of threatened ecological communities, plants and animals within the three local government areas of Warrumbungle, Coonamble and Gilgandra.

Matters of conservation significance listed under the Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth) (EPBC Act) that are known or predicted to occur in the study area was determined using the EPBC Protected Matters search tool based on a 4km radius from each core hole site.

4.6.1 Plant Communities

The NSW National Parks and Wildlife Service (2003) has identified the following plant communities in the Brigalow Belt South Bioregion:

- Woodlands dominated by Blue-leaved Ironbark (*Eucalyptus fibrosa*), Scribbly Gum (*Eucalyptus rossii*), Black Cypress Pine (*Callitris endlicheri*), Whitewood (*Atalaya hemiglauca*) and Rough-barked Apple (*Angophora floribunda*) are found on stony sandstone plateau and streams;
- Silver-leaved Ironbark (*Eucalyptus melanophloia*), Spotted Gum (*Eucalyptus maculata*) and Smooth-barked Apple (*Angophora costata*) occur on stony hills in the north of the bioregion. Narrow-leaved Red Ironbark (*Eucalyptus creba*), White Cypress Pine (*Callitris glaucophylla*), Red Stringybark (*Eucalyptus macrorhynca*), patches of Mallee (*Eucalyptus* sp.) and Broom Heath (*Melaleuca uncinata*) occur on gentler sandstone slopes (NPWS, 2003);
- Acacia species are present in rocky outcrops. Grey box (*Eucalyptus microcarpa*), Yellow Box (*Eucalyptus melliodora*) and Rough-barked apple occur on valley floors, while river red gum (*Eucalyptus camaldulensis*) lines larger streams and river oak (*Casuarina cunninghamiana*) the tributaries;
- The vegetation on the northern basalts includes Brigalow (*Acacia harpophylla*), Belah (*Casuarina cristata*), Whitewood, Wilga (*Geijera parviflora*), Budda (*Eremophila mitchellii*) and Poplar Box (*Eucalyptus populnea*) on the hills, with River Red Gum, Belah, Myall (*Acacia pendula*) and Poplar Box on the flats. White box with Silver-leaved Ironbark, White Wood, Bull Oak and Brigalow are present on alluvial clays. River Red Gum occurs on all streams;
- Diverse grasslands dominate the Liverpool Plains. Common species include plains grass (*Stipa* sp.), panic grass (*Panicum* sp.), windmill grass (*Chloris* sp.) and blue grass (*Dicanthium* sp.) on black earths, with the occasional White Box, Yellow Box, Poplar Box and Wilga. On the high (colder) ridge crests, Silvertop Stringybark (*Eucalyptus laevopinea*), Manna Gum (*Eucalyptus viminalis*) and Mountain Gum (*Eucalyptus dalrympleana*) are found with Snow Gum (*Eucalyptus pauciflora*) in cold air drainage hollows;
- Tallowood (*Eucalyptus microcorys*), Blackbutt (*Eucalyptus pilularis*) and Blue Gum (*Eucalyptus saligna*) occur on eastern slopes with small areas of vine forest. On

northern slopes, White Box with rough-barked apple occur with belah in the creeks. Yellow box and Blakely's Red Gum are found on slopes with a southerly aspect.

The core holes will avoid the environmentally sensitive areas described in section 4.8. The core hole sites are planned to be located in already disturbed areas. Figure 4.5 shows the typical vegetation cover of the area where the core holes are planned to be located.

Figure 4-5: Typical vegetation cover at proposed core hole sites



4.6.2 Weeds

The noxious weeds that have been declared in the region are provided in Appendix A. In all there are 101 species that are declared.

4.6.3 Significant flora

There are three endangered ecological communities within the bioregion listed under Schedule 1 of the Threatened Species Conservation Act 1995 (TSC Act). These are the Semi-evergreen Vine Thicket (*Cadellia pentastylis*) (Ooline or scrub myrtle), Brigalow, and Carbeen open forest communities. NPWS, 2003, found that the bioregion is important for the long-term viability of these vegetation communities which are predominantly found here, with a small area lying in the Nandewar Bioregion. The Carbeen open forest communities are now restricted to the Brigalow Belt South Bioregion and very limited areas of the Darling Riverine Plains Bioregion. The White Box-Yellow Box-Blakely's Red Gum-Grassy Woodland and Derived Native Grassland threatened ecological community also occurs in this bioregion. It is critically endangered and protected under the EPBC Act 1999. However, the core hole sites have been cleared for rural activities.

Records within the bioregion tend to be concentrated in the major reserves and forests of the bioregion such as Goonoo State Forest, the Warrumbungles, Mt Kaputar and the Pilliga.

Based on the TSC Act listings specifically for the Warrumbungle, Coonamble and Gilgandra Shire Council areas, there are 16 threatened plants that are known to occur within these areas and are listed in Appendix B. However, the core hole sites have been cleared for rural activities and do not provide suitable habitat for these species.

4.6.4 Fauna

Although few systematic surveys have been conducted in the bioregion, records from a variety of surveys can be used to illustrate the vertebrate fauna of the bioregion, which consists of 18 amphibian species, 68 reptiles, 281 birds and 82 mammal species (see NPWS 2003). A review of this area by the NPWS, 2003, found that:

- Many of these species are considered threatened, including the endangered mallee fowl (*Leipoa ocellata*), for which the bioregion contains important habitat, and the vulnerable koala (*Phascolarctos cinereus*) which has important populations in the Warrumbungles, the Pilliga and the area around Gunnedah. In this bioregion the tree species often selected by koalas include Blakely's red gum, river red gum and white box, while pilliga box, poplar box, narrow-leaved ironbark and rough-barked apple are occasionally used for food.
- Another significant mammal species in the bioregion is the vulnerable eastern pygmy possum (*Cercartetus nanus*) which has a very patchy distribution, with more than 10 records of the species known from each of only 5 locations in NSW, the Pilliga State Forest being one of them.
- The Pilliga mouse (*Pseudomys pilligaensis*) is known only from the Pilliga State Forest, although its preferred habitat has not yet been established. It is thought to prefer mixed eucalypt forest with a shrubby understorey with logs and litter and may face threat from disturbance of ground storey vegetation.
- The birds of the bioregion are highly diverse, mainly consisting of tropical woodland species and comprising the largest number of Australian resident species of any bioregion. There are no major populations of rare or threatened birds in the bioregion and although many birds within the bioregion have restricted ranges; none are endemic. Exotic species are low in numbers and those present are located mainly around towns.
- Although bird species diversity is high relative to other NSW bioregions, the Brigalow Belt South Bioregion has experienced major declines in ground-nesting, ground-feeding insectivorous and grassland birds, a trend common to many parts of Australia. An increased reporting rate in the bioregion's rainforest and temperate forest taxa may reflect greater survey effort in these habitats. Reduction of bird diversity in habitat fragments and the continued loss of woodland and freshwater birds seem to be the prediction for the future. However, there was an increase in the numbers of mallard (*Anas platyrhynchos*), cattle egret (*Bubulcus ibis*) and the common myna (*Acridotheres tristis*).

A search of the NSW Department of Environment and Climate Change Atlas of NSW on-line data base for NSW listed threatened species was conducted and identified 52 threatened fauna species in the WSC, CSC and GSC. These are listed in Appendix C.

However, the core hole sites have been cleared for rural activities and will not be critical habitat for any of these species.

4.6.5 EPBC Act Due Diligence

The EPBC Database was searched and a Matters of Environmental Significance Report was generated. The results are summarised below in Table 4.2 and show that there are no World Heritage Properties, National Heritage Places, Wetlands of International

Significance (Ramsar Sites), or Commonwealth marine areas located near the core hole sites.

Table 4-2: Matters of Environmental Significance under EPBC Act

Aspect	Presence within vicinity of all core hole nodes
World Heritage Properties	None
National Heritage Places	None
Wetlands of International Significance (RAMSAR Sites)	None
Commonwealth Marine Areas	NA
Threatened Ecological Communities	1
Threatened Species	15
Migratory Species	12

4.6.5.1 Threatened Ecological Community

There is one Threatened Ecological Community (TEC) that could potentially be found within the region where the core hole sites are to be located. This is the White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland which is critically endangered. This was formerly widespread along the western slopes and table lands of the Great Dividing Range, throughout southern Queensland, western NSW, ACT and Victoria. Now less than 5% remains in good condition and much of this occurs in small isolated pockets (DEWHA, 2006).

The proposed core hole sites will be located on land previously cleared for rural activities and as such will not have a significant impact on this TEC.

4.6.5.2 Threatened Species

There are 19 threatened species that could be potentially located in PEL 450. These are summarised in Appendix D. The proposed core hole sites will be located on land previously cleared for rural activities and as such will not provide critical habitat for threatened species.

4.6.5.3 Migratory Species

There are up to 12 migratory bird species. However, it is considered that the planned activities will not have any significant impact on these species as the proposed core hole sites will be located on land previously cleared for rural activities which do not provide suitable habitat for these species.

4.6.5.4 Listed Marine Species

There are 9 species of birds that are listed marine species that may overfly the area. These are ‘other matters’ protected by the EPBC Act. However, it is considered that the planned activities will not have any significant impact on these species.

4.7 Socio-Economic

4.7.1 Local Government Area

The planned activities lie within the local government areas of Warrumbungle, Coonamble and Gilgandra Shire Councils. Population figures below are based on the 2006 census (ABS, 2006).

The Warrumbungle LGA covers 12,374 sq km with a population of 9808 persons. The major population settlements within the Shire are located along the Castlereagh, Talbragar and Coolaburragundy Rivers. Coonabarabran is the main service centre with 2609 persons. Other towns include Coolah, Baradine, Binnaway, Dunedoo and Mendooran.

The Coonamble LGA covers 9,916 sq km with a population of 4,208 persons. The largest centre is Coonamble with a population of 2,975 persons. Other towns include Gulargambone and Quambone.

The Gilgandra LGA covers 4,836 sq km with a population of 4,522 persons. The town of Gilgandra is the main service centre with a population of 3,244 persons.

4.7.2 Landuse & Other Activities

The proposed core hole sites are located on cleared agricultural areas. Sheep, beef cattle and grain farming are the main industries in the region employing about 25-28% of the workforce. The next major employment categories are in school education, local government administration, hospitals, supermarket and grocery stores, and residential care services.

There are no mining tenures in the area covered by PEL 450.

