



**Australian Government**

**Department of Sustainability, Environment, Water, Population and Communities**



## **Referral of proposed action**

**Santos NSW (Eastern) Pty Ltd  
Narrabri Gas Project  
Gunnedah Basin, NSW**

**October 2014**

**Prepared by:**



## Referral of the Project

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### Project title: Narrabri Gas Project

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## 1 Summary of proposed action

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### 1.1 Short description

Santos NSW (Eastern) Pty Ltd (Santos) is proposing to develop natural gas from coal seams in the Gunnedah Basin in New South Wales (NSW), southwest of Narrabri. The primary objective of the Narrabri Gas Project (the proposed development, or the Project) is to commercialise natural gas from coal seams for the Eastern Australia gas market and to support the energy security needs of NSW.

The Project seeks to develop gas wells, gas and water gathering systems, and supporting infrastructure southwest of Narrabri for the commercial production of gas. The natural gas produced would be treated to a commercial quality at a centralised gas processing facility on a rural property located southwest of Narrabri (the Leewood property).

The key components of the Project include construction and operation of exploration, appraisal and production activities and infrastructure to be carried out under proposed petroleum production leases including:

- Exploration and appraisal - Seismic acquisition, chip holes, core holes and appraisal wells.
- Gas field - Drilling of production wells, monitoring bores and gas and water gathering systems and in-field compression.
- A central gas processing facility for the dehydration, compression and treatment of the gas to commercial quality.
- Water management, treatment and beneficial reuse facilities that are required after the proposed petroleum production leases are issued.
- Supporting infrastructure such as power generation and distribution and operational management facilities.

The referral does not include the ongoing exploration and appraisal activities undertaken pursuant to Petroleum Exploration Licence 238 and Petroleum Assessment Lease 2 including, for example, the exploration and appraisal program the subject of EPBC Referral 2013/6918.

Santos currently has no plans to use hydraulic fracture stimulation in the Project area and is not seeking approval to use hydraulic fracture stimulation for the Project. Geological data indicates it would not increase gas flows in the coal seams that are being targeted. If additional geologic data supported the use of the technology in the future, a range of additional Government approvals would be required and community consultation would be undertaken.

The estimated \$2 billion dollar Project is forecast to create approximately 1,200 jobs during the construction phase and sustain approximately 200 jobs during the operational phase. The Project would contribute to the NSW economy, including the regional economies of NSW, via the direct supply chain, in addition to the creation of indirect job opportunities. This Project has the potential to supply up to 50% of NSW's gas requirements which is significant given the impending expiration of existing interstate gas contracts.

The project will be delivered in conjunction with the joint venture partners EnergyAustralia and Santos NSW (Eastern) Pty Ltd as the tenement holders.

**1.2 Latitude and longitude**

The four points included in the table represent the corner points of a rectangle which completely encompasses the Project.

LOCATION POINT	LATITUDE	LONGITUDE
1	30° 18' 25.73" S	149° 28' 4.90" E
2	30° 20' 34.93" S	149° 52' 44.10" E
3	30° 46' 17.65" S	149° 49' 11.43" E
4	30° 45' 15.06" S	149° 22' 42.51" E

**1.3 Locality and property description**

The Project is located within existing petroleum tenures Petroleum Exploration Licence (PEL) 238, Petroleum Assessment Lease (PAL) 2, and Petroleum Production Lease (PPL) 3, in the Narrabri local government area in NSW, between approximately 20 and 45 kilometres south of Narrabri and within the Bibblewindi, Jacks Creek, and Pilliga East State Forests.

The Project area will avoid the following conservation areas, Brigalow Park Nature Reserve, Pilliga National Park, the Pilliga East State Conservation Area and the Pilliga Nature Reserve.

In order to develop the necessary gas wells and gathering systems for the Project, Petroleum Production Leases must be granted over the areas where production activities may take place. As a result, Santos NSW Pty Ltd and EnergyAustralia Narrabri Gas Pty Ltd, lodged four Petroleum Production Lease Applications (PPLAs), No. 13, 14, 15 and 16, with the NSW Department of Trade and Investment, Regional Infrastructure and Services on 1 May 2014. The PPLAs were lodged over parts wholly within PEL 238 and PAL 2.

**1.4 Size of the development footprint or work area (hectares)**

The total Project area is approximately 98,000 hectares in size. However, surface infrastructure will directly impact approximately one percent of the total Project area, and this area will be quantified during the detailed impact assessment phase.

It is important to recognise that for projects such as the Narrabri Gas Project, not all wells are drilled and operational at once. Within the Project area, exploration, appraisal, and production would all occur to maintain the target gas production rate throughout the Project life. The rehabilitation and decommissioning of individual well sites would be undertaken progressively in accordance with regulatory requirements and industry standards.

**1.5 Street address of the site**

Access to the Project area is via the Newell Highway between Coonabarabran and Narrabri.

**1.6 Lot description**

Lot/Plan Number					
1//1023058	2//757126	37//757104	13//757086	276//815515	554//613281
1//1040807	2//771141	38//43335	14//609017	28//44006	56//757114
1//1049313	2//781866	38//757104	14//757083	28//757104	57//757114
1//1050103	2//790376	39//705390	14//757084	28//757120	58//757114
1//1064422	2//829368	39//757104	14//757120	29//44006	59//757104
1//126331	2//843278	39//843103	141//708354	29//757083	6//757083
1//131115	2//860120	4//1064422	142//708354	29//757104	6//757098
1//217871	20//757083	4//45260	143//708354	29//757120	6//757126
1//232897	20//757084	4//715462	144//708354	3//1064422	60//757104
1//248407	20//757087	4//757084	15//757083	3//1114784	61//804736
1//32500	20//757098	4//757086	15//757084	3//115246	62//791840

1//588635	20//757120	4//757087	15//757086	3//45260	62//804736
1//604751	201//877118	4//757097	15//757098	3//623250	63//804736
1//623250	202//877118	4//757126	15//757120	3//715462	67//44033
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1//653174	21//757083	40//705390	161//802977	3//757097	68//757104
1//653781	21//757086	40//757104	163//1012802	3//757098	69//757104
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1//757084	22//1055453	402//872809	17//757098	3//843278	7//757126
1//757086	22//746781	403//872809	18//757087	30//757104	7//805987
1//757095	22//757084	404//872809	18//757098	31//1034772	70//757104
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1//757126	22//757093	42//856653	1811//840549	31//757083	7001//1068410
1//757128	22//757120	431//1018381	1812//840549	31//757087	7001//1122341
1//771141	23//757087	432//1018381	182//628398	31//757104	7002//1030015
1//781866	24//757086	441//708169	182//814965	32//1034772	7002//1032496
1//790376	24//757087	442//708169	1821//880046	32//757083	7002//1068410
1//837801	24//757098	45//757093	1822//880046	32//757086	7002//1118445
1//843278	241//620138	45//757120	183//814965	32//757087	7003//1032496
1//860120	242//620138	451//1038294	184//814965	32//757104	7003//1068406
10//705417	25//757086	452//1038294	185//814965	32//828711	7003//1117084
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102//852566	251//777153	5//757084	2//1040807	331//1095730	7005//1059043
103//852566	252//777153	5//757086	2//1049313	332//1095730	7005//1068409
104//852566	253//777153	5//757093	2//1050103	34//757087	7005//1118446
11//746733	26//757086	5//757126	2//1064422	34//757104	71//757104
11//757084	26//757098	5//790376	2//1114784	34//791317	8//757084
11//757098	26//757120	5//843278	2//115246	35//757087	8//757087
11//805987	26//863891	51//43308	2//126331	35//757104	8//757097
12//746733	27//757086	51//757114	2//623250	35//757114	8//757098
12//757083	27//757098	52//43308	2//713934	36//757087	8//757126
12//757084	27//757120	52//757114	2//715462	36//757104	8//805987
12//757086	271//815515	53//43308	2//757084	36//757114	9//705417
12//757087	272//815515	53//757114	2//757087	36//828078	9//757083
12//757098	273//815515	54//821267	2//757093	361//603671	9//757084
13//609017	274//815515	55//821267	2//757095	363//845815	9//757087
13//757084	275//815515	551//609651	2//757098	37//43335	

**1.7 Local Government Area and Council contact (if known)**

The Project is located in the Narrabri Local Government Area (LGA). The contact for Narrabri Shire Council is:

Ms Dianne Hood  
General Manager - Narrabri Shire Council  
T: (02) 6799 6866

**1.8 Time frame**

Subject to obtaining all the required regulatory approvals, construction of the Project is expected to commence in early 2016. Mobilisation and construction of the gas processing facility and water treatment facility would occur for two years between approximately 2016 and 2017, with wells progressively drilled from mid-2016 over the life of the development.

<b>1.9 Alternatives to the proposed action</b>		No
	X	Yes, refer to section 2.2
<b>1.10 Alternative time frames etc.</b>	X	No
		Yes, you must also complete Section 2.3. For each alternative, location, time frame, or activity identified, you must also complete details in Sections 1.2-1.9, 2.4-2.7 and 3.3 (where relevant).
<b>1.11 State assessment</b>		No
	X	Yes, refer to Section 2.5
<b>1.12 Component of larger action</b>	X	No
		Yes, you must also complete Section 2.7
<b>1.13 Related actions/proposals</b>		No
	X	Yes This referral relates to a previous referral (EPBC 2013/6918 – 1 October 2013) which pertained to Santos undertaking a natural gas exploration and appraisal program within PEL 238 and PAL 2. The outcome of this referral was <i>not a controlled action if undertaken in a particular manner</i> . It is proposed that gas from the Project will be transported via a new gas transmission pipeline linking the Project Area to the existing Eastern Australia pipeline network. A separate referral will be made for any pipeline that will be developed through an independent commercial structure and/or contractual arrangements.
<b>1.14 Australian Government funding</b>	X	No
		Yes, provide details:
<b>1.15 Great Barrier Reef Marine Park</b>	X	No
		Yes, you must also complete Section 3.1 (h), 3.2 (e)

## 2 Detailed description of the proposed action

### 2.1 Description of the proposed action

The Project includes the undertaking, construction and operation of exploration, appraisal and production activities and infrastructure for the commercial production of gas to be carried out under the proposed petroleum production leases:

- Exploration and appraisal activities including approximately 500 km of seismic surveys, approximately 30 coreholes, approximately ten chip holes and approximately ten sets of four-well pilots .
- Installation and operation of up to 850 individual production wells from a maximum of 425 well sets. A single well may be vertical, vertical with a slight incline, or lateral; the latter may include several horizontal connections sometimes referred to as a multi-lateral. The target production peak rate is approximately 200 terajoules (TJ/day).
- Gas and water gathering systems and in-field compression.
- A central gas processing facility for the compression, dehydration and treatment of the gas to commercial quality.
- Water management, treatment and beneficial reuse facilities that are required after the proposed petroleum production leases are issued.
- Supporting infrastructure such as power generation and distribution, communications, roads and operational management facilities.