Siding Spring Observatory is located about 36km drive from Coonabarabran; and is situated 1165 metres above sea level in the Warrumbungle National Park on Mount Woorat also known as Siding Spring Mountain. The observatory is part of the Research School of Astronomy & Astrophysics (RSAA) at the Australian National University (ANU) and incorporates the Anglo-Australian Telescope along with a collection of other telescopes owned by the Australian National University, the University of New South Wales, and other institutions.

4.7.3 Heritage

4.7.3.1 **Aboriginal Heritage**

The Local Aboriginal Land Councils for the pertinent to the PEL 450 area are the Coonabarabran, Barradine, Weilwan, Coonamble, and Gilgandra Local Aboriginal Land Councils. A search of the NSW Department of Environment and Climate Change (DECC) Aboriginal Heritage Information Management System (AHIMS) was made in September 2008 (DECC, 2008). Details of the results are not to be made available to the public. None of the sites identified in the AHIMS search are in close proximity to the planned core hole sites. The nearest recorded Aboriginal heritage site is located about 300 m from the closest core hole site. Other sites are more than 1km from the next nearest core hole site. The proposed core holes are away from the banks of any waterholes, creeks and ridgelines which are generally accepted as having a higher potential for the location of Aboriginal objects and places. As well, core hole sites are proposed on pastoral land which has been disturbed by clearing, grazing, cropping and general agricultural pursuits.

As of September, 2008 there were no Native Title claims over the proposed core hole site locations².

The NSW State Heritage Register also lists the Burra Bee Dee Aboriginal Mission Cemetery and Burra Bee Dee Reserve (~100 ha; also known as Forked Mountain Reserve). This area is located on the Oxley Highway about 14 Km NE of Coonabarabran.

4.7.3.2 Non-Indigenous Cultural Heritage

A search of the NSW Heritage Office database for the WSC, GSC, and CSC local government areas did not identify any sites of cultural heritage in the vicinity of the proposed core hole sites (see http://www.heritage.nsw.gov.au/07_subnav_04.cfm).

4.8 National Parks, Reserves and Community Conservation Areas

4.8.1 National Parks and Reserves

Warrumbungle National Park lies about 36 km drive west of Coonabarabran and covers an area of 21,534 hectares. The nearest core hole is located about 5km from this area. The Pilliga Nature Reserve lies 5km to north of Coonabarabran. The nearest core hole is located about 200 m from its nearest boundary. These areas are shown in Figure 4.6.

4.8.2 Community Conservation Areas

The area where the proposed core holes will be located falls under the *Brigalow and Nandewar Community Conservation Area Act 2005*. This Act under its schedules identifies four types of Community Conservation areas namely:

- Zone 1 of the Community Conservation Area means the land described or referred to in Schedule 1-Conservation and Recreation Zone (Includes National Parks);
- Zone 2 of the Community Conservation Area means the land described or referred to in Schedule 2-Conservation and Aboriginal Culture Zone;
- Zone 3 of the Community Conservation Area means the land described or referred to in Schedule 3-Conservation, Recreation and Mineral Extraction Zone; and
- Zone 4 of the Community Conservation Area means the land described or referred to in Schedule 4-Forestry, Recreation and Mineral Extraction Zone.

The nearest CCAs to the proposed core hole locations in PEL 450 are summarised below.

- Garrawilla (CCCA Z1): An area of about 937 hectares, being the whole or a part of Garrawilla State Forest No 884.
- Timallallie (CCA Z1): An area of about 17,370 hectares, being the whole or a part of Timallallie State Forest No 819.
- Yarragin (CCA Z1): An area of about 3,201 hectares, being the whole or a part of Yarragin State Forest No 272.

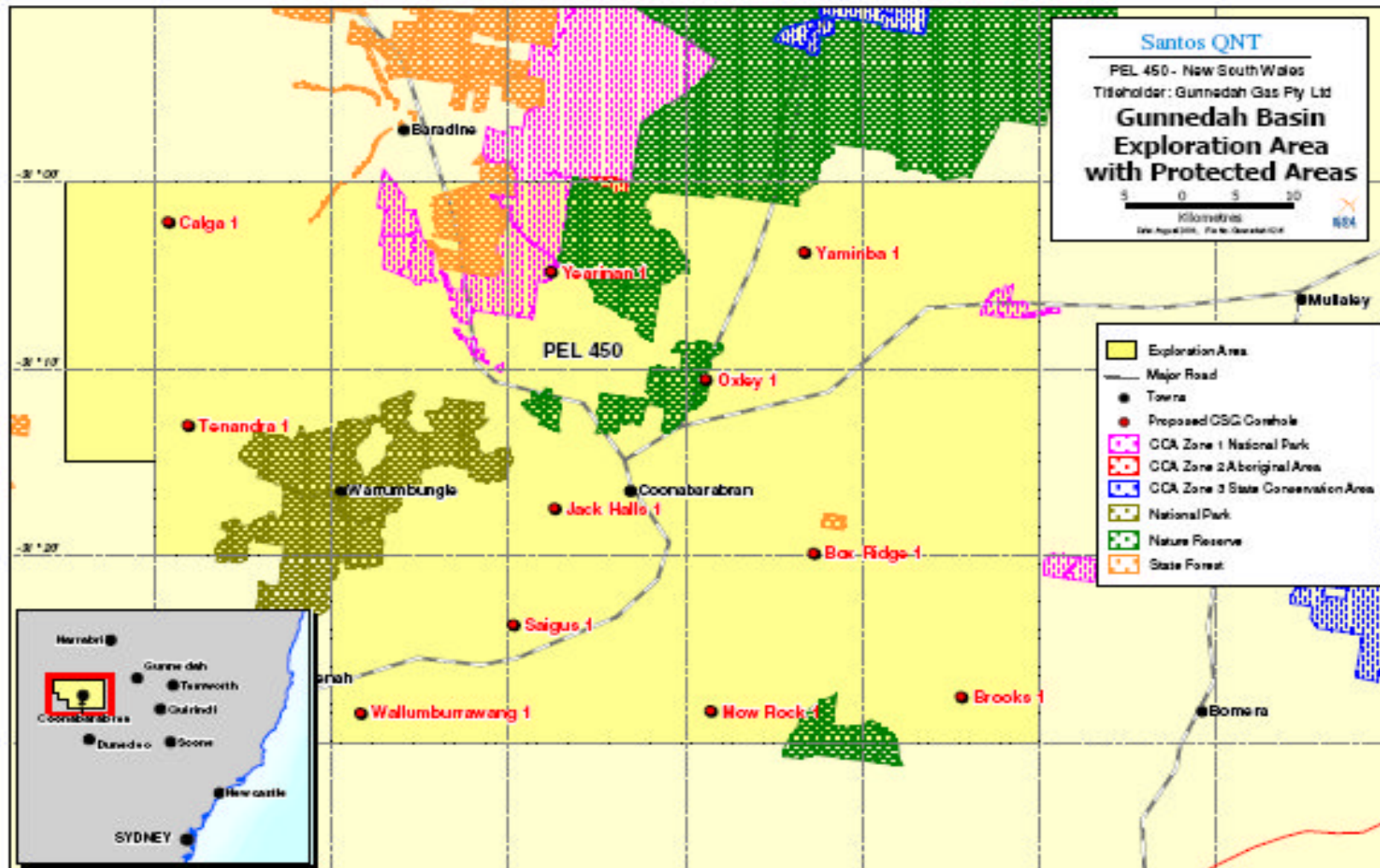
² See Map at <http://www.nntt.gov.au/Publications-And-Research/Maps-and-Spatial-Reports/Pages/State-Maps.aspx>

Core Hole Drilling: PEL 450

- Dandry Gorge (CCA Z2): An area of about 382 hectares, being the whole or a part of Timmallallie State Forest No 819; and
- Tinkrameanah (CCA Z1): An area of about 969 hectares, being the whole or a part of Tinkrameanah State Forest No 915.

No core holes will be located within these areas.

Figure 4-6: Location of National Parks, Nature Reserves, Community Conservation Areas



5 Environmental Impacts and Mitigation Measures

5.1 General

The activities will be undertaken in accordance with the APPEA, 1996, Code of Environmental Practice-Onshore where applicable and the Schedule of Onshore Petroleum Exploration and Production Safety Requirements (DPI, 1992).

5.2 Socio-Economic

5.2.1 Existing Environment

The region has been used extensively for agricultural activities since the early 1800s. The main agricultural activities include broadacre cropping. Sheep and cattle grazing also occur within the area. There is also logging within the broader region. The particular area of the proposed core hole activities is rural.

5.2.2 Potential Impacts and Mitigation Measures

Potential impacts include disturbance to farming activities, disturbance to livestock and potential bushfire risks to flora, fauna, stock and personnel. Santos will seek to enter into a Land Access Agreement with affected landowners in respect to land access conditions, compensation, rehabilitation and other matters as required under the Petroleum (Onshore) Act 2007. This consultation will involve the conducting of various land enquiries and meetings with the landowners in question. Regular contact with landholders will be made as necessary. Other matters such as air quality, weeds, water, and noise are addressed in further sections below.

To minimise impacts on landholders the following actions will be undertaken:

- Prior to the commencement of activities at each site, landholders will be provided with a notice of the planned activities, in particular drilling, including immediate neighbours of the land on which the activities are to take place. Reasonable requests by landholders for rescheduling of activities will be considered;
- If unfenced roads are present on the roads to/from the rig, then as part of the site induction or journey management program, drivers will be made aware both of the hazard this presents and the environmental impact a collision could have;
- Access roads will be maintained in a condition satisfactory to the DPI-MR and Landholders until restoration of lease is completed;
- If fencing is required, the site will be adequately fenced with a lockable gate and adequate signs warning of potential danger will be erected;
- Drilling sites will be selected such that a cleared buffer exists outside the drilling pad area to maintain an effective barrier against bushfires;
- The flare pit will be kept free of grass and leaf litter;
- A fire control water pump and hoses on site will be maintained;
- Liaison will occur with the local rural fire service officer;
- Fires on the surface of the land will be prohibited at each of the well sites;
- Hot work (e.g. welding) specific procedures will be in place;

- The area of land disturbance will be minimised subject to safety constraints; and
- The site will be maintained in a clean and tidy condition.

5.3 Air Quality

5.3.1 Existing Environment

The existing air quality of the area is generally of good quality. The majority of pollutants, such as plant and vehicle emissions, arise from rural based activities.

5.3.2 Potential Impacts and Mitigation Measures

The proposed activity has the potential to introduce additional air emissions arising from the sources discussed below.

5.3.2.1 Dust generation

The dust generated by the mobilisation of the drilling and ancillary equipment travelling to and from a location will vary depending on road and weather conditions. In the case of improved or well compacted roads, dust will not be a significant issue. Occasional dust suppression using a water cart will be used to reduce dust generation (see Section 5.5 for details on its source).