The regional location of PEL 238, PPL 3 and PAL 2 is shown in Figure 1 with the Project Area and PPLA 13, PPLA 14, PPLA 15 and PPLA 16 detailed in Figure 2.

General descriptions of construction and operational activities associated with the Project are provided in further detail below.

#### ***Gas field life cycle***

Gas resources are geographically extensive and variable in quality and quantity. This requires widespread project infrastructure which is progressively developed over the life of a project. Gas field development is a co-ordinated program over time that determines the best locations for all project components, including for example, core holes, pilot wells, production wells, gathering lines, transmission pipelines, gas compression and treatment facilities, ground and surface water monitoring, water management facilities and associated infrastructure.

A summary of the life cycle of a gas field is as follows:

- Exploration. This broadly involves undertaking seismic surveys, chip holes, drilling core holes and collecting baseline scientific data.
- Appraisal. The drilling of core holes and pilot wells to gain knowledge of the gas content and composition, to inform gas field design.
- Construction. Building components of the gas field, including drilling wells, field compression, the gas processing facility and the water treatment facility.
- Operation. Extracting water and gas, compressing gas to commercial quality and treatment and beneficial reuse of the water.
- Well decommissioning and rehabilitation. Once wells are no longer economically producing gas, they are plugged and abandoned and the lease pad rehabilitated.
- Gas project decommissioning and rehabilitation. Once the gas field is no longer commercial, equipment is decommissioned, and the site is rehabilitated.

To produce natural gas from coal seams, water must first be extracted from those seams. This release of pressure allows the natural gas to flow to the surface via the well. After the water and gas are extracted at the well, they pass through a separator at the well head. The water then travels

through discrete flowlines to storage and/or treatment facilities. The gas travels through separate flowlines to a processing facility where it is compressed before being sent to market (refer Figure 3). It is important to recognise that for projects such as the Narrabri Gas Project, the entire gas field is not developed at once. Within the Project area, exploration, appraisal, and production would all occur to maintain the target gas production rate throughout the Project life. The rehabilitation and decommissioning of the coal seam gas fields would be undertaken progressively in accordance with regulatory requirements and industry standards.

# Narrabri Gas Project - Regional location

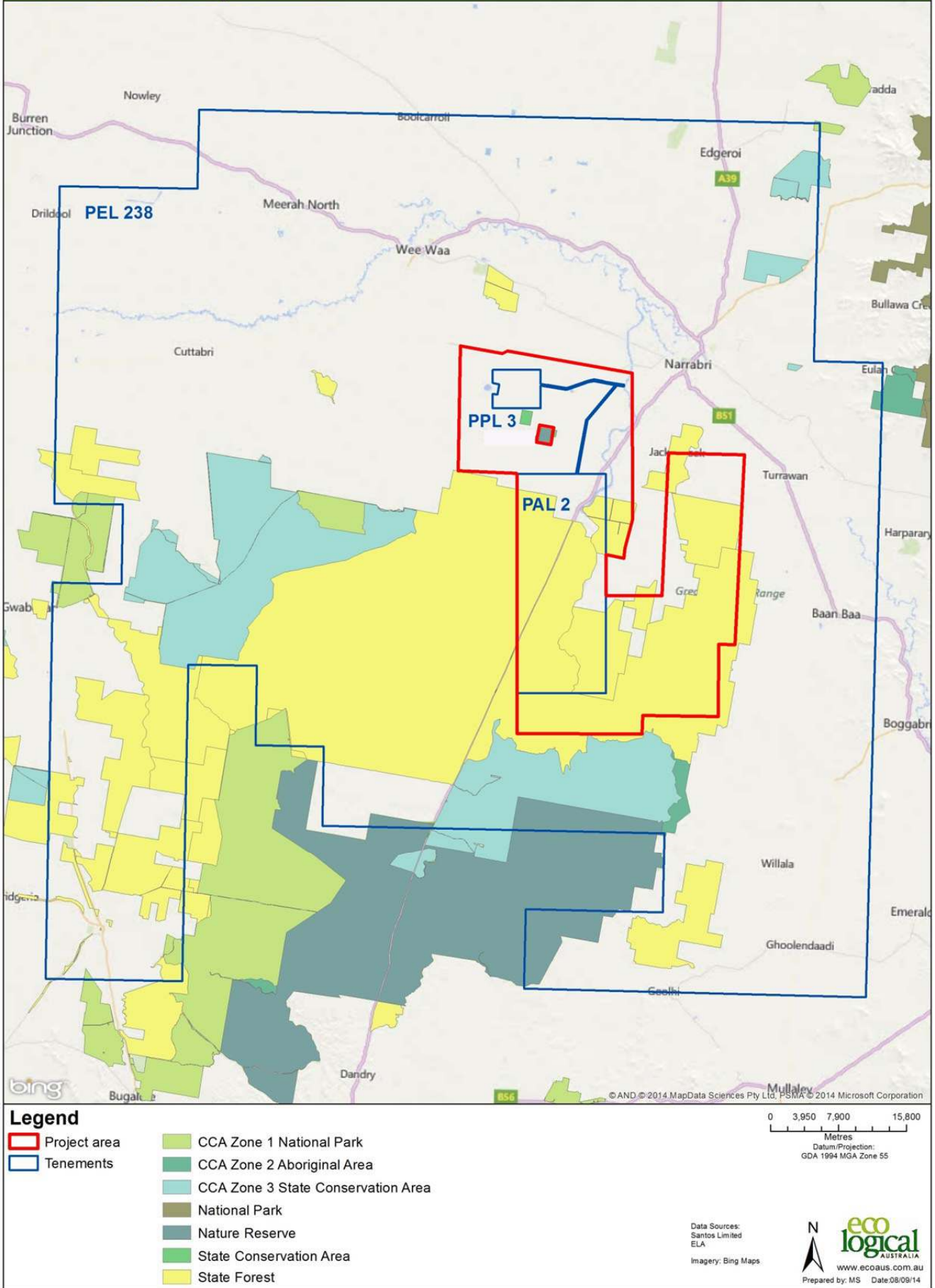
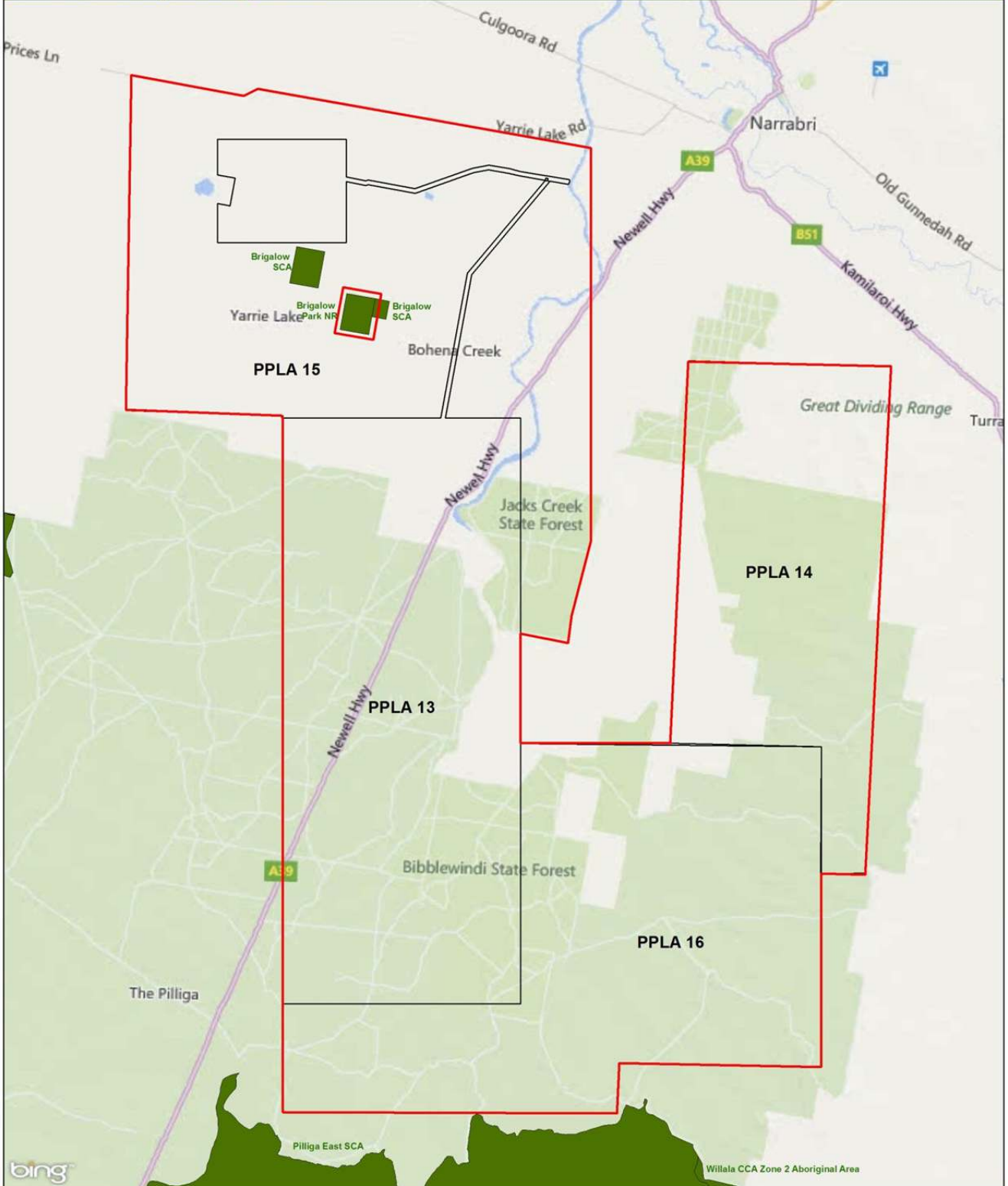