Liaison with local homesteads which may be affected by rig traffic will take place, informing occupants of possible high traffic periods (i.e. during transport of the rig and equipment). Speed limits on rig traffic may be imposed to minimise dust when passing homesteads. If speed limits are required the limit imposed will be clearly sign posted.

The movement of rig equipment to and from the proposed drill sites is expected to have more impact than the movements of equipment on sealed and unsealed roads within the district. The rig mobilisation, consisting up to 10 trailer loads, may require additional preparation of access ways. Additional access preparation will take place on external road ways where required to facilitate the safe entry of the drilling rig. Damage to any external/internal access will be repaired as soon as possible after occurrence to minimise any impact on the landholder/ public. It is not expected to have any significant impacts on road side vegetation.

The Operator will notify WSC, CSC and GSC of the proposed start time of exploration drilling prior to its commencement and will liaise with the appropriate Council representatives should any repairs to Council roads be necessary.

5.3.2.2 Emissions from equipment

Operation of diesel fuelled vehicular traffic, plant and power generation, will be temporary and the minimal emissions are not expected to impact on air quality or be a major contributor of greenhouse gases.

5.3.2.3 Flaring of gas

It is considered possible that gas bearing formations will be intersected during core hole drilling. A number of safety precautions and contingencies are therefore incorporated into the program in order to minimise any risks.

An appropriately sized and located flare pit will be installed at the commencement of drilling operations. The drill rig operator will locate the "blooie lines" so that gas is

directed into the flare pit where an ignition source can safely burn/flare any gas that is intersected by drilling.

Approval from the relevant DPI-MR Safety Inspector will be sought prior to any gas flaring other than that occurring as part of drilling safety procedures. There is a well established process for flaring produced gas during Drill Stem Testing.

5.4 Hydrology

5.4.1 Existing Environment

There are several creeks in the vicinity of the core hole sites that could be potentially affected if there are incidents such as spills.

5.4.2 Potential Impacts and Mitigation Measures

Preference will be to procure water supplies from dams or bores located in the vicinity of the core hole sites (with landholder permission) or from municipal supply via a water carter. In order to acquire the water necessary for drilling in situations where water can not be obtained through the above means, approval will be sought from the appropriate authorities and landholder for the installation of a bore to access water from suitable reservoirs. This consent will be sought before the commencement of drilling operations.

There is potential to contaminate surface water or ground water via run off from activities associated with chemical storage & handling, refuelling and drilling fluids and cuttings management. Mitigation measures for these activities are discussed in Section 5.8 and 5.10. Groundwater cross contamination with the drilling fluid will be prevented as the core holes will be cased and completed in accordance with DPI-MR requirements and specific well designs for each planned site.

In the case of a drilling sump, a liner may be used depending on the environment assessment of a given location. If a liner is used it will be removed after drilling with the water re-used or taken to an appropriate site for disposal. Any waste pits temporarily left open after the rig has left will be fenced to protect livestock and other animals.

Associated water from the coal seams is not expected to be produced as part of the core hole drilling activity and therefore no mitigation measures are presented.

5.5 Soils, Land use and Rehabilitation

5.5.1 Existing Environment

The soils in the vicinity of the core hole sites are a valuable resource to pastoral or agricultural interests.

5.5.2 Potential Impacts and Mitigation Process

An area of 45 metres by 60 metres plus access is required to accommodate a fully operational drilling rig and ancillary equipment, access to site, with about 30% of the core hole site comprising hard stand. A level area is required for the drilling rig pad and associated sumps and flare pit will be constructed on site. These will require topsoil to be removed and stockpiled for replacement during site rehabilitation. If imported soils are required these will be sourced from the local area and if required, permission will be obtained prior to this being undertaken.

Management measures will include:

- Restricting the area to be disturbed to the minimum;
- Stockpiling top soil separately from other spoil and respreading if earth works are required;
- Return of natural/previous land contours;
- Reseeding if required in consultation with landholders; and
- Removal of all imported soil material.

5.6 Noise

5.6.1 Existing Environment

Noise levels in the location of the proposed core holes are generally low but variable due to periodic rural or coal mining activities.

5.6.2 Potential Impacts and Mitigation Measures

The proposed activity is like to generate noise as a result of the following procedures:

- The drilling activity; and
- The movement of trucks and other vehicles.

The equipment used for the mobilisation and powering of the drilling rigs have mufflers installed on their respective power plants and prime movers. The proposed drilling sites are a significant distance from the nearest dwellings and combined with the muffling of the engines and the short term nature of the drilling activity, operations are unlikely to create any significant noise impacts for residents. Drilling operations will be in accordance with agreements with landowner and DPI-MR requirements. Mitigation Measures will include:

- Identifying all potentially affected noise and/or vibration sensitive receivers (including rural residences, and noise sensitive equipment) that may be affected by the approved activities;
- Predicting potential noise and vibration levels from the proposed operations where appropriate (depending on where nearest sensitive receptors are located relative to the well sites);
- Noise and vibration monitoring may be undertaken on receipt of a complaint; and
- Appropriately informing affected residences and other relevant parties in advance of any activities and providing those people with updated information as required.

5.7 Flora and Fauna

5.7.1 Existing Environment

The proposed core hole locations will be located on land that has been previously cleared and is unlikely to be of significance to threatened species or communities. Appendix A lists the many potential weeds that could be in or near the proposed core hole locations.

5.7.2 Potential Impacts and Mitigation Measures

The likelihood of disturbing actual or potential habitats associated with species of significance is low because of the small area and temporary nature of the impact; the extent and duration of clearing and grazing that has occurred locally; and the absence of remnant vegetation at the proposed core hole locations. Scouting will be undertaken prior to drilling commencing to confirm this and that there are no likely habitat disturbances.

There is a potential for the introduction of weeds and pest species to the site via the entry of vehicles and plant. This shall be mitigated as follows; all vehicles travelling to site will be required to follow the Operators standards. These vehicles will be assessed for weed exposure in the area of origin and if it is deemed required the vehicle, plant or ancillary equipment will be washed and/or brushed down at a suitable site external to the project area. This will entail the complete removal of soils and organic matter from all areas capable of holding such material. This may also be undertaken between core hole locations depending on weed infestations at each site. Scouting of the proposed core hole sites will identify any weeds present and assist in the determination of any additional measures that may be required as a result.

The need for washing and/or brushing down of vehicles and ancillary equipment will depend on the equipment mobilisation location.

5.8 Chemical and Hazardous Substance Management

5.8.1 Existing Environment

The area is rural and there would be a variety of chemicals that could be stored and used through out the region.

5.8.2 Potential Impacts and Mitigation Measures

Appropriate storage and handling is necessary to avoid the risk of land or water contamination or posing a threat to health or safety of personnel or residents at or near the site.

The following management measures will be implemented:

- The amount of hazardous material stored and used on site shall be kept to the minimum practicable;
- Hazardous materials shall be transported, stored and handled in accordance with the requirements of relevant legislation (e.g. Road and Rail Transport (Dangerous Goods) Act 1997, Australian Dangerous Goods Code) and Australian and Industry Standards;
- Fuels, lubricants and chemicals shall be stored and handled within containment areas (such as portable bunding) that are designed to prevent the release of spilt substances to the immediate neighbouring environment, in accordance with relevant legislation and standards. A spill kit appropriate to operations of this size will be available at site; and
- Material Safety Data Sheets and handling procedures for hazardous chemicals and materials shall be kept on site.

Spill prevention and response measures will include:

- Personnel shall be advised of the location and use of the spill containment equipment in the site induction;

- Spills or leaks shall be immediately reported to the senior Santos representative onsite and clean up actions initiated;
- In the event of a spill, the material shall be contained to the smallest area practicable;
- Spilt material and contaminated soils shall be treated on site with landholder acceptance or removed off-site for disposal at an appropriately licensed facility, as determined in consultation with Department of Environment and Climate Change (DECC) and DPI-MR; and
- Spills shall be reported in accordance with regulatory and licensing requirements. There is a duty to notify the appropriate regulatory authority (broadly, the DECC or the local council) of pollution incidents where material harm to the environment is caused or threatened (see Section 2.1 for definition of material harm).

The information about a pollution incident required to be included in a notification consists of the following:

- the time, date, nature, duration and location of the incident;
- the nature, the estimated quantity or volume and the concentration of any pollutants involved;
- the circumstances in which the incident occurred (including the cause of the incident, if known);
- the action taken or proposed to be taken to deal with the incident and any resulting pollution or threatened pollution; and
- other information prescribed by the regulations.

5.9 Contaminated Land

5.9.1 Existing Environment

The land is currently either used for pastoral or crop production and the core hole sites are not expected to have been previously contaminated.

Core hole drilling will have minimal impact on the site's soils. On completion of core hole activities, all other excavated material would be backfilled on site. Santos does not reasonably suspect that land contamination would be an issue at any proposed core hole site.

5.9.2 Potential Impacts and Mitigation Measures

Mitigation measures are discussed in the following sections:

- Hydrology- Section 5.4;
- Soils- Section 5.5;
- Chemicals and Hazardous Substance Management- Section 5.8;
- Waste Minimisation and Management: Section 5.10

5.10 Waste Minimisation and Management

5.10.1 Existing Environment

No wastes are presently stored at any of the core hole sites. The proposed core hole sites are located on cleared rural lands.

5.10.2 Potential Impacts and Mitigation Measures

The worksite will require the provision of systems for the management of sewage wastes. Personnel numbers can reach up to 10 in the case of drilling operations.

All industrial solid wastes created during drilling and well operations will be collected in designated skips for eventual recycling or disposal to an appropriately licensed facility. Water based drilling fluids and associated cuttings, will be stored in an excavated sump. Cuttings may remain in the sump or be removed, and a liner may or not be utilised depending on an environmental assessment of each core hole location. Topsoil will be respread over restored surfaces at final abandonment of the site to encourage revegetation of disturbed surfaces.