Figure 1: Regional location

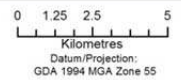


# Narrabri Gas Project – Project Area



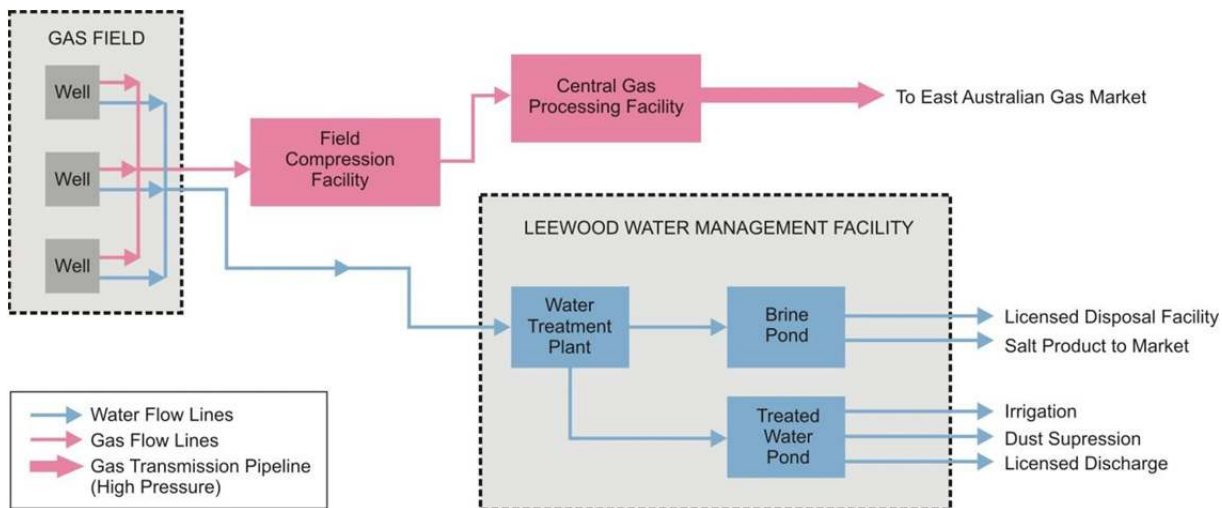
### Legend

- Project area
- Proposed Petroleum Production Lease Area (PPLA)
- NPWS Estate



Imagery: Bing Maps Prepared by: MS Date: 01/09/2014

Figure 2: Project area



**Figure 3: Schematic of water and gas flow during operations**

### ***Exploration and appraisal activities***

Exploration and appraisal activities as part of the Project would continue through the development of the field over time to help continually enhance the understanding of the resource. Exploration and appraisal activities would include seismic surveys, chip holes, core holes and pilot wells, associated temporary supporting infrastructure (flares or water balance tanks) and the installation of monitoring equipment. Permanent water and gas management facilities would be utilised where possible.

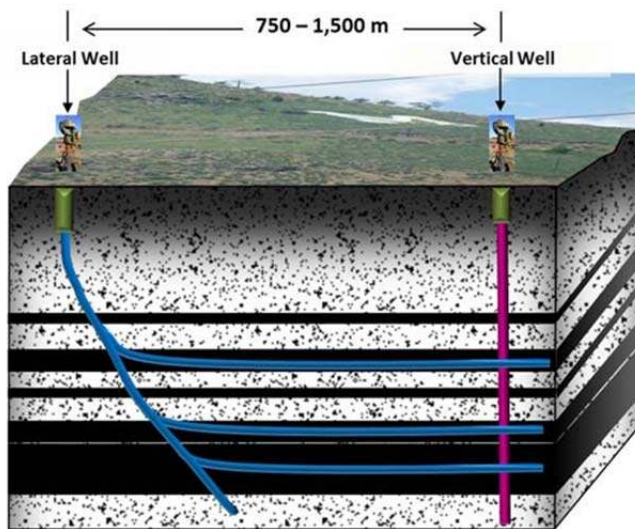
Santos proposes to drill approximately 30 core holes, approximately ten chip holes and approximately ten sets of four-well pilots during the exploration and appraisal process. Approximately 500 kilometres of seismic surveys are also proposed. At completion of exploration and appraisal, all wells will either be:

- Plugged and abandoned and the drill pad rehabilitated.
- Converted to monitoring bores.
- Converted to production wells and counted within the total maximum number of production wells proposed.

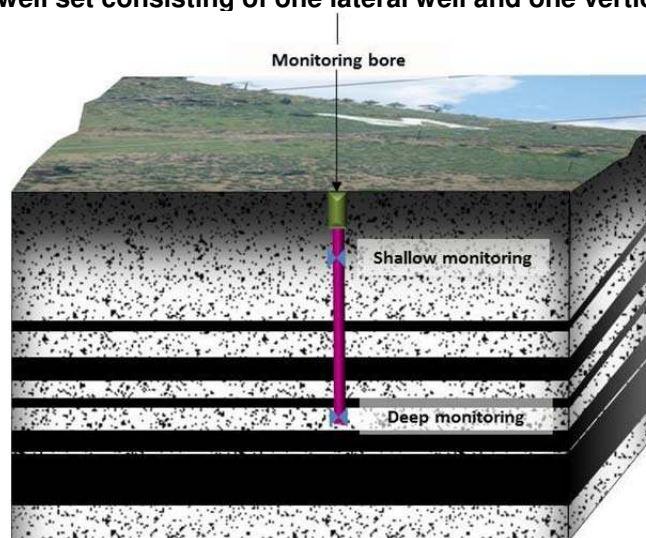
### ***Production wells***

It is anticipated that up to 850 individual production wells partnered to a maximum of 425 well sets would be progressively advanced and decommissioned within the Project area over the life of the Project. This would include any core holes or pilots drilled as part of the exploration and appraisal program that are converted to production wells as noted above. All drilling activities would be undertaken in accordance with the NSW Code of Practice for Coal Seam Gas Well Integrity (DTIRIS 2012).

A single well may be vertical, vertical with a slight incline, or lateral; the latter may include several horizontal connections sometimes referred to as multi-laterals. Wells would be drilled using a minimum number of well pad locations with wells and monitoring bores co-located on the same pad, where possible in order to reduce environmental footprint (refer to Figure 4 and Figure 5).



**A: A well set consisting of one lateral well and one vertical well**



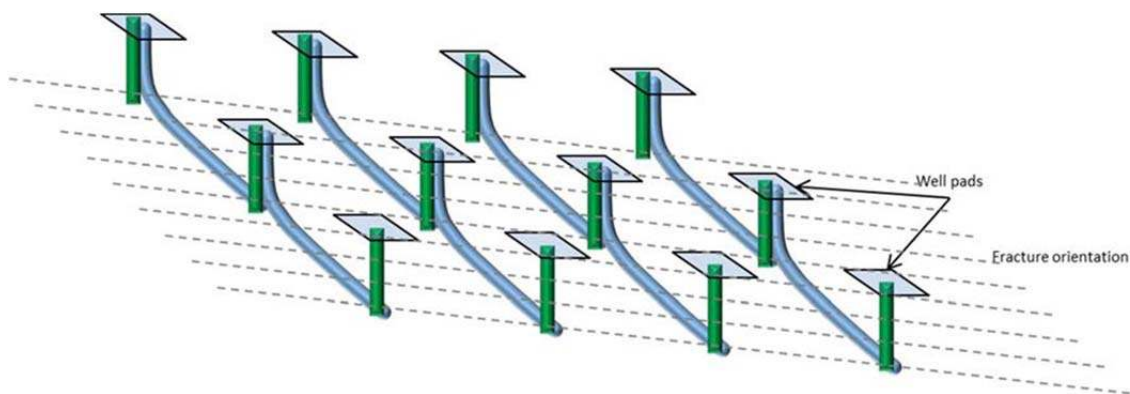
**B: Monitoring bore**

**Figure 4: Types of well and bore configurations. (A): A well set consisting of one lateral well and one vertical well. (B): Monitoring bore.**

The well pads would be spaced approximately 750 to 1,500 metres apart, depending on surface geography and subsurface characteristics. Each well pad would be approximately 100 by 100 metres (one hectare) in size during drilling and construction.

In order to provide a stable working area for the drill rigs during well installation, vegetation would be either trimmed or cleared and either industrial matting laid, or topsoil scraped and stockpiled for use during site rehabilitation. Following well installation, rehabilitation of the pad commences, with remaining surface facilities to include the well head, metering skids, power generation and remote sensor telemetry unit. If remote communication to the well site is lost, the operator is sent a “Loss of Communications Alarm”. The operator would then travel to the well site to monitor. In the event of a well process failure, the standalone mechanical and electrical process protection devices would shut down the well.

Access to the well pads would be via existing roads and access tracks, wherever possible. Where it is not possible to utilise existing roads and access tracks, new tracks would be constructed. A right of way approximately 12 metres wide would be required for the construction of the new access tracks. The right of way would be restored and reduced to approximately 7 metres during operation; slightly wider on bends as required.



**Figure 5: Indicative shared lease pad well configuration (well sets)**

The specific location of each well would depend on local operational (e.g. geology/gas accessibility) and environmental factors. It is proposed that the specific location of each well pad within the Project area would be determined in accordance with a field development protocol which would set out the detailed environmental criteria for selecting the specific location of the well pad within the Project area. The environmental criteria would include for example, proximity to watercourses and significant ecology, upper impact limits for ecology and vegetation clearing, cultural heritage considerations, land access, and amenity. It is proposed that field clearance surveys for well micro-siting in accordance with the field development protocol would be undertaken before construction. The development of the Project in accordance with the field development protocol and micro-siting procedure will be detailed and assessed in the detailed impact assessment.