The following management measures will be implemented:

- Waste material (including domestic waste) shall be collected and stored in suitable bins to prevent loss and scavenging by stock, wildlife and feral animals;
- Where practicable, recyclable material (e.g. glass and cans, scrap metals, used chemical and fuel drums and timber pallets) shall be collected in designated skips for recycling;
- The waste bins shall be removed from the site as necessary following completion of drilling and their contents are to be deposited at a licensed waste management facility for appropriate disposal;
- All wastes are to be transported in covered or sealed containers to prevent the loss of waste materials during transport;
- Waste shall be transported in accordance with appropriate standards and legislative requirements;
- All industrial waste materials including liquids and solids will be removed for reuse or disposed at an appropriate site;
- Staff will be housed at accommodation in nearby towns; 'portaloos' will be provided at the site and maintained as required by a suitable contractor;
- Pits shall not be established in locations which pose a hazard to stock or wildlife. Any fencing shall be stock proof and, suitable for 'organic beef accredited' properties, steel or untreated timber posts shall be used;
- Flare pits may also be fenced as above;
- Sumps containing waste fluids/cuttings shall be fenced off immediately following the rig moving off the premises; and
- A perimeter fence around the site will be considered at each site, if required to enclose all the above pits, sumps etc.

5.11 Visual Amenity

5.11.1 Existing Environment

The landscape in the region is dominated by broad views of rural properties, with scattered pastoral infrastructure such as bores, tanks, dams, fences, roads, homesteads and other buildings.

5.11.2 Potential Impacts and Mitigation Measures

The visual impacts of drilling will be temporary and relatively insignificant and all equipment will be removed at the end of the coring program. If drilling is operated on a

24 hour a day basis, the site will be sufficiently lit for safe working conditions. Due to the level terrain, this light can be expected to be visible from a reasonable distance, however due to the short duration of each well (approx one month) this is not considered a significant alteration to the visual amenity. Lighting will be kept to a minimum and will be focused on the working areas only.

5.12 Aboriginal Heritage

5.12.1 Existing Environment

The land where the core hole sites are proposed (including access tracks) has been previously disturbed and cleared. A search of the DECC AHIMS database for the general area of the proposed core hole drilling has been made (DECC, 2008). No Aboriginal objects or places are recorded in close proximity (within 300 m) of a proposed core hole site. As well, the general topography of the proposed sites is distant from features that are commonly held to have a higher likelihood of Aboriginal objects and places (e.g. creeks, water holes, ridgelines) being present. Initial consultations with representatives of the Red Chief Local Aboriginal Land Council have commenced.

5.12.2 Potential Impacts and Mitigation Measures

Potential impacts include disturbance of unrecorded artefacts or burial sites. However to minimise any potential impacts the following management measures will be implemented:

- Undertaking a pre-preparation heritage site inspection of the proposed drilling site;
- Heritage exclusion zones or sites identified during the heritage site inspection shall be avoided;
- Personnel, vehicles and equipment shall be restricted to designated work areas and access tracks; and
- Aboriginal heritage issues and the potential for discovery of sites shall be covered in site inductions.

If a site is discovered during site preparation works, the following procedure shall be implemented:

- Halt work at this location and establish a 100 metre buffer around the site. Work may continue outside the buffer area;
- Contact the Operator's Cultural Heritage Group, relevant Local Aboriginal Land Council and National Parks and Wildlife Service (DECC), so that an evaluation of the nature of the discovery can be undertaken, along with the development of an appropriate course of action;
- The course of action may consist of recording the site location, removal of the cultural material or site protection as appropriate under the relevant legislation; and
- If human remains are encountered, the local Police shall also be notified.

5.13 Cumulative Environmental Impacts

The core hole activities are temporary in nature and each site will be restored to enable previous land-uses to continue into the future. The mitigation measures outlined above will ensure that there are no significant cumulative environmental impacts.

6 Conclusions

Drilling of the proposed core holes is an essential step in evaluating the hydrocarbon potential of PEL 450 within the Gunnedah Basin. Discovery of coal seam gas resources in this area has the potential to increase the state's reserves and revenue from gas and underpin future exploration or production in the region.

Santos will consult with landholders so as to identify any concerns with regard to planned activities. A Land Access Agreement will be sought with affected landholders and the agreement would address matters such as access, compensation and rehabilitation.

Scouting surveys will be undertaken in consultation with the relevant landholder prior to drilling taking place to locate sites such that impacts are minimal. Desktop assessment has shown that there is minimal risk of affecting potential threatened species and critical habitat identified in the region. It should be noted that an initial assessment of proposed locations has shown that all core holes should be located in cleared grazing land. Proposed core hole sites can be moved to avoid any sensitive areas.

The proposed activities have associated potential environmental impacts, which are common to drilling activities such as those carried out elsewhere in the Gunnedah Basin. It is considered that the potential impacts can be successfully mitigated with the application of the management strategies outlined in this document. The strategies are consistent with the APPEA Code of Environmental Practice and are typical of good hydrocarbon field practice.

Section 5A of the EP Act lists seven factors to be considered, commonly referred to the seven part test of significance. An assessment was made against the seven factors to be considered under Section 5A of the EP & P Act i.e. "seven part test of significance" and concluded that:

- There are no known threatened species that would be impacted by the planned activities. The size and nature of the proposal is unlikely to effect the life cycle of any viable populations of threatened flora/fauna if present;
- There are no known endangered populations that have been identified that would be impacted by this proposal. The size and nature of the proposal is unlikely to effect the life cycle of any viable populations of endangered populations;
- There are no known endangered ecological communities or critically endangered communities that have been identified that would be impacted by this proposal; and
- It is not proposed to clear any critical habitat for this proposal.

If the management strategies are effectively implemented, it is expected that:

- Impacts on landholders will be minimal;
- Impacts to air quality will be minor, localised and insignificant;
- Adverse effects on water resources will be minimal during core hole drilling;
- Off-site impacts to soils will be avoided and on-site impacts will be minor and temporary;
- The potential noise impacts will be short term, and no threatened species or communities are likely to be impacted;
- There will be no significant use of, or impact to, natural resources;
- Impacts on the community and visual amenity will be insignificant and short term, particularly as the core hole sites are in a sparsely populated area ;

- Impacts to heritage places or sites will be avoided;
- Disturbances to existing land uses will be minor and short term and managed in consultation with affected landholder(s); and
- There will be no significant cumulative environmental impacts.

On completion of the activities, the sites will be rehabilitated to reflect the pre-existing land form and use in consultation with relevant landholders. All waste will be disposed of in an appropriate manner.

7 References

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Warrumbungle Shire Council, 2007, Warrumbungle Shire Council Social/Cultural Plan, December.

Further reading:

Petroleum Exploration Licence (PEL) 1 Licence Instrument

Mineral Resources Division, 2006, Guidelines for Review of Environmental Factors, June, NSW Department of Primary Industries.

Abbreviations

ABN	Australian Business Number
ABS	Australian Bureau of Statistics
AGR	AGR Asia Pacific
AHIMS	Aboriginal Heritage Information Management System
APPEA	Australian Petroleum Production & Exploration Association
CCA	Community Conservation Area
CSC	Coonamble Shire Council
CSG	Coal Seam Gas
DECC	NSW Department of Environment and Climate Change
DST	Drill Stem Test
DPI	NSW Department of Primary Industries
DPI- MR	NSW Department of Primary Industries- Mineral Resources
EP & A	Environmental Planning and Assessment Act 1979
EPI	Environment Planning Instrument
EPBC	The Environmental Protection and Biodiversity Conservation Act 1999
GDA	Geocentric Datum of Australia
GSC	Gilgandra Shire Council
km	kilometre
LEP	Local Environment Plan
LGA	Local Government Area
mm	millimetre
n.d.	No date
NP	National Park
NSW	New South Wales
REF	Review of Environmental Factors
PEL	Petroleum Exploration Licence
SEPP	State Environment Planning Policy
TSC	Threatened Species Conservation Act 1995
WSC	Warrumbungle Shire Council

Appendix A.

Noxious weeds likely to be found in region

Source: Gunnedah Shire Council

Weed	Class	Legal requirements
African boxthorn [<i>Lycium ferocissimum</i>]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
African feathergrass [<i>Pennisetum macrourum</i>]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
African turnipweed [<i>Sisymbrium runcinatum</i>]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
African turnipweed [<i>Sisymbrium thellungii</i>]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Alligator weed [<i>Alternanthera philoxeroides</i>]	2	The plant must be eradicated from the land and the land must be kept free of the plant
Anchored water hyacinth [<i>Eichhornia azurea</i>]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Annual ragweed [<i>Ambrosia artemisiifolia</i>]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Arrowhead [<i>Sagittaria montevidensis</i>]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Artichoke thistle [<i>Cynara cardunculus</i>]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Athel pine [<i>Tamarix aphylla</i>]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Bathurst/Noogoora/Californian/cockle burrs [<i>Xanthium species</i>]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Bear-skin fescue [<i>Festuca gautieri</i>]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with

Weed	Class	Legal requirements
		This is an All of NSW declaration
Black knapweed [Centaurea nigra]	1	The plant must be eradicated from the land and the land must be kept free of the plant
		This is an All of NSW declaration
Blackberry [Rubus fruticosus aggregate species]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
except cultivars Black satin, Chehalem, Chester Thornless, Dirksen Thornless, Loch Ness, Murrindindi, Silvan, Smoothstem, Thornfree		This is an All of NSW declaration
Blue heliotrope [Heliotropium amplexicaule]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Bridal creeper [Asparagus asparagoides]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
		This is an All of NSW declaration
Broomrapes [Orobanche species]	1	The plant must be eradicated from the land and the land must be kept free of the plant
Includes all Orobanche species except the native O. cernua variety australiana and O. minor		This is an All of NSW declaration
Burr ragweed [Ambrosia confertiflora]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
		This is an All of NSW declaration
Cabomba [Cabomba caroliniana]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
		This is an All of NSW declaration
Cayenne snakeweed [Stachytarpheta cayennensis]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
		This is an All of NSW declaration
Chilean needle grass [Nassella neesiana]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Chinese violet [Asystasia gangetica subspecies micrantha]	1	The plant must be eradicated from the land and the land must be kept free of the plant
		This is an All of NSW declaration
Clockweed [Gaura lindheimeri]	5	The requirements in the Noxious Weeds Act 1993 for a

Weed	Class	Legal requirements
		notifiable weed must be complied with This is an All of NSW declaration
Clockweed [Gaura parviflora]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Cockle burrs [Xanthium species]		See Bathurst/Noogoora/Californian/cockle burrs
Columbus grass [Sorghum x alnum]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Corn sowthistle [Sonchus arvensis]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Dodder [Cuscuta species] Includes All Cuscuta species except the native species C. australis, C. tasmanica and C. victoriana	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
East Indian hygrophila [Hygrophila polysperma]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Espartillo [Achnatherum brachychaetum]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Eurasian water milfoil [Myriophyllum spicatum]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Fine-bristled burr grass [Cenchrus brownii]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Fountain grass [Pennisetum setaceum]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Gallon's curse [Cenchrus biflorus]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Galvanised burr [Sclerolaena birchii]	4	The plant must be controlled where it impacts on normal agricultural practices including cropping and pasture

Weed	Class	Legal requirements
		management
Giant Parramatta grass [Sporobolus fertilis]	3	The plant must be fully and continuously suppressed and destroyed
Glaucous starthistle [Carthamus glaucus]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Golden dodder [Cuscuta campestris]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Golden thistle [Scolymus hispanicus]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Green cestrum [Cestrum parqui]	3	The plant must be fully and continuously suppressed and destroyed
Harrisia cactus [Harrisia species]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed This is an All of NSW declaration
Hawkweed [Hieracium species]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Hemlock [Conium maculatum]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Horsetail [Equisetum species]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Hymenachne [Hymenachne amplexicaulis]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Italian bugloss [Echium species]		See Paterson's curse, Vipers bugloss, Italian bugloss
Johnson grass [Sorghum halepense]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Karoo thorn [Acacia karroo]	1	The plant must be eradicated from the land and the land

Weed	Class	Legal requirements
		<p>must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
<p>Kochia [Bassia scoparia]</p> <p>except Bassia scoparia subspecies trichophylla</p>	1	<p>except B.scoparia subspecies trichophylla</p> <p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
<p>Lagarosiphon [Lagarosiphon major]</p>	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
<p>Lantana [Lantana species]</p>	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
<p>Leafy elodea [Egeria densa]</p>	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
<p>Lippia [Phyla species]</p>	4	<p>The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed</p>
<p>Long-leaf willow primrose [Ludwigia longifolia]</p>	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
<p>Long-style feather grass [Pennisetum villosum]</p>	4	<p>The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority</p>
<p>Mesquite [Prosopis species]</p>	2	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p>
<p>Mexican feather grass [Nassella tenuissima]</p>	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
<p>Mexican poppy [Argemone mexicana]</p>	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
<p>Miconia [Miconia species]</p>	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p>

Weed	Class	Legal requirements
		This is an All of NSW declaration
Mimosa [Mimosa pigra]	1	The plant must be eradicated from the land and the land must be kept free of the plant
		This is an All of NSW declaration
Mossman River grass [Cenchrus echinatus]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
		This is an All of NSW declaration
Mother-of-millions [Bryophyllum species and hybrids]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Onion grass [Romulea species]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
Includes all Romulea species and varieties except R. rosea var. australis		This is an All of NSW declaration
Oxalis [Oxalis species and varieties]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
Includes all Oxalis species and varieties except the native species O. chnoodes, O. exilis, O. perennans, O. radicata, O. rubens, and O. thompsoniae		This is an All of NSW declaration
Pampas grass [Cortaderia species]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Parkinsonia [Parkinsonia aculeata]	2	The plant must be eradicated from the land and the land must be kept free of the plant
Parthenium weed [Parthenium hysterophorus]	1	The plant must be eradicated from the land and the land must be kept free of the plant
		This is an All of NSW declaration
Paterson's curse, Vipers bugloss, Italian bugloss [Echium species]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Perennial ragweed [Ambrosia psilostachya]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Pond apple [Annona glabra]	1	The plant must be eradicated from the land and the land must be kept free of the plant
		This is an All of NSW declaration
Prickly acacia [Acacia nilotica]	1	The plant must be eradicated from the land and the land must be kept free of the plant

Weed	Class	Legal requirements
		This is an All of NSW declaration
Prickly pear [Cylindropuntia species]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
		This is an All of NSW declaration
Prickly pear [Opuntia species except O. ficus-indica]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
		This is an All of NSW declaration
Red rice [Oryza rufipogon]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
		This is an All of NSW declaration
Rhus tree [Toxicodendron succedaneum]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
		This is an All of NSW declaration
Rubbervine [Cryptostegia grandiflora]	1	The plant must be eradicated from the land and the land must be kept free of the plant
		This is an All of NSW declaration
Sagittaria [Sagittaria platyphylla]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
		This is an All of NSW declaration
Salvinia [Salvinia molesta]	2	The plant must be eradicated from the land and the land must be kept free of the plant
Sand oat [Avena strigosa]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
		This is an All of NSW declaration
Senegal tea plant [Gymnocoronis spilanthoides]	1	The plant must be eradicated from the land and the land must be kept free of the plant
		This is an All of NSW declaration
Serrated tussock [Nassella trichotoma]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed

Weed	Class	Legal requirements
Siam weed [Chromolaena odorata]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Silk forage sorghum [Sorghum species hybrid cultivar]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Silver-leaf nightshade [Solanum elaeagnifolium]	3	The plant must be fully and continuously suppressed and destroyed
Smooth-stemmed turnip [Brassica barrelieri subspecies oxyrrhina]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Soldier thistle [Picnomon acarna]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Spiny burrgrass [Cenchrus incertus]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Spiny burrgrass [Cenchrus longispinus]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed
Spotted knapweed [Centaurea maculosa]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
St. John's wort [Hypericum perforatum]	3	The plant must be fully and continuously suppressed and destroyed
Texas blueweed [Helianthus ciliaris]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Tree-of-heaven [Ailanthus altissima]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Water caltrop [Trapa species]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration

Weed	Class	Legal requirements
Water hyacinth [Eichhornia crassipes]	2	The plant must be eradicated from the land and the land must be kept free of the plant
Water lettuce [Pistia stratiotes]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Water soldier [Stratiotes aloides]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Wild radish [Raphanus raphanistrum]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Willows [Salix species] Includes all Salix species except S. babylonica, S. x reichardtii, S. x calodendron	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration
Witchweed [Striga species] Includes all Striga species except native species and Striga parviflora	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Yellow burrhead [Limnocharis flava]	1	The plant must be eradicated from the land and the land must be kept free of the plant This is an All of NSW declaration
Yellow nutgrass [Cyperus esculentus]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with This is an All of NSW declaration

Appendix B.

Threatened Flora Species located in the Warrumbungle, Coonamble and Gilgandra Shire Council Areas

Species	Common Name	Status	Habitat/breeding
<i>Sida rohlenae</i>	Shrub Sida	Endangered	<p>Shrub Sida has a limited distribution in Queensland, the Northern Territory, South Australia and Western Australia. In NSW it has been recorded south of Enngonia, south of Bourke and north-west of Coonamble with one collection north of Bourke which is likely to have been transported from Queensland.</p> <p>Shrub Sida grows on flood-out areas, creek banks and at the base of rocky hills.</p> <p>NSW specimens have been found along roadsides in hard red loam to sandy-loam soils. The species can become locally abundant and is often more common in disturbed sites.</p>
<i>Philotheca ericifolia</i>	No common name provided in Atlas	Vulnerable	<p>Known only from the upper Hunter Valley and Pilliga to Peak Hill districts of NSW. The records are scattered over a range of over 400 km between West Wyalong and the Pilliga Scrub. Site localities include Pilliga East State Forest, Goonoo State Forest, Hervey Range, Wingen Maid Nature Reserve, Toongi, Denman, Rylestone district and Kandos Weir.</p> <p>Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops.</p>
<i>Rulingia procumbens</i>	No common name provided in Atlas	Vulnerable	<p>Endemic to NSW, mainly confined to the Dubbo-Mendooran-Gilgandra region, but also in the Pilliga and Nymagee areas. Recent collections made from the Upper Hunter region, and four additional populations found in Goonoo SF. Grows in sandy sites, often along roadsides.</p> <p>Prostrate shrub with trailing stems to 30 cm long. Plants covered with star-shaped hairs on all parts. Leaves rounded to lance-shaped, 2-5 cm long, 15-25 mm wide, with wavy or lobed margins, upper surface green and sprinkled with star-shaped hairs, lower surface densely white-hairy.</p>
<i>Digitaria porrecta</i>	Finger Panic grass	Endangered	<p>Finger Panic Grass occurs in NSW and Queensland. In NSW it is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran. It largely occurs on private land.</p>
<i>Swainsona murrayana</i>	Slender Darling Pea	Vulnerable	<p>Found throughout NSW, it has been recorded in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree.</p> <p>The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams.</p> <p>Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated.</p>
<i>Tylophora linearis</i>	No common name	Endangered	<p>Found in the Barraba, Mendooran, Temora and West Wyalong districts in the northern and central western slopes of NSW. Records include Crow Mountain near Barraba, Goonoo SF, Eura SF and Goobang NP. Also occurs in Qld, from near Glenmorgan in the western Darling Downs.</p>

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Species	Common Name	Status	Habitat/breeding
			<p>Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of <i>Eucalyptus fibrosa</i>, <i>Eucalyptus sideroxylon</i>, <i>Eucalyptus albens</i>, <i>Callitris endlicheri</i>, <i>Callitris glaucophylla</i> and <i>Allocasuarina luehmannii</i>.</p> <p>Also grows in association with <i>Acacia hakeoides</i>, <i>Acacia lineata</i>, <i>Myoporum</i> species and <i>Casuarina</i> species.</p> <p>Flowers in spring, with flowers recorded in November or May with fruiting probably 2 to 3 months later. Has been recorded in very low abundances.</p>
<i>Swainsona sericea</i>	Silky Swainson-pea	Vulnerable	<p>Silky Swainson-pea has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. There is one isolated record from the far north-west of NSW. Its stronghold is on the Monaro. Also found in South Australia, Victoria and Queensland. Habitat on plains unknown. Regenerates from seed after fire.</p>
<i>Swainsona recta</i>	Mountain Swainson-pea	Endangered	<p>Mountain Swainson-pea is a slender, erect perennial herb growing to 30 cm tall. The leaves are divided into up to six pairs of 10 mm long, very narrow leaflets, each with a pointed tip. There is also a single leaflet at the end of each divided leaf. It bears one to several sprays of between 10 and 20 purple, pea-shaped flowers, between late September and early December. Flowers are followed by pods up to 10 mm long in summer.</p> <p>Mountain Swainson-pea was recorded historically from places such as Carcoar, Culcairn and Wagga Wagga where it is probably now extinct. Populations still exist in the Queanbeyan and Wellington-Mudgee areas. Over 80% of the southern population grows on a railway easement. It is also known from the ACT and Victoria.</p> <p>Before European settlement Mountain Swainson-pea occurred in the grassy understorey of woodlands and open-forests dominated by Blakely's Red Gum <i>Eucalyptus blakelyi</i>, Yellow Box <i>E. melliodora</i>, Candlebark Gum <i>E. rubida</i> and Long-leaf Box <i>E. goniocalyx</i>.</p> <p>Grows in association with understorey dominants that include Kangaroo Grass <i>Themeda australis</i>, poa tussocks <i>Poa</i> spp. and spear-grasses <i>Austrostipa</i> spp.</p>
<i>Acacia ausfeldii</i>	Ausfeld's Wattle	Vulnerable	<p>Ausfeld's Wattle is mostly found on flat sandy ground in remnant roadside patches of eucalypt woodland. Established plants are likely to be killed by fire, as mature and juvenile plants have a single-stemmed growth form. Associated species include <i>Eucalyptus albens</i>, <i>E. blakelyi</i> and <i>Callitris</i> spp., with an understorey dominated by <i>Cassinia</i> spp. and grasses.</p> <p>It is likely to have a dormant soil seedbank from which germination is stimulated by fire, however a small fraction of seeds have been observed to germinate in the absence of fire.</p> <p>Flowers from August to October.</p>
<i>Pomaderris queenslandica</i>	Scant Pomaderris	Endangered	<p>Widely scattered but not common in north-east NSW and in Queensland. It is only known from a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolatai, and also from several locations on the NSW north coast.</p> <p>Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.</p>