### ***Monitoring Bores***

Groundwater monitoring bores to characterise baseline groundwater conditions are in the process of being installed and commissioned as part of the current exploration and appraisal activities under PEL 238 and PAL 2. The installation and commissioning of these groundwater monitoring bores is excluded from this referral. Further water bores will be drilled after the production leases are issued, and these are a part of the proposed action. The entire water bore network will be monitored as part of the Project. The groundwater monitoring network will comprise shallow depth monitoring bores completed in the Great Artesian Basin (GAB) Surat Pilliga Sandstone and overlying sediments whilst deeper monitoring bores will target groundwater conditions in the underlying Permo-Triassic Gunnedah Basin strata. The network will be designed and instrumented to yield continuous data on groundwater pressures and water quality across the monitoring domain which encompasses the Project area.

### ***Gas and water gathering systems***

The gas and water gathering systems (comprised of a network of separate, low pressure, underground pipelines) would link each well head to the in-field compression, gas processing facility, and the water management, treatment and beneficial reuse facilities, respectively (refer to Figure 4 and Figure 6).

Where possible, the gas and water gathering systems would be co-located proximal to, and parallel with, existing access roads, tracks or other existing linear features such as fence lines to minimise the need for any additional clearing. The corridors of any new access tracks constructed would also be used to co-locate the gathering systems to further minimise the need for additional clearing. The right of way width would be consistent with that described above.

Installation of the gas and water gathering systems would be undertaken via plough-in, trenching or directional drilling, depending on selected piping material, subsurface soil conditions and land use. The burial depth of the gathering systems would range from 0.75 to 2 metres depending on land use, specific assessment of crossings (such as creeks/roads/existing or new infrastructure) would be



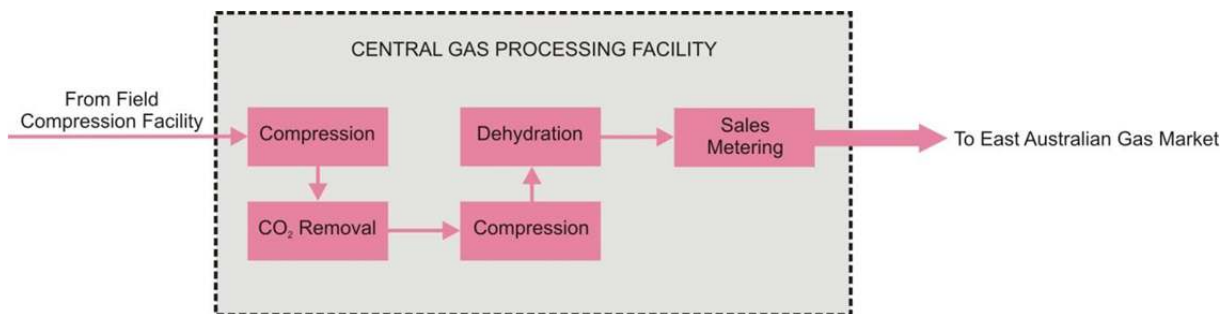
assessed and designed accordingly during detail design. The specific location of the gathering system will be in response to the locations of the wells and would be guided by the field development protocol.

Where required, field compression will be installed to boost the gas to the centralised gas processing facilities. The compression stations will require services such as power, process equipment, communications, instrumentation and control. The field compression will be minimised and optimised during detailed design.

### **Central gas processing facility**

A new central gas processing facility would be constructed and operated at the Leewood property, with some in-field compression potentially also required closer to the central location of the wells depending on gas pressure. In-field compression would comprise of package compressors that boost the gas pressure to enable it to be transported to the central gas processing facility.

At the central gas processing facility the gas will be conditioned to a domestic specification by removal of predominately CO<sub>2</sub>, then treated to remove suspended moisture before odourisation and export compression (refer Figure 6). The central gas processing facility would be constructed predominantly from prefabricated units transported to site, with a footprint size subject to final design.



**Figure 6: Schematic of the central gas processing facility**

Infrastructure installed at the central gas processing facility would include, for example:

- Gas conditioning equipment, as required, to achieve gas quality specification.
- Compressors, compression after coolers and dehydration units.
- Plant overpressure protection systems including pressure safety valves and flares.
- Sales gas metering.
- Power generation equipment.
- Utilities including instrument air, fuel gas systems and power generators.
- Petroleum fuel and lubrication oil tanks.
- Buildings including a control room, switch rooms, equipment shelters, offices, workshop, storerooms and first aid room.

### **Supporting infrastructure**

Supporting infrastructure and services would be required as part of the Project.

#### ***A concrete batching plant***

In order to minimise the transportation of concrete, particularly during the construction of the gas processing facility, a concrete batching plant may be established at the Leewood property.

#### ***Worker accommodation***

Construction camp(s) would be established as required. The accommodation would consist of demountable buildings and include mess facilities, a canteen, an amenities building, laundry, medical/first aid room and a recreation/games/gym room. Communications facilities and storage

areas, vehicle maintenance and parking areas, fuel handling and storage areas, and facilities for the collection, treatment and disposal of wastes would also be provided.

If well sites are located in remote or difficult to access locations, small relocatable accommodation facilities may be established to service the drill rigs.

Approximately 200 workers associated with the ongoing operations of the Project would primarily reside in Narrabri.

### *Electricity*

Construction activities would use temporary power generators to supply sites and facilities prior to the connection of a permanent supply. Power at the proposed worker accommodation would be generated by diesel generators. During operation, power will be required at each well head, at in-field compression stations and at Leewood for the central gas processing facility and water treatment.

Electricity to power the operational requirements of the Project would likely be provided primarily via a combination of the Wilga Park Power Station, with additional electricity provided from a connection to the existing NSW electricity transmission network, or the utilisation of gas fired turbines located in the Project area. The electricity supply for the Project may be one of the options outlined above, or more likely a combination of some or all of the three.

Any required upgrade to the NSW electricity transmission network and associated infrastructure located outside of the Project area would be subject to a separate approval process.

### **Water management, treatment and beneficial reuse facilities**

Additional facilities are required at the Leewood property in order to treat the produced water (i.e. to remove salt). The construction and operation of a pilot water treatment facility to treat water from Santos' exploration and appraisal activities as part of PEL 238 and PAL 2 will be the subject of a separate approval process. An application is currently under preparation for these works.

The water treatment facility on the Leewood property (which will be the subject of a separate approval) will be upgraded as part of the proposed development to cater for the volumes of water the proposed development would generate.

Subject to detailed engineering design, specific upgrades or additional water management requirements activities required by the proposed development may include:

- An upgrade of the water treatment facility to store and treat the produced water.
- The treatment of increased brine volumes at the Leewood property to produce solid salt products.
- The upgrade of the water treatment plant layout, tanks and pipes to accommodate increased produced water, brine and permeate.
- The management of water treatment by-products. This would include:
  - Permeate management. The beneficial re-use of permeate for dust suppression, during construction activities, for firefighting purposes, for agricultural irrigation activities, and/or discharge to local waterways.
  - Salt management. The commercial re-use of salt after brine treatment, or, the disposal of salt at an appropriately licensed landfill and/or recycling facility.

### *Sewerage*

Onsite sewage management (e.g. septic) is proposed to cater for the worker accommodation and the central gas processing facility. Untreated sewage from the accommodation would be transported from site to local approved treatment facilities. In cases where local facilities cannot accommodate these wastes, sewage would be treated onsite using transportable sewage treatment unit(s).

### *Telecommunications*

Telecommunications services would include voice and data network services and telemetry services. Existing carrier services would be used, where available. Alternative methods would be used where existing services are insufficient and may include:

- A fibre network extended from existing facilities and installed parallel with the water and gas gathering systems.
- Communications equipment accommodated in operational or administration buildings.
- Satellite communications used in remote locations.
- VHF radio network.

Telemetry services would be provided to facilitate the operation and monitoring of field production. Strategically located radio towers would be used for both data telemetry and voice radio services. These services would be connected to the data networks at operation or administration facilities.

### ***Project decommissioning and rehabilitation***

A detailed decommissioning and rehabilitation strategy would be developed for the Project. The objectives of the decommissioning and rehabilitation strategy would include:

- Returning disturbed areas to a stable condition similar to that of the surrounding area within an acceptable time frame consistent with stakeholder requirements and expectations.
- Enabling the effective transfer of operating areas to landholders compatible with agreed post-closure land use.
- Minimising disturbance to drainage patterns and avoiding contamination of soil, surface waters and shallow groundwater resources.
- Minimising disturbance to native vegetation and fauna.
- Ensuring each rehabilitated area is capable of supporting sustainable ecosystems.

The overriding rehabilitation strategy is the promotion of natural vegetation regrowth through appropriate topsoil stripping, storage and replacement. Only when the native vegetation fails to regenerate to meet approved rehabilitation target metrics would intervention be considered.

It is anticipated that decommissioning of surface infrastructure, with subsequent rehabilitation, would be undertaken progressively as the wells become depleted during the Project life cycle.

At the cessation of production, the gathering systems would be isolated at the well head and also where they are connected to both the water treatment and gas processing facilities. The gathering systems would then be made safe, isolated, drained, vented and capped in accordance with the Australian Pipeline Industry Association (APIA) Code of Environmental Practice for Onshore Pipelines, 2013. All above ground components of the gathering system would be removed, including all pipeline marker signs.

Rehabilitation of the gathering system corridor would occur after its installation and in accordance with the rehabilitation strategy. After the well sets are decommissioned, the subsurface components of the gathering system would remain in situ as described above, and vegetation maintenance within the gathering system corridor would cease.

Final site rehabilitation for disturbed areas may vary from area to area depending on the nature of the development in that area and input from the local landholder, Traditional Owners and other relevant stakeholders. Any existing infrastructure that is useful to the landholder may remain once agreement is made, and remaining disturbed areas revegetated in accordance with agreed future land use.

### ***Activities not included in the Referral***

This referral relates to the activities required for the commercial production of gas proposed to be undertaken under the petroleum production leases, if granted, in respect of PPLA 13, PPLA 14, PPLA15 and PPLA16.

The proponent is currently undertaking, and proposes to continue carrying out, exploration and appraisal activities pursuant to PEL 238 and PAL2, including within the Project Area, until the petroleum production lease applications are determined.

- This referral does not include the ongoing exploration and appraisal activities undertaken pursuant to PEL 238 and PAL 2 for example, the exploration and appraisal program the subject of EPBC Referral 2013/6918 including the operation of pilot wells;
- further exploration and appraisal activity undertaken prior to the petroleum production leases being granted;
- the construction and use of the water management facilities, including but not limited to the Leewood property, for exploration and appraisal purposes;
- the management and use of produced water from the exploration and appraisal activities;
- the installation and use of groundwater monitoring bores;

If the petroleum production lease applications are granted, then the proponent may use the above infrastructure for gas production purposes and the use of such infrastructure for gas production pursuant to the petroleum production leases, if granted, is included in this referral.