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Species	Common Name	Status	Habitat/breeding
<i>Boronia granitica</i>	Granite Boronia	Vulnerable	<p>Granite Boronia occurs in scattered localities on the New England Tablelands and North West Slopes north from the Armidale area to the Stanthorpe district in southern Queensland.</p> <p>Grows on granitic soils amongst rock outcrops, often in rock crevices, and in forests and woodlands on granite scree and shallow soils. At Severn River it grows on deep red soils.</p>
<i>Zieria ingramii</i>	Keith's Zieria	Endangered	<p>Grows in dry sclerophyll forest on light sandy soils. All known populations have been recorded in Eucalyptus-Callitris woodland or open forest with a shrubby to heathy understorey.</p> <p>Mostly from gentle slopes in red-brown and yellow-brown sandy loams, often with a rocky surface.</p>
<i>Prostanthera spinosa</i>	Spiny-mint bush	Vulnerable	<p>IN NSW <i>Prostanthera spinosa</i> is an aromatic, scrambling, prostrate shrub, to 0.5 metres high. It is erect and reaches up to 2 metres in Victoria and South Australia. The branches are glabrous or hairy with spines to 16 mm long that alternate in pairs at right angles. Leaves are 1.5-6 mm long, 1-4 mm wide slightly recurved and a light to dark green surface. The, lower surface is paler and glabrous. Pale mauve-lilac to almost white flowers appear on a 0.4-1 mm long stem from the angle between the branch or leaf and the stem between July and December.</p> <p>It grows in skeletal sandy soils of rocky areas.</p>
<i>Homoranthus prolixus</i>	Granite Homoranthus	Vulnerable	<p>Granite Homoranthus is a horizontally spreading shrub about 80 cm high with the ends of the branches growing upwards. The dull, blue-green leaves are paired on the stem, with successive pairs at right angles to each other, and 3 - 6 mm long and 0.5 - 1 mm wide, with a tapered tip. The red to yellow flowers are about 5 mm long and grow in the upper part of the branches, with one to six flowers on each branch. Homoranthus prolixus is characterised by the low spreading habit and short and more or less glaucous (dull blue green in colour with whitish bloom) leaves.</p> <p>Homoranthus prolixus grows in heath patches, in skeletal soil among crevices of granite outcrops. Associated vegetation at the 'Longford station' site north-east of Bendemeer is comprised of <i>Acacia neriifolia</i>, <i>Acacia granitica</i>, <i>Olearia elliptica</i>, <i>Cryptandra amara</i> and <i>Callitris endlicheri</i>. Associated vegetation at other sites includes <i>Callitris endlicheri</i>, <i>Eucalyptus dealbata</i> and <i>Angophora floribunda</i> forest, and dry heath or open scrub with <i>Acacia triptera</i>, <i>Kunzea parvifolia</i>, <i>Leptospermum</i> and <i>Callitris</i>.</p> <p>Likely to be highly fire-sensitive and intolerant to frequent fire disturbance.</p> <p>Homoranthus prolixus has a localised distribution and may be the dominant shrub at some sites. Its abundance in populations ranges from frequent or common, to very locally abundant. The 'Longford station' site north-east of Bendemeer comprised approximately 300 healthy, ungrazed plants spread over two rock outcrops. Flowers from October to November.</p>

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Species	Common Name	Status	Habitat/breeding
<i>Lepidium aschersonii</i>	Spiny Peppergrass	Vulnerable	<p>Not widespread, occurring in the marginal central-western slopes and north-western plains regions of NSW (and potentially the south western plains). A recent survey has located several populations at Narrabri, from where the species had last been recorded in 1899. Also known from the West Wyalong, Barmedman and Temora areas, although most records are old. Approximately 50% of the total <i>Lepidium aschersonii</i> recorded for Australia occurs in NSW.</p> <p>Found on ridges of gilgai clays dominated by Brigalow (<i>Acacia harpophylla</i>), with <i>Austrodanthonia</i> and/or <i>Austrostipa</i> species in the understorey. The species grows as a component of the ground flora, in grey loamy clays. Vegetation structure varies from open to dense Brigalow, with sparse grassy understorey and occasional heavy litter.</p>
<i>Rulingia procumbens</i>	No common name provided	Vulnerable	<p>Endemic to NSW, mainly confined to the Dubbo-Mendooran-Gilgandra region, but also in the Pilliga and Nymagee areas. Recent collections made from the Upper Hunter region, and four additional populations found in Goonoo SF. Grows in sandy sites, often along roadsides.</p> <p>Recorded in <i>Eucalyptus dealbata</i> and <i>Eucalyptus sideroxylon</i> communities, <i>Melaleuca uncinata</i> scrub, under mallee eucalypts with a <i>Calytrix tetragona</i> understorey, and in a recently burnt Ironbark and <i>Callitris</i> area. Also in <i>Eucalyptus fibrosa</i> subsp. <i>nubila</i>, <i>Eucalyptus dealbata</i>, <i>Eucalyptus albens</i> and <i>Callitris glaucophylla</i> woodlands north of Dubbo.</p> <p>Other associated species include <i>Acacia triptera</i>, <i>Callitris endlicheri</i>, <i>Eucalyptus melliodora</i>, <i>Allocasuarina diminuta</i>, <i>Philotheca salsolifolia</i>, <i>Xanthorrhoea</i> species, <i>Exocarpos cupressiformis</i>, <i>Leptospermum parvifolium</i> and <i>Kunzea parvifolia</i>. Fruiting period is summer to autumn. Flowers from August to December. Appears to produce seed which persists for some time in the seed bank. Large numbers of seedlings have been observed germinating after fire at sites where the species was not apparent above ground before the fires. Clusters of individuals may be clonal.</p> <p>The species is often found as a pioneer species of disturbed habitats. It has been recorded colonising disturbed areas such as roadsides, the edges of quarries and gravel stockpiles and a recently cleared easement under power lines.</p>

Appendix C.

Threatened Fauna Species in Warrumbungle, Coonamble, and Gilgandra Shire Council Areas

Species	Common Name	Status	Habitat/foraging/breeding
<i>Anseranas semipalmata</i>	Magpie Goose	Vulnerable	The Magpie Goose is still relatively common in the Australian northern tropics, but had disappeared from south-east Australia by 1920 due to drainage and overgrazing of reed swamps used for breeding. Since the 1980s there have been an increasing number of records in central and northern NSW. Vagrants can follow food sources to south-eastern NSW. Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges.
<i>Ardeotis australis</i>	Australian Bustard	Endangered	<p>The Australian Bustard mainly occurs in inland Australia and is now scarce or absent from southern and south-eastern Australia. In NSW, they are mainly found in the north-west corner and less often recorded in the lower western and central west plains regions. Occasional vagrants are still seen as far east as the western slopes and Riverine plain. Breeding now only occurs in the north-west region of NSW.</p> <p>Mainly inhabits tussock and hummock grasslands, though prefers tussock grasses to hummock grasses; also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams.</p>
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Vulnerable	The Australasian Bittern is a large, stocky bird, reaching up to 75 cm in length. Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (<i>Typha</i> spp.) and spikerushes (<i>Eleocharis</i> spp.).
<i>Burhinus grallarius</i>	Bush Stone-curlew	Endangered	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights.
<i>Calyptorhynchus banksii</i>	Red-tailed Black Cockatoo	Vulnerable	The Red-tailed Black-Cockatoo is the most widespread of the Black-Cockatoos, ranging broadly across much of northern and western Australia as well as western Victoria. In NSW, one population occurs on the north-western slopes and plains but another small isolated population is found in the coastal north-east. Red-tailed Black-Cockatoos are found in a wide variety of habitats. In coastal north-east NSW they have been recorded in dry open forest and areas of mixed rainforest/eucalypt forest. Breeds in trees with hollows >12 cm diameter that are > 2 m above the ground.
<i>Calyptorhynchus lathami</i>	Glossy Black Cockatoo	Vulnerable	<p>The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia.</p> <p>Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (<i>Allocasuarina littoralis</i>), Forest She-oak (<i>A. torulosa</i>) or Drooping She-oak (<i>A. verticillata</i>) occur.</p>
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Vulnerable	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Hirundo ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof

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Species	Common Name	Status	Habitat/foraging/breeding
			<p>domes in sandstone caves. They remain loyal to the same cave over many years.</p> <p>Found in well-timbered areas containing gullies.</p>
<i>Chalinolobus picatus</i>	Little Pied Bat	Vulnerable	The Little-Pied Bat is found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria. Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, Bimbil box. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings.
<i>Climacteris picumnus</i>	Brown Treecreeper	Vulnerable	<p>The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges.</p> <p>The Brown Treecreeper climbs up the trunks and branches of trees in search of food. It probes into cavities and under loose bark with its long downward curving bill. In this way it searches for insects and their larvae. The most favoured insects are ants. Some feeding also takes place on the ground on fallen logs. Sometimes, birds can be seen diving on ground-dwelling prey from a perch in a tree. Feeding normally takes place in pairs or small groups.</p> <p>Brown Treecreepers breed from June to January each year. During this season, pairs often have two broods of two to three young. The nest is a collection of grasses, feathers and other soft material, placed in a suitable tree hollow or similar site.</p>
<i>Cercartetus nanus</i>	Eastern Pygmy-Possum	Vulnerable	<p>The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes.</p> <p>Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.</p> <p>Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (<i>Pseudocheirus peregrinus</i>) dreys or thickets of vegetation, (eg. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.</p>
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	Vulnerable	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Mostly nocturnal, although will hunt during the day; spends most of the time on the ground, although also an excellent climber and may raid possum and glider dens and prey on roosting birds.
<i>Ephippiorhynchus Asiaticus</i>	Black-necked Stork	Endangered	The species is widespread across coastal northern and eastern Australia, becoming increasingly uncommon further south into NSW, and rarely south of Sydney. Some birds may move long distances and can be recorded well outside their normal range. Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries.
<i>Grantiella Picta</i>	Painted honey-eater	Vulnerable	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow

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Species	Common Name	Status	Habitat/foraging/breeding
			and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> . Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.
<i>Grus rubicunda</i>	Brolga	Vulnerable	<p>The Brolga was formerly found across Australia, except for the south-east corner, Tasmania and the south-western third of the country. It still abundant in the northern tropics, but very sparse across the southern part of its range.</p> <p>Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged</p>
<i>Hoplovephalus bitorquatus</i>	Pale headed Snake	Vulnerable	The Pale-Headed Snake is a medium-sized largely tree-dwelling snake to 90 cm long. A patchy distribution from north-east Queensland to north-east NSW. In NSW it occurs from the coast to the western side of the Great Divide as far south as Tuggerah. Found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest. Favours streamside areas, particularly in drier habitats.
<i>Leipoa ocellata</i>	Malleefowl	Endangered	Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300-450 mm mean annual rainfall) areas. Less frequently found in other eucalypt woodlands (e.g., mixed Western Grey Box and Yellow Gum or Bimble Box, Ironbark-Callitris Pine, Callitris Pine, Mulga (<i>Acacia aneura</i>), and Gidgee (<i>A. cambagei</i>).
<i>Lophoictinia isura</i>	Square-tailed Kite	Vulnerable	<p>The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March.</p> <p>Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.</p>
<i>Macropus dorsalis</i>	Black-striped Wallaby	Endangered	From the Townsville area in Queensland to northern NSW where it occurs on both sides of the Great Divide. On the north west slopes of NSW it occurs in Brigalow remnants to south of Narrabri. On the north coast it is confined to the upper catchments of the Clarence and Richmond Rivers. Preferred habitat is characterised by dense woody or shrubby vegetation within three metres of the ground. This dense vegetation must occur near a more open, grassy area to provide suitable feeding habitat.
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south eastern form)	Vulnerable	<p>The Hooded Robin is common in few places, and rarely found on the coast. It is considered a sedentary species, but local seasonal movements are possible. The south-eastern form is found from Brisbane to Adelaide throughout much of inland NSW, with the exception of the north-west. The species is widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania.</p> <p>Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.</p>
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	Vulnerable	The subspecies is widespread, from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond River district. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions. Occupies mostly upper levels of drier open forests or

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Species	Common Name	Status	Habitat/foraging/breeding
			<p>woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>Eucalyptus albens</i>), Grey Box (<i>Eucalyptus microcarpa</i>), Yellow Box (<i>Eucalyptus melliodora</i>) and Forest Red Gum (<i>Eucalyptus tereticornis</i>).</p> <p>Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees. A gregarious species usually seen in pairs and small groups of up to 12 birds. Feeding territories are large making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares.</p>
<i>Neophema pulchella</i>	Turquoise Parrot	Vulnerable	<p>The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter.</p> <p>Forages quietly and may be quite tolerant of disturbance. However, if flushed it will fly to a nearby tree and then return to the ground to browse as soon as the danger has passed.</p> <p>Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.</p>
<i>Ninox connivens</i>	Barking Owl	Vulnerable	<p>The Barking Owl is found throughout Australia except for the central arid regions and Tasmania. It is quite common in parts of northern Australia, but is generally considered uncommon in southern Australia. It has declined across much of its distribution across NSW and now occurs only sparsely. It is most frequently recorded on the western slopes and plains. It is rarely recorded in the far west or in coastal and escarpment forests.</p> <p>Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or the dense clumps of canopy leaves in large Eucalypts.</p>
<i>Oxyura australis</i>	Blue-Billed Duck	Vulnerable	<p>The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached.</p> <p>Blue-billed Ducks will feed by day far from the shore, particularly if dense cover is available in the central parts of the wetland. They feed on the bottom of swamps eating seeds, buds, stems, leaves, fruit and small aquatic insects such as the larvae of midges, caddisflies and dragonflies.</p>
<i>Petaurus norfolcensis</i>	Squirrel Glider	Vulnerable	<p>The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.</p> <p>Prefers mixed species stands with a shrub or Acacia midstorey. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.</p>
<i>Petrogale penicillata</i>	Brush-tailed Rock Wallaby	Vulnerable	<p>Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as</p>

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Species	Common Name	Status	Habitat/foraging/breeding
			<p>well as the foliage and fruits of shrubs and trees.</p> <p>Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night. Highly territorial and have strong site fidelity with an average home range size of about 15 ha.</p>
<i>Polytelis swainsonii</i>	Superb Parrot	Vulnerable	<p>The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west.</p> <p>Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest.</p> <p>In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box</p>
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	Vulnerable	<p>The Grey-crowned Babbler is found throughout large parts of northern Australia and in south-eastern Australia. In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Hay.</p> <p>Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses</p> <p>Build and maintain several conspicuous, dome-shaped stick nests about the size of a football. A nest is used as a dormitory for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Nests are maintained year round, and old nests are often dismantled to build new ones.</p>
<i>Pseudomys pilligaensis</i>	Pilliga Mouse	Vulnerable	<p>Distribution restricted to the Pilliga region of New South Wales. The Pilliga Mouse is very sparsely distributed and appears to prefer areas with a sparse ground cover. Some evidence exists of marked population fluctuations by this species.</p> <p>The Pilliga Mouse is restricted to an isolated area of low-nutrient deep sand which has long been recognised as supporting a distinctive vegetation type (Pilliga Scrub). Recent studies indicate that the Pilliga Mouse were found in greatest abundance in recently burnt moist gullies, areas dominated by broombush and areas containing an understorey of kurricabah (<i>Acacia burrowii</i>) with a bloodwood (<i>Corymbia trachyphloia</i>) overstorey. Consistent features of the latter two habitats were: a relatively high plant species richness; a moderate to high low shrub cover; and a moist groundcover of plants, litter and fungi. The gully where high rates of capture were encountered had an extensive cover by low grasses and sedges, with little shrub cover and large areas of ash-covered ground. It is nocturnal and appears to live in burrows.</p>
<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	Vulnerable	<p>The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100ha survive.</p> <p>The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in</p>

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Species	Common Name	Status	Habitat/foraging/breeding
			<p>an area.</p> <p>The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding.</p> <p>The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside.</p>
<i>Rostratula australis</i>	Australian Painted Snipe	Vulnerable	The Australian Painted Snipe is usually found in shallow inland wetlands, either freshwater or brackish, that are either permanently or temporarily filled. It is a cryptic bird that is hard to see and often overlooked. Usually only single birds are seen, though larger groups of up to 30 have been recorded. It nests on the ground amongst tall reed-like vegetation near water, and feeds near the water's edge and on mudflats, taking invertebrates, such as insects and worms, and seeds.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	Vulnerable	The Yellow-bellied Sheath-tail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country.
<i>Tyto novaehollandiae</i>	Masked Owl	Vulnerable	<p>Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. Lives in dry eucalypt forests and woodlands from sea level to 1100 m.</p> <p>A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.</p>
<i>Xanthomyza phrygia</i>	Regent Honeyeater	Endangered	<p>The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years non-breeding flocks converge on flowering coastal woodlands and forests.</p> <p>The Regent Honeyeater is a flagship threatened woodland bird whose conservation will benefit a large suite of other threatened and declining woodland fauna. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species.</p>
<i>Ninox strenua</i>	Powerful Owl	Vulnerable	<p>The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.</p> <p>The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine <i>Syncarpia glomulifera</i>, Black She-oak <i>Allocasuarina littoralis</i>, Blackwood <i>Acacia melanoxylon</i>, Rough-barked Apple <i>Angorphora</i></p>

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Species	Common Name	Status	Habitat/foraging/breeding
			floribunda, Cherry Ballart Exocarpus cupressiformis and a number of eucalypt species.
<i>Leporillus apicalis</i>	Lesser Stick-nest Rat	Endangered	See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=136#summary Believed to be extinct on mainland.
<i>Leporillus conditor</i>	Greater Stick-nest Rat	Endangered	See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=137#summary Unlikely to be present.
<i>Isoodon auratus auratus</i>	Golden Bandicoot (mainland)	Endangered	See http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66665 Unlikely to be present.
<i>Phascolartos cinereus</i>	Koala	Vulnerable	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees, but will descend and traverse open ground to move between trees.
<i>Bettongia lesueur graii</i>	Boodie, Burrowing Bettong (mainland)	Endangered	Believed to be extinct on mainland.
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	Vulnerable	Very little is known about the biology of this uncommon species. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	Vulnerable	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. Hibernates in winter.
<i>Pachycephala inornata</i>	Gilbert's Whistler	Vulnerable	The Gilbert's Whistler occurs in ranges, plains and foothills in arid and semi-arid timbered habitats. In NSW it occurs mostly in mallee shrubland, but also in box-ironbark woodlands, Cypress Pine and Belah woodlands and River Red Gum forests. Within the mallee the species is often found in association with an understorey of spinifex and low shrubs including acacias, hakeas, sennas and grevilleas. In woodland habitats, the understorey comprises dense patches of shrubs. The Gilbert's Whistler forages on or near the ground in shrub.
<i>Pedionomus torquatus</i>	Plains-wanderer	Endangered	The Plains-wanderer is found in the low-land native grasslands.
<i>Ixobrychus flavicollis</i>	Black Bittern	Vulnerable	The Black Bittern is a heron, dark grey to black in colour, with buff streaks on the throat and a characteristic yellow streak on the sides of the head and down the neck. The female is paler than the male, with a more yellow wash on the underparts. The species has a characteristic booming call