This referral does not include the construction and use of the Wilga Park Power Station for gas produced under PEL 238 and PAL 2.

### **2.2 Alternatives to taking the proposed action**

Projections to 2030 indicate that the global, National and State consumption of gas will continue to increase (International Energy Agency 2009). In regards to NSW, growth in annual gas consumption is predicted to be approximately 0.8%, with modelling of existing and committed projects shows that there may be a gas supply shortfall from winter 2018 onwards (AEMO 2013).

NSW currently imports approximately 95% of its gas from other States (Queensland, Victoria and South Australia) (NSW Chief Scientist and Engineer 2013). The interstate gas contracts under which NSW is supplied begin to expire in 2014 and will be almost completely expired by the end of 2017, when the existing gas supply from Moomba will be redirected to Queensland liquefied natural gas (LNG) export facilities (NSW Chief Scientist and Engineer, 2013). Under this scenario, both the gas supply pipelines from Victoria (Eastern Gas Pipeline and NSW-Vic Interconnect) will be at maximum capacity.

On constrained gas supply into NSW markets as a result of increased demand from both NSW consumers and Queensland LNG contracts, the AEMO (2013) Gas Statement of Opportunities noted that “there will be flow-on effects for NSW with potential shortfalls of 50 to 100 TJ/day (terajoules per day) over winter peak demand days from 2018”. AEMO (2013) noted that “committed and advanced projects in NSW are not sufficient to completely alleviate these shortfalls without further support from the Moomba to Sydney Pipeline. Opportunities exist to augment transmission capability between Victoria and New South Wales, increase production in the Cooper Basin, undertake moderate development of the Gunnedah Basin, or develop an alternative transmission route between Queensland and New South Wales.”

The anticipation of restricted gas supply to NSW heightens the need for a local gas resource for NSW to provide increased security for the current demand and to meet the projected future demand. The proposed development would provide infrastructure to help facilitate overcoming these predicted challenges and thereby meet projected demand for the eastern states over the next decades. The



Project would have the capacity to produce approximately 70 PJ per year, which is equivalent to approximately 50% of NSW's gas consumption (using the NSW Chief Scientist and Engineer's (2013) data).

The do nothing option would result in the absence of potentially 50% of NSW gas requirements being available for supply to the NSW gas market. Should the Project not proceed, there is a risk that there would be a shortfall in gas supply resulting from the expiration of interstate gas supply contracts with no other alternative currently secured (Wood et.al. 2013).

The do nothing option would result in the following benefits being forgone:

- Increased gas supply security to meet current and projected future demand.
- Creation of approximately 1,200 jobs during the construction phase and 200 jobs during the operational phase.
- An alternative to coal reserves as a means of energy production and potential for lower carbon emissions from power generation (compared to coal-fired power generation), consistent with the Commonwealth Government's commitments under the Kyoto Protocol.
- Contribution to the State's economy through royalties paid, jobs created and infrastructure investment.
- Improved competition on price, also having flow on benefits for NSW's economic efficiency, productivity and prosperity.
- Contributions to the regional community benefit fund.

Without a feasible alternative to current gas supply, industries reliant on gas may be impacted by rising gas prices as supply contracts expire and are re-negotiated (Wood et.al. 2013).

### **2.3 Alternative locations, time frames or activities that form part of the referred action**

During design development, alternative locations and alternative infrastructure were considered, however, the location of the Project has been selected as:

- It is greater than 2 kilometres from residential zones or identified future residential growth and does not impact on any critical industry clusters (CICs) as defined in the *NSW State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007* (the Mining SEPP).
- It avoids conservation areas such as the Pilliga National Park, the Pilliga State Conservation Area, the Pilliga Nature Reserve and the Brigalow Park Nature Reserve.
- It is consistent with NSW government policy and targets an area that has been identified within the NSW Strategic Regional Land Use Plans and the *Brigalow and Nandewar Community Conservation Area Act 2005* as suitable for development of natural gas from coal seams.
- Exploration and appraisal has taken place to enable an estimation of the recoverable gas resources available in the area to underpin a gas development. The same level of exploration and appraisal has not been undertaken by Santos in other PELs and hence there is not the same level of confidence in the recoverable resources in those areas. As a result, the time required to produce gas from those areas would be substantially longer, thereby delaying further supply to the NSW market.

Further, a range of alternative infrastructure options were considered prior to selecting the current configuration, including for example:

- Alternate well pad sizes.
- Alternate water processing configurations; decentralised rather than centralised.
- An alternate location for the centralised gas processing facility.
- Alternate gas field development logic.

## **2.4 Context, planning framework and state/local government requirements**

The Project will be undertaken in accordance with the requirements of relevant environmental and planning legislation. All associated environmental and planning approvals will be obtained, including but not limited to:

- Commonwealth environmental approval.
- State Government planning approvals.
- Operational approvals (such as an Environment Protection Licence).
- Other approvals required under relevant environmental and planning legislation and regulations.

A list of legislation, policies and guidelines applying to the Project includes:

### Commonwealth Legislation

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- *National Greenhouse and Energy Reporting Act 2007*.
- *Native Title Act 1993*.
- *Water Act 2007*.

### NSW State Legislation

- *Environmental Planning and Assessment Act 1979*.
- *Petroleum (Onshore) Act 1991*.
- *Water Management Act 2000*.
- *Water Act 1912*.
- *Protection of the Environment Operations Act 1997*.
- *Forestry Act 2012*.
- *Native Vegetation Act 2003*.
- *Threatened Species Conservation Act 1995*.
- *Roads Act 1993*.
- *National Parks and Wildlife Act 1974*.
- *Rural Fires Act 1997*.
- *Catchment Management Act 1989*.
- *Noxious Weeds Act 1993*.

### NSW State Environmental Planning Policies (SEPPs)

- State Environmental Planning Policy No 44 – Koala Habitat Protection.
- State Environmental Planning Policy (State and Regional Development) 2011.
- State Environmental Planning Policy – Mining, Petroleum Production and Extractive Industries, 2007.

### Other relevant policies and plans

- NSW Aquifer Interference Policy 2012.
- NSW Biodiversity Strategy 1999.
- Narrabri Local Environmental Plan 2012.
- Strategic Regional Land Use Plan: New England North West 2012.

## **2.5 Environmental impact assessments under Commonwealth, state or territory legislation**

The Project has the potential to have significant impacts on Matter of National Environmental Significance (MNES), and is therefore being referred to the Commonwealth Department of the Environment under the EPBC Act (i.e. this referral). Santos believes that the Project is a controlled action and will require additional assessment prior to approval.

### *State assessment*

The NSW EP&A Act provides the statutory basis and framework for planning and environmental assessment in NSW. The EP&A Act includes provisions to ensure that the potential environmental impacts of a development are assessed and considered in the decision-making process.

The Project is permissible with development consent under the *State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007*, and is identified as 'State significant development' under section 89C(2) of the EP&A Act and the *State Environmental Planning Policy (State and Regional Development) 2011*.

The Project is subject to the assessment and approval provisions of Division 4.1 of the EP&A Act. The Minister for Planning and Infrastructure is the consent authority, who is able to delegate the consent authority function to the Planning Assessment Commission, the Director General or to any other public authority.

Section 79C of the EP&A Act applies to State significant development applications and requires the consent authority to take into consideration a broad range of matters. The matters identified in Section 79C of the EP&A Act would be considered in preparation of a detailed impact assessment for the Project.

Under Division 4.1 of Part 4 of the EP&A Act, the planning and approval process involves the following key steps:

- Submission of a request to the Director-General of the Department of Planning and Infrastructure, including accompanying supporting documentation seeking the Director General's Requirements for the content of an Environmental Impact Statement (EIS).
- Preparation of an EIS, addressing the matters outlined in the Director General's Requirements.
- Submission of a development application, accompanied by the EIS.
- Public exhibition of the EIS for a minimum of 30 days.
- Assessment of the application by the Department of Planning and Infrastructure and preparation of the Director-General's environmental assessment report.
- Determination by the Minister for Planning or delegate, including conditions of approval if development consent for the Project is granted.

A preliminary environmental assessment (PEA) was completed to inform Santos' request for Director-General's Requirements for use in the preparation of an EIS for the Project (GHD 2014). Secretary's Environmental Assessment Requirements were issued for the Narrabri Gas Project on 25 July 2014.

## **2.6 Public consultation (including with Indigenous stakeholders)**

### *Consultation objectives*

Santos has initiated a comprehensive consultation program with the community, government agencies and other potentially affected stakeholders. This program is being undertaken to assist with identifying relevant environmental issues and social impacts, as well as enabling a process to address concerns regarding the Project.

The objectives of the consultation process are to:

- Increase overall awareness and understanding of the coal seam gas industry and in particular the proposed activity.
- Identify and keep informed landholders, neighbours, residents, and relevant local and state government agencies.
- Build and maintain effective relationships with stakeholders and communities based on open communication, trust and understanding of the Project.

- Ensure the interests of stakeholders are considered in the proposed activity design and implementation.
- Provide timely, accurate and credible information to stakeholders and the broader community.
- Identify potential issues and/or risks and strategies for mitigation and resolution.

#### *Approach to consultation*

A stakeholder engagement plan has been initiated and stakeholder groups identified. These stakeholder groups have been categorised according to their level of interest in the Project and their potential level of impact on planning, implementation and outcomes of the Project.

Engagement regarding the Project is occurring with all relevant stakeholders to ensure that potential impacts are identified and, where possible, avoided or minimised. To achieve this, communication is being undertaken in an open, transparent manner.

This consultation program will be ongoing throughout the development of the EIS and would continue during construction and operation of the Project. The consultation process is dynamic and the role and importance of stakeholders is likely to vary during the assessment process as new stakeholders emerge as the process progresses. Stakeholders for the Project include:

- Local, State and Commonwealth government authorities.
- Industry stakeholders.
- Property owners and neighbours.
- Aboriginal community and Local Aboriginal Land Councils.
- Registered Native Title Applicants.
- Elected representatives (federal, state and local).
- Interest groups, such as community, environment and business groups.
- The broader community.
- Media (local and national).

There are four levels of targeted engagement and consultation proposed:

- Inform – aimed at community, business and industry in the broader regional and state-wide context.
- Consult – aimed at community groups, industry, business and residents not directly involved but living and operating within the local area; landholders, government departments; non-government organisations, local industry and business.
- Involve – aimed at key stakeholder groups directly involved. This includes neighbouring landholders; government departments listed as referral agencies; non-government organisations; community groups; local contractors and businesses.
- Collaborate – aimed at individuals and entities that are directly impacted by the Project and/or involved in project decisions. This includes landholders; government departments responsible for assessments and approvals; local government; native title claimant groups; and community consultative committees.

## *Consultation to date*

### Eastern Star Gas

A number of consultation activities were undertaken in 2010-2011 in response to the Director-General's Requirements for an earlier gas production project proposed for part of the Project area by Eastern Star Gas. Consultation activities undertaken as part of the Eastern Star Gas environmental assessment process included:

- A Planning Focus Meeting held in October 2010.
- Meetings with relevant government authorities.
- Consultation with industry stakeholders.
- Consultation, meetings and field visits with representatives of the Aboriginal community and Local Aboriginal Land Councils.
- Communication with specialist interest groups including community and business groups.
- Site visits and meetings with potentially directly affected property owners.
- Engagement and consultation activities with the broader community, including establishment of a Community Working Group, holding Community Information Sessions, publication of Community Information Sheets and advertising in local media.

The main issues raised by government agencies included: hazard and risk, ecology, rehabilitation, water, waste, heritage, soils, air quality, noise, land use, landscape, traffic, and greenhouse gas emissions.

### Santos

Consultation undertaken to date by Santos, in relation to this Project includes:

- Meetings with relevant State and Commonwealth government authorities.
- Information provided to an independently chaired Community Consultative Committee that meets monthly in Narrabri.
- Regular Government Information forums and meetings with local government staff and elected representatives.
- Technical briefings and site tours with the Gomerai Native Title Applicants, follow up meetings and ongoing liaison.
- Information forums, on-site meetings and site tours with neighbouring landholders, Aboriginal representative groups, farmers and rural industry representatives and local business and contractors.
- Provisions of information through Santos' website and media announcements, shopfronts in Narrabri and Gunnedah, information stands at local agricultural shows and community events.

### *Proposed consultation*

The planned community and stakeholder consultation throughout development of the EIS is described in the summary table below.

<b>STAKEHOLDER</b>	<b>FORMAT/ENGAGEMENT TOOLS</b>
Government	Briefing to Councillors and Officers prior to lodgement of the EIS. Ongoing regular updates to Council. Letters to State and Federal members to provide project updates on the status of the planning approval process. Offer a briefing if required. Notification of EIS exhibition process.
Regulators	Invitation to attend government forums for local and regional staff. Additional one-on-one meetings as required.

STAKEHOLDER	FORMAT/ENGAGEMENT TOOLS
Landholders	<p>Written communication to advise of EIS process.</p> <p>Follow up telephone calls.</p> <p>Opportunity to attend landholder information sessions.</p> <p>Sharing studies and monitoring data.</p> <p>Seek input into EIS development on those areas of interest/concern.</p> <p>Invitation to field tours.</p> <p>Notification in a public newspaper of advice of public exhibition and opportunity to submit comments.</p>
Registered Native Title Applicants	<p>Written communication to advise of EIS process.</p> <p>Follow up telephone calls.</p> <p>Direct and ongoing engagement.</p> <p>Sharing studies and monitoring data.</p> <p>Seek input into EIS development on those areas of interest/concern.</p> <p>Notification in a public newspaper of advice of public exhibition and opportunity to submit comments.</p>
Local Aboriginal communities and Aboriginal Land Council	<p>Direct one-on-one briefings to identify concerns and demonstrate how the EIS is designed to manage/mitigate those issues.</p> <p>Seek input into relevant aspects of EIS development.</p> <p>Sharing studies and monitoring data.</p> <p>Invitation to attend field tours.</p> <p>Advertorials on PEA and EIS summary documents in local media.</p>
Neighbouring landholders	<p>Advertorials on PEA and EIS summary documents in local media.</p> <p>Neighbour landholder meetings as required.</p>
Local community - including schools and all community associations	<p>Community Consultative Committee briefings.</p> <p>Project updates in local papers including fortnightly activities updates.</p> <p>Advertorials on PEA and EIS summary documents in local media.</p> <p>Information forums and community open days.</p> <p>Invitation to attend field tours.</p>
NGOs/ Interest Groups	<p>Direct one-to-one engagements with priority stakeholders to provide opportunity to comment on/input into EIS development.</p> <p>Advertorials on PEA and EIS summary documents in local media.</p> <p>Invitations to attend information forums.</p> <p>Invitation to attend field tours.</p>
Local business/contractor community (existing relationships)	<p>Letters of advice to update on the status of the planning approval process.</p> <p>Advertorials on PEA and EIS summary documents in local media.</p> <p>Invitation to attend information forums.</p> <p>Invitation to attend field tours.</p>
Media	<p>Regular updates in local media to include status of the EIS process.</p>

## 2.7 A staged development or component of a larger project

This is not a staged development for the purposes of this referral. However, as discussed above, the entire gas field will not be developed all at once. Within the Project area, exploration and appraisal, drilling, production, and decommissioning and rehabilitation activities would occur simultaneously in different parts of the Project area to maintain the target gas production rate throughout the Project life.

It is proposed that gas from the Project will be transported to the NSW gas pipeline network via a new gas transmission pipeline linking the Project Area to the existing Eastern Australia pipeline network. A separate referral will be made for any pipeline that will be developed through an independent commercial structure and/or contractual arrangements.

## 3 Description of environment & likely impacts

### 3.1 Matters of national environmental significance

The total Project area is approximately 98,000 hectares in size, however, surface infrastructure would directly impact approximately one percent of the native vegetation in the Project area. The majority of the Project is located within an area known as the 'Pilliga', with the remaining approximately 30% located on agricultural land supporting dry-land cropping and pastoral (livestock) activities. The collective term 'Pilliga' represents an agglomeration of forested area that totals in excess of 500,000 hectares within north-western NSW around Coonabarabran, Baradine and Narrabri. Within the Pilliga, the Project would be developed primarily within State Forest, and also on some privately managed land, but will avoid the following conservation areas, the Pilliga National Park, the Pilliga State Conservation Area, Pilliga Nature Reserve and Brigalow Park Nature Reserve.

A search of the Department of the Environment (DotE) Protected Matters Search Tool (PMST) for the Project utilising the co-ordinates provided in Section 1.2 of this referral (and a 50 km buffer) was undertaken on 17 March 2014. The results are detailed in the relevant sections below.

#### 3.1 (a) World Heritage Properties

##### Description

Not applicable – a search of the DotE PMST has not identified World Heritage Properties in the vicinity of the Project area.

##### Nature and extent of likely impact

N/A

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#### 3.1 (b) National Heritage Places

##### Description

One National Heritage Property is identified approximately 9 kilometres from the Project area, the Narrabri Post Office and former Telegraph Office.

This does not fall within the Project area, and the Project will not impact on the Narrabri Post Office and former Telegraph Office

##### Nature and extent of likely impact

N/A

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#### 3.1 (c) Wetlands of International Importance (declared Ramsar wetlands)

##### Description

Not applicable – a search of the DotE PMST has not identified Wetlands of International Importance in the vicinity of the Project area.

##### Nature and extent of likely impact

N/A



### 3.1 (d) Listed threatened species and ecological communities

#### Description

The Project has the potential to impact on a number of listed species and ecological communities. The DotE PMST identified eight listed Threatened Ecological Communities (TECs) and 31 listed threatened species as having the potential to occur in the Project area.

A full listing of these species is provided below. Note that additional species to those from the PMST are also included below. These species were identified from the Atlas of NSW Wildlife (OEH 2014a), review of relevant literature, vegetation mapping, flora and fauna survey results, and professional judgement.

#### Nature and extent of likely impact

A number of flora and fauna surveys have been carried out within the Project area since 2002, totalling more than 13,000 hours of survey effort. The majority of the approximately 98,000 hectare Project area has been covered by one or more of these surveys over this time. These assessments provide a detailed understanding of the biodiversity values of the Project area including the presence and distribution of MNES.

#### Presence of threatened species and ecological communities

The likelihood of presence or absence of species and ecological communities within the Project area has been assessed. The assessment considered results of field surveys, suitable habitat presence, geographic features of the Project area, searches of the PMST and Atlas of NSW Wildlife and professional judgement by qualified and experienced ecologists. The results are presented in the tables below.

Five terms for the likelihood of occurrence of species and communities are used and are defined as follows:

“Known”	= the species has been observed within the Project area
“Likely”	= a medium to high probability that a species uses the Project area
“Potential”	= suitable habitat for a species occurs within the Project area, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
“Unlikely”	= a very low to low probability that a species uses the Project area
“No”	= habitat within the Project area and in the vicinity is unsuitable for the species

As part of the ongoing detailed impact assessment phase of the Project, ELA mapped all vegetation within the Project area, categorised it by fauna habitat type and then allocated breeding, foraging or other habitat types based on the likely presence or use of the habitat by the species.

#### Nature and extent of likely impact

The Project will impact on threatened species, ecological communities and their potential habitats. The total extent to which impacts will be realised depends on a number of factors, which will be determined during the detailed impact assessment phase. Santos is committed to minimising impacts to MNES as much as practicable during the construction and operation of the Project and where complete avoidance is not possible, management and mitigation measures will be implemented.

The final areas of impact to threatened species, ecological communities and their potential habitats will be informed by a field development protocol. The protocol will be an iterative, constraints based, multicriteria environmental management tool. These will be weighted towards prioritising MNES (including habitat) and other key species for avoidance, and will also consider cultural heritage, land access and amenity. Additionally, field clearance procedures for well micro-siting will be undertaken during construction to ensure that facilities are appropriately located for minimal impact on MNES. The micro-siting procedure and field development protocol will be fully documented in the detailed impact assessment phase.