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Species	Common Name	Status	Habitat/foraging/breeding
			<p>that is mainly heard during the breeding season, at day or night. The colour alone readily distinguishes it from the other two much paler bittern species.</p> <p>Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Generally solitary, but occurs in pairs during the breeding season, from December to March. Like other bitterns, but unlike most herons, nesting is solitary. Nests, built in spring are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks. Between three and five eggs are laid and both parents incubate and rear the young.</p>
<i>Pseudomys oralis</i>	Hastings River Mouse	Endangered	<p>The Hastings River Mouse is a small rodent with a head-and-body length of about 17 cm. It has brownish-grey fur above, buff to greyish-white fur below and white feet. The 15 cm long tail is also furred white on the underside. They have large, bulging eyes surrounded by a black eye-ring and a strongly rounded snout.</p> <p>A patchy distribution along the east side of the Northern Tablelands and great escarpment of north-east NSW, usually but not always at elevations between 500 m and 1100 m. Also recorded in south-east Queensland.</p>
<i>Nyctophilus timorienensis</i>	Eastern Long-Eared Bat	Vulnerable	<p>Inhabits a variety of vegetation types, including mallee, bullocke <i>Allocasuarina leuhmanni</i> and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.</p> <p>Roosts in tree hollows, crevices, and under loose bark.</p>
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	Vulnerable	<p>Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water.</p> <p>Feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines.</p> <p>Normally found in pairs or small groups, though flocks of hundreds may be found where food is abundant.</p> <p>Nesting, in tree hollows, occurs throughout the second half of the year; nests are at least 1 km apart, with no more than one pair every 30 square kilometres.</p>
<i>Limosa limosa</i>	Black-tailed Godwit	Vulnerable	<p>The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia (Palearctic) and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. The species has been recorded within the Murray-Darling Basin, on the western slopes of the Northern Tablelands and in the far north-western corner of the state.</p> <p>Forages for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles in soft mud or shallow water.</p>
<i>Lathamus discolor</i>	Swift Parrot	Endangered	Breeds in Tasmania; migrates in autumn and winter to mainland; forages in nectar rich iron bark forests
<i>Macrotis lagotis</i>	Bilby	Endangered	<p>As members of a group of ground-dwelling marsupials known as Bandicoots, Bilbies have long pointed snouts and compact bodies. Bilbies measure between 29 and 55cm in length and differ from other Bandicoots by their larger ears, long silky fur and longer tails.</p> <p>Bilbies are remarkable burrowers, using their strong forelimbs and claws</p>

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Species	Common Name	Status	Habitat/foraging/breeding
			to build extensive tunnels. One Bilby may make up to twelve burrows within its home range to use for shelter. They have long slender tongues that they use to eat a specialised diet of seeds, insects, bulbs, fruit and fungi. Bilbies are active at night, sheltering in their burrows during the daytime.
<i>Stagonopleura gutta</i>	Diamond Firetail	Vulnerable	<p>Member of the finch family. Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities.</p> <p>Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.</p> <p>Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season).</p> <p>Usually encountered in flocks of between five to 40 birds, occasionally more.</p> <p>Birds roost in dense shrubs or in smaller nests built especially for roosting.</p> <p>Appears to be sedentary, though some populations move locally, especially those in the south.</p>
<i>Falco hypoleucos</i>	Grey Falcon	Vulnerable	<p>The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. The breeding range has contracted since the 1950s with most breeding now confined to arid parts of the range. There are possibly less than 5000 individuals left. Population trends are unclear, though it is believed to be extinct in areas with more than 500mm rainfall in NSW.</p> <p>Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.</p> <p>Also occurs near wetlands where surface water attracts prey.</p> <p>Preys primarily on birds, especially parrots and pigeons, using high-speed chases and stoops; reptiles and mammals are also taken.</p> <p>Like other falcons it utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse; peak laying season is in late winter and early spring; two or three eggs are laid.</p>

Appendix D.

EPBC Threatened Species

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Species	Common Name	Status	Habitat/foraging/breeding
Birds			
<i>Lathamus discolor</i>	Swift Parrot	Endangered	Breeds in Tasmania; migrates in autumn and winter to mainland; forages in nectar rich iron bark forests
<i>Polytelis swainsonii</i>	Superb Parrot	Vulnerable	<p>The Superb Parrot is a bird found in central woodland areas of southern New South Wales (NSW), the Australian Capital Territory (ACT) and Victoria. Under threat from land clearing, loss of hollows, and lack of regeneration of woodland habitat.</p> <p>Each spring they retreat towards the southwest to breed, mainly in River and Blakely's red gums. They then move further north and east, relying on woodland habitat for flowers, fruits and seed, particularly in box and Blakely's red gum.</p>
<i>Rostratula australis</i>	Australian Painted Snipe	Vulnerable	The Australian Painted Snipe is usually found in shallow inland wetlands, either freshwater or brackish, that are either permanently or temporarily filled. It is a cryptic bird that is hard to see and often overlooked. Usually only single birds are seen, though larger groups of up to 30 have been recorded. It nests on the ground amongst tall reed-like vegetation near water, and feeds near the water's edge and on mudflats, taking invertebrates, such as insects and worms, and seeds.
<i>Xanthomyza phrygia</i>	Regent Honey Eater	Endangered	<p>The Regent Honeyeater was once common in the woodlands of eastern Australia, particularly along the inland slopes of the Great Dividing Range. It once occurred as far west as Adelaide, but has now disappeared from South Australia and western Victoria. Within this reduced range its population is fragmented, and the only breeding habitat is in north-eastern Victoria and the central coast of New South Wales.</p> <p>Regent Honeyeaters feed on nectar and insects within box-ironbark eucalypt forests. When they're not breeding, birds roam widely in search of these unpredictable food sources. Approximately 75% of this habitat has been destroyed by clearing, and the habitat that remains is being degraded by the continuing removal of trees.</p>
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable	The Malleefowl is found in semi-arid to arid shrublands and low woodlands, especially those dominated by mallee and/or acacias. A sandy substrate and abundance of leaf litter are required for breeding. Densities of the birds are generally greatest in areas of higher rainfall and on more fertile soils where habitats tend to be thicker and there is an abundance of food plants. Much of the best habitat for Malleefowl has already been cleared or has been modified by grazing by sheep, cattle, rabbits and goats.
Mammals			
<i>Chalinolobus dwyeri</i>	Large eared Pied Bat	Vulnerable	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland

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Species	Common Name	Status	Habitat/foraging/breeding
			south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.
<i>Nyctophilus timorienensis</i>	Eastern Long-Eared Bat	Vulnerable	Inhabits a variety of vegetation types, including mallee, bullocke <i>Allocasuarina leuhmanni</i> and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark.
<i>Petrolegale penicillata</i>	Brush-tailed Rock wallaby	Vulnerable	The range of the Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night.
<i>Dasyurus maculates maculatus</i>	Spot-tailed Quoll	Endangered	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Mostly nocturnal, although will hunt during the day; spends most of the time on the ground, although also an excellent climber and may raid possum and glider dens and prey on roosting birds.
<i>Pseudomys pilligaensis</i>	Pilliga Mouse	Vulnerable	The Pilliga Mouse is restricted to an isolated area of low-nutrient deep sand which has long been recognised as supporting a distinctive vegetation type (Pilliga Scrub). Recent studies indicate that the Pilliga Mouse were found in greatest abundance in recently burnt moist gullies, areas dominated by broombush and areas containing an understorey of kurricabah (<i>Acacia burrowii</i>) with a bloodwood (<i>Corymbia</i>

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Species	Common Name	Status	Habitat/foraging/breeding
			trachyphloia) overstorey.
Ray finned Fishes			
<i>Maccullochella Pealii peelii</i>	Murray Cod, Cod, Goodoo	Vulnerable	Rivers
Reptiles			
<i>Eseya belli</i>	Bells' Turtle Namoi River Turtle	Vulnerable	Sandy banks and pools
<i>Underwoodisaurus sphyrurus</i>	Border Thick-tailed Gecko	Vulnerable	<p>This species is patchily distributed throughout the north-western slopes and northern tablelands of NSW and the Stanthorpe region of southern Qld. The distribution in NSW is bounded by the top of the Great Dividing Range to the east, the Liverpool Range in the south and Gunnedah in the west</p> <p>Occurs in dry sclerophyll open forest and woodland associated with outcrops of granite, basalt, sandstone and metamorphic rocks. The majority of sites are associated with granite outcrops</p>
Plants			
<i>Digitaria porrecta</i>	Finger Panic grass	Endangered	Finger Panic Grass occurs in NSW and Queensland. In NSW it is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran. It largely occurs on private land.
<i>Swainsona murrayana</i>	Slender Darling Pea	Vulnerable	<p>Found throughout NSW, it has been recorded in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree.</p> <p>The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams.</p> <p>Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated.</p>
<i>Diuris sheaffiana</i>	Tricolour Diuris Pink Donkey Orchid	Vulnerable	<p>The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (<i>Callitris</i> spp.). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW.</p> <p>Usually recorded as common and locally frequent in populations, however only one or two plants have also been observed at sites. The species has been noted as growing in large colonies.</p>

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Species	Common Name	Status	Habitat/foraging/breeding
			<p>Disturbance regimes are not known, although the species is usually recorded from disturbed habitats.</p> <p>Associated species include <i>Callitris glaucophylla</i>, <i>Eucalyptus populnea</i>, <i>Eucalyptus intertexta</i>, Ironbark and Acacia shrubland. The understorey is often grassy with herbaceous plants such as Bulbine species.</p> <p>Flowers from September to November or generally spring. The species is a tuberous, deciduous terrestrial orchid and the flowers have a pleasant, light sweet scent.</p>
<i>Philothea ericifolia</i>	No common name	Vulnerable	<p><i>Philothea ericifolia</i> is a shrub growing to 2 m high with white, possibly pink flowers</p> <p>This species occurs in drainage areas in dry sclerophyll open forest or woodland on sandstone and in heath on damp sandy flats and gullies. Specific microclimates include damp sandy flats, alluvial deposits of coarse gravel in dry creek beds and along a spur receiving soakage from high ground.</p>
<i>Pterostylis cobarensis</i>	Cobar Greenhood Orchid	Vulnerable	<p>Known chiefly from the Nyngan-Cobar-Bourke district in the far western plains of New South Wales. Recorded districts include Narrabri, Nyngan, Cobar, Nymagee, Mt Gundabooka, Mt Grenfel and Mutawintji National Park.</p> <p>Habitats are eucalypt woodlands, open mallee or <i>Callitris</i> shrublands on low stony ridges and slopes in skeletal sandy-loam soils.</p>
<i>Rulingia procumbens</i>	No common name provided in Atlas	Vulnerable	<p>Endemic to NSW mainly confined to the Dubbo-Mendooran-Gilgandra region, but also in the Pilliga and Nymagee areas. Recent collections made from the Upper Hunter region, and four additional populations found in Goonoo SF. Grows in sandy sites, often along roadsides.</p> <p>Prostrate shrub with trailing stems to 30 cm long. Plants covered with star-shaped hairs on all parts. Leaves rounded to lance-shaped, 2-5 cm long, 15-25 mm wide, with wavy or lobed margins, upper surface green and sprinkled with star-shaped hairs, lower surface densely white-hairy.</p>