The total Project area encompasses approximately 98,000 hectares. However, the expected direct impact (i.e. native vegetation clearance) from all surface infrastructure is expected to be approximately one percent of the native vegetation in the Project area. For individual MNES, this figure will be determined during the detailed impact assessment phase. All species and communities have large areas of suitable habitat available within the Project area (detailed below), and only a small portion is likely to be impacted by the Project. Specifically, the loss of habitat will occur in discrete areas across the landscape for the well heads and linear corridors for the gas and water gathering systems which will follow existing tracks where possible. The majority of the clearing associated with well pads and the gas and water gathering systems will be rehabilitated on completion of construction.

### **Management, mitigation and offsetting**

A range of management and mitigation measures will be implemented with the Project. In particular, the following will address impacts to a range of MNES:

- Preparation of a field development protocol which considers threatened species, ecological communities and their potential habitats and prioritising them for avoidance.
- Detailed sensitivity mapping to inform field development planning.
- Micro-siting of well pads.
- Pre-clearing survey to relocate fauna species and habitat features prior to clearing.
- Clearing within approved overall limits for specific ecological features.
- Measures to protect ecological values to be retained, such as exclusion fencing.
- Sediment and erosion controls, signage and site inductions.
- Rehabilitation of disturbed sites, including weed management.
- Minimising surface disturbance with the lateral well design.
- Co-locating gas and water gathering systems with existing roads, access tracks and disturbance corridors, where practicable.
- Construction of the gas and water gathering systems will use a 'plough-in' technique where possible as this reduces the width of the corridor required for construction, minimises disruption to topsoil, and minimises the need for traditional trenching and dewatering of open trenches.
- A weed and pest management plan will be developed and implemented.
- A water management plan will be developed and implemented.
- A bushfire hazard and risk assessment will be developed and implemented.

Following the application of reasonable measures to avoid and mitigate impacts to MNES, any residual significant impacts to the species/communities will be offset in a single consolidated biodiversity offset package developed in accordance with the NSW Biodiversity Offsets Policy for Major Projects.

## Birds

SCIENTIFIC NAME	COMMON NAME	EPBC LISTING STATUS	LIKELIHOOD OF OCCURRENCE	SIGNIFICANT IMPACTS?
<i>Anthochaera phrygia</i>	Regent Honeyeater	Endangered, Migratory	Potential	No
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Endangered	Potential	No
<i>Erythrotriorchis radiatus</i>	Red Goshawk	Vulnerable	Unlikely	No
<i>Geophaps scripta scripta</i>	Squatter Pigeon	Vulnerable	Unlikely	No
<i>Lathamus discolor</i>	Swift Parrot	Endangered, Migratory	Potential	No
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable, Migratory	Unlikely	No
<i>Polytelis swainsonii</i>	Superb Parrot	Vulnerable	Potential	No
<i>Rostratula australis</i>	Australian Painted Snipe	Vulnerable	Potential	No

### ***Anthochaera phrygia* (Regent Honeyeater) – Endangered**

#### *Background – ecology and distribution*

The Regent Honeyeater is listed as endangered and migratory under the EPBC Act. This species mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Birds are also found in drier coastal woodlands and forests in some years. The species is known to make large scale nomadic movements across the landscape, which is thought to coincide with flowering times of different eucalypt species on which they feed (DotE 2014a).

There are three known key breeding regions; one in north-east Victoria (Chiltern-Albury) and two in NSW at Capertee Valley and in the Bundarra-Barraba region. In NSW, the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands, although other known breeding sites, closer to Project area, include the Warrumbungle National Park and Pilliga Nature Reserve (NPWS 1999a).

In 2011, the entire Regent Honeyeater population was estimated to be approximately 350 – 400 individuals; however, given the highly mobile nature of the species accurate estimates are difficult with previous estimates of population size fluctuating between 10 – 2000 (DotE 2014a).

This species is at threat mainly from the loss, fragmentation and degradation of its habitat. The causes for this habitat decline are agricultural clearing, increased dieback and tree decline in agricultural and pastoral areas, grazing by livestock and rabbits, which prevents native vegetation from regenerating, silvicultural practices that promote dense regrowth of immature trees via the removal of large spreading trees from box-ironbark woodlands, and the removal of ironbark trees for fence posts, firewood and timber supplies (DotE, 2014a).

#### *Regent Honeyeater within the Project area*

Regent Honeyeaters have been recorded sporadically in the Pilliga. OEH records have been from four years since 1991 (1991, 1992, 1997 and 2003) (OEH 2013b). The presence of Regent Honeyeaters in the Pilliga may be linked to fluctuations in eucalypt flowering within the region including *Eucalyptus albens* (White Box). Minor and sporadic breeding occurs in Warrumbungle National Park, the Pilliga and Mudgee-Wollar region.

There are no existing records for the species within the Project area and the species has not been identified to date during field surveys. The species has been recorded nearby with two records in the Pilliga Nature Reserve, and one in Pilliga East State Forest. Breeding behaviour has been observed in the Pilliga Nature Reserve; however the important Bundarra-Barraba breeding area is located 150 kilometres to the east.

As part of the ongoing detailed impact assessment phase of the Project, Eco Logical Australia (ELA) mapped all vegetation within the Project area, categorised it by fauna habitat type and then allocated breeding, foraging or other habitat types based on the likely presence or use of the habitat by the species. This analysis indicated that there is approximately 67,291 hectares of potential foraging habitat for the Regent Honeyeater in the Project area.

The Project area contains habitat that the species may utilise on occasion, but is unlikely to rely upon for its survival. Whilst the species has the potential to occur, it does not have an important population or habitat critical to the survival of the species within the Project area.

#### *Potential impacts and mitigation*

The Regent Honeyeater has the potential to be impacted both directly and indirectly by the project. However, it is unlikely that the Project would constitute a significant impact as defined under the EPBC Act.

Vegetation clearance will result in the removal of foraging habitat, the total extent of which will be determined during the detailed impact assessment phase. Vegetation types likely to be impacted by the Project constitute only transient foraging habitat rather than a significant foraging resource for the Regent Honeyeater (i.e. does not contain profusely flowering winter-blooming species). There is no known breeding habitat within the Project area.

Vegetation clearance will also result in habitat fragmentation. However, the Regent Honeyeater is a highly mobile species with a large home range, and the scale of disturbance from the Project is unlikely to cause fragmentation of this species' habitat within the Pilliga region.

Vegetation clearance will result in the removal of key tree species, which may provide foraging resources for the Regent Honeyeater. This, coupled with increased disturbance, may result in the proliferation of aggressive honeyeater species and increase competition for foraging resources. Given the wide extent of available habitat within the Project area, and its' likely use more as a transient rather than core resource, increased competition within the disturbed sections of the Project area is unlikely to have a significant impact on the Regent Honeyeater.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the Regent Honeyeater are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and rehabilitation of temporarily impacted areas following construction.

#### *Summary*

Occurrence records and analysis of available habitat do not indicate there is an important population or habitat critical to the survival of the Regent Honeyeater within the Project area. Whilst the Project may have direct and indirect impacts on the species, these are unlikely to be significant. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

### ***Botaurus poiciloptilus* (Australasian Bittern) – Endangered**

#### *Background – ecology and distribution*

The Australasian Bittern listed as endangered under the EPBC Act. It is a stocky stork-like bird which uses its mottled colouring as camouflage in swampy vegetation. The Australasian Bittern is distributed from south-eastern Queensland through to south-eastern South Australia, Tasmania and Western Australia (DotE, 2014b). In NSW, the species occurs mainly along the coast regions and

throughout the Murray-Darling Basin in flooded wetland vegetation. The species is highly dependent on inundated wetlands and plains where it builds nests in large emergent macrophytes such as *Phragmites australis*, *Baumea* spp., and *Typha* spp. The Australasian Bittern is an active hunter which targets fish, beetles, snakes, frogs as well as leaves and fruit. The species has been known to construct feeding platforms out of reeds in permanent swamps, which are often littered with the remains of prey (OEH, 2014).

The Australasian Bittern is also known to occur in New Zealand and a number of islands in the Pacific including New Caledonia. It is thought that between 25 and 50 per cent of the population (approximately 2500-3000 individuals) of the species resides in Australia (DotE, 2014b).

This species is at threat from loss and degradation of habitat through in-filling or clearance of wetlands and associated vegetation, river regulation, heavy grazing and urbanisation (DotE, 2014b).

#### *Australasian Bittern within the Project area*

The Atlas of NSW Wildlife contains records of the Australasian Bittern within 10 km of the Project area. The species has not been recorded in the Project area, however the Project area contains some limited foraging resources for the species around some farm dams with emergent macrophytes present.

As part of the ongoing detailed impact assessment phase of the Project, ELA mapped all vegetation within the Project area, categorised it by fauna habitat type and then allocated breeding, foraging or other habitat types based on the likely presence or use of the habitat by the species. This analysis indicated there is approximately 100 hectares of potential foraging habitat for the Australasian Bittern in the Project area.

The Project area contains habitat that the species may utilise on occasion. Whilst the species has the potential to occur, it does not have an important population or habitat critical to the survival of the species within the Project area.

#### *Potential impacts and mitigation*

The Australasian Bittern has the potential to be impacted both directly and indirectly by the Project. However, it is unlikely that these would constitute a significant impact as defined under the EPBC Act.

Vegetation clearance will result in the removal of foraging habitat, the total extent of which will be determined during the detailed impact assessment phase. The Project area does not contain considerable areas of permanent water or large macrophyte beds. As such the Project area is considered to contain only minimal transient foraging habitat and not a significant foraging or breeding resource for the Australasian Bittern.

Alterations to the hydrological regime of the Project area also have the potential to impact wetland habitats of the Australia Bittern. A detailed impact assessment of water resources is currently being prepared as part of the detailed impact assessment phase of the Project, and this will determine impacts to hydrological regimes and flow on effects to wetland-dependent species such as the Australasian Bittern. Nevertheless, the Project area contains only minimal transient foraging habitat for this species.

Habitats for this species are located outside of the main body of the Pilliga and are not likely to be fragmented by the Project.

As the species is a wetland dweller it may be at risk from increased predation from pest species which gain new or increased access to the area as a result of the Project. These risks will be managed through a pest management protocol to be developed and implemented by Santos.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the Australasian Bittern are detailed in Section 4. These include the development

and implementation of management plans for surface, groundwater and pest management measures.

### *Summary*

Occurrence records and analysis of available habitat do not indicate there is an important population or habitat critical to the survival of the Australian Bittern within the Project area. Whilst the Project may have direct and indirect impacts to the species, these are unlikely to be significant. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

### ***Lathamus discolor (Swift Parrot) – Endangered***

#### *Background – ecology and distribution*

The Swift Parrot is listed as endangered and migratory under the EPBC Act. It is a wide-ranging, highly mobile species which is endemic to south-eastern Australia (DotE 2014c). Swift Parrots breed in Tasmania during spring and summer (Sept to Jan), then migrate to Victoria, the eastern parts of South Australia and up to south-east Queensland in the autumn and winter months. In NSW this species mostly occurs on the coast and south west slopes. It is known to use habitat within the Namoi Catchment Management Area (OEH 2013b).

On the mainland, birds occur in areas where eucalypts are flowering profusely or where there is abundant lerp (from sap-sucking bugs) infestations (OEH 2013b). Favoured feed trees include winter flowering species such as *Eucalyptus robusta* (Swamp Mahogany), *Corymbia maculata* (Spotted Gum), *C. gummifera* (Red Bloodwood), *E. sideroxylon* (Mugga Ironbark), and *E. albens* (White Box). Commonly used lerp infested trees include *E. microcarpa* (Inland Grey Box), *E. moluccana* (Grey Box) and *E. pilularis* (Blackbutt).

Breeding season survey data suggest that the population is at best stable (DotE 2014c). The most recent estimates of the Swift Parrot suggest that less than 1,000 pairs remain (DPIPWE 2010).

Current threats to the Swift Parrot include clearing and fragmentation of wintering and breeding habitats (i.e. Tasmania) decline of nest site availability, competition from other species and death from collision (Garnett and Crowley 2000).

#### *Swift Parrot within the Project area*

There are no existing records for the Swift Parrot within the Project area and the species has not identified during field surveys. The closest records from the Atlas of NSW Wildlife (2014) are approximately 24 kilometres to the east in Boggabri and 55 kilometres to the south east near Gunnedah.

As part of the ongoing detailed impact assessment phase of the Project, ELA mapped all vegetation within the Project area, categorised it by fauna habitat type and then allocated breeding, foraging or other habitat types based on the likely presence or use of the habitat by the species. This analysis indicated there is approximately 47,236 hectares of potential foraging habitat for the Swift Parrot in the Project area.

The Project area contains foraging habitat that the species may utilise on occasion. Whilst the species has the potential to occur, it does not have an important population or habitat critical to the survival of the species within the Project area.

#### *Potential impacts and mitigation*

The Swift Parrot has the potential to be impacted both directly and indirectly by the Project. However, it is unlikely that these would constitute a significant impact as defined under the EPBC Act.

Vegetation clearance will result in the removal of foraging habitat, the total extent of which will be determined during the detailed impact assessment phase. Vegetation types likely to be impacted by the Project constitute only transient foraging habitat rather than a significant foraging resource for the

Swift Parrot (i.e. does not contain profusely flowering winter-blooming species). This species breeds exclusively in Tasmania.

Vegetation clearance will also result in habitat fragmentation. However, the Swift Parrot is a highly mobile species with a large home range, and the scale of disturbance from the Project is unlikely to cause fragmentation of this species' habitat within the Pilliga region.

Vegetation clearance will result in the removal of key tree species, which provide foraging resources for the Swift Parrot. This, coupled with increased disturbance, may result in the proliferation of aggressive honeyeater species and increase competition for foraging resources. Given the wide extent of available habitat within the Project area, and its' likely use as a transient rather than core resource, increased competition within the disturbed sections of the Project area is unlikely to have a significant impact on the Swift Parrot.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the Swift Parrot are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and rehabilitation of temporarily impacted areas following construction.

#### *Summary*

Occurrence records and analysis of available habitat do not indicate there is an important population or habitat critical to the survival of the Swift Parrot within the Project area. Whilst the Project may have direct and indirect impacts to the species, these are unlikely to be significant. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

#### ***Polytelis swainsonii* (Superb Parrot) – Vulnerable**

##### *Background – ecology and distribution*

The Superb Parrot is listed as vulnerable under the EPBC Act. This species is found throughout eastern inland NSW and northern Victoria, with occasional vagrants recorded in southern Queensland (DotE 2013e). In the South Western Slopes of NSW their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The other main breeding sites in NSW and Victoria are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round.

The species inhabits Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian *Eucalyptus camaldulensis* (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 *E. blakelyi* (Blakely's Red Gum), *E. melliodora* (Yellow Box), *E. bridgesiana* (Apple Box) and *E. polyanthemos* (Red Box). During the breeding season, individuals may forage up to 10 kilometres from nesting sites, primarily in grassy box woodland. The species feed in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants. Also eaten are fruits, berries, nectar, buds, flowers, insects and grain (OEH 2013b).

This species is most at threat from habitat clearing and degradation (DotE 2013e). Additional threats include grazing by stock reducing the amount of food available to Superb Parrots, the exploitation of water in watercourses throughout the range of the species directly affecting the health of both the breeding and foraging habitats, competition for nest sites, poisoning from insecticides, and other threats including trapping, vehicle strike, and beak and feather disease. The main biological characteristic of the Superb Parrot which threatens its survival is its special requirement for specific breeding habitat (River Red Gum forests) and specific foraging habitat (box woodland) to be located no more than 10 km from each other.

### *Superb Parrot within the Project area*

There are no existing records for the species within the Project area and the species has not been identified during field surveys. The closest records from the Atlas of NSW Wildlife are approximately 20 kilometres to the north of the Project area and east of Narrabri.

As part of the ongoing detailed impact assessment phase of the Project, ELA mapped all vegetation within the Project area, categorised it by fauna habitat type and then allocated breeding, foraging or other habitat types based on the likely presence or use of the habitat by the species. This analysis indicated there is approximately 35,647 hectares of potential foraging habitat for the Superb Parrot in the Project area.

The Project area contains habitat that the species may utilise on occasion. Whilst the species has the potential to occur, it does not have an important population or habitat critical to the survival of the species within the Project area.

### *Potential impacts and mitigation*

The Superb Parrot has the potential to be impacted both directly and indirectly by the Project. However, it is unlikely that these would constitute a significant impact as defined under the EPBC Act.

Vegetation clearance will result in the removal of foraging habitat, the total extent of which will be determined during the detailed impact assessment phase. The species has access to a wide range of foraging resources across the Project area of which only a very small proportion will be affected by the Project. There is no known breeding habitat within the Project area.

Vegetation clearance will also result in habitat fragmentation. However, the Superb Parrot is a highly mobile species with a large home range, and the scale of disturbance from the Project is unlikely to cause fragmentation of this species' habitat within the Pilliga region.

Vegetation clearance will result in the removal of key tree species, which provide potential foraging resources for the Superb Parrot. This, coupled with increased disturbance, may result in the proliferation of aggressive honeyeater species and increase competition for foraging resources. Given the wide extent of available habitat and foraging resources within the Project area, increased competition within the disturbed sections of the Project area is unlikely to have a significant impact on the Superb Parrot.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the Superb Parrot are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and rehabilitation of temporarily impacted areas following construction.

### *Summary*

Occurrence records and analysis of available habitat do not indicate there is an important population or habitat critical to the survival of the Superb Parrot within the Project area. Whilst the Project may have direct and indirect impacts to the species, these are unlikely to be significant. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

## ***Rostratula australis (Australian Painted Snipe) – Endangered***

### *Background – ecology and distribution*

The Australian Painted Snipe is listed as endangered under the EPBC Act. It is a stocky wading bird around 220-250 mm in length with a long pinkish bill. This species is generally seen singly or in pairs, or less often in small flocks (DotE 2014n). Flocking occurs during the breeding season, when adults sometimes form loose gatherings around a group of nests. Flocks can also form after the breeding season, and at some locations small groups regularly occur. Groups comprising of a male and up to six offspring have been observed.



The species generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans (DotE 2014n). They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of *Muehlenbeckia* sp. (Lignum) or canegrass or sometimes *Melaleuca* spp. (Tea-tree). The Australian Painted Snipe sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber (Marchant & Higgins 1993).

The Australian Painted Snipe has been recorded in all states of Australia. It is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, NSW, Victoria and south-eastern South Australia. It has been recorded less frequently at a smaller number of more scattered locations farther west in South Australia, the Northern Territory and Western Australia (DotE 2014n).

The total population size of the Australian Painted Snipe is effectively unknown, but tentative estimates range from a few hundred individuals to 5000 breeding adults (DotE 2014n). The reporting rate of the Australian Painted Snipe in eastern Australia has decreased by more than 90% since the 1950s, despite an increase in the number of observers and surveys, and awareness among observers that records of the snipe should be reported.

The primary factor in the decline of the Australian Painted Snipe has probably been a loss and alteration of wetland habitat. Predation by feral animals (cats and foxes) is also a potential threat.

#### *Australian Painted Snipe within the Project area*

There are no existing records for the species within the Project area and the species has not been identified during field surveys. The Atlas of NSW Wildlife contains two records of the Australian Painted Snipe, from 1992 and 2007, within 10 km of the Project area.

As part of the ongoing detailed impact assessment phase of the Project, ELA mapped all vegetation within the Project area, categorised it by fauna habitat type and then allocated breeding, foraging or other habitat types based on the likely presence or use of the habitat by the species. This analysis indicated there is approximately 100 hectares of potential breeding and foraging habitat for the Australian Painted Snipe throughout the Project area:

The Project area contains habitat that the species may utilise on occasion. Whilst the species has the potential to occur, it does not have an important population or habitat critical to the survival of the species within the Project area.

#### *Potential impacts and mitigation*

The Australian Painted Snipe has the potential to be impacted both directly and indirectly by the Project. However, it is unlikely that these would constitute a significant impact as defined under the EPBC Act.

Vegetation clearance will result in the removal of foraging and breeding habitat, the total extent of which will be determined during the detailed impact assessment phase. The Project area does not contain considerable areas of permanent water or wetlands. As such the Project area is considered to contain only minimal transient foraging habitat and is unlikely to provide a significant foraging or breeding resource for the Australian Painted Snipe.

Alterations to the hydrological regime of the Project area also have the potential to impact wetland habitats of the Australian Painted Snipe. A detailed impact assessment of water resources is currently being prepared as part of the detailed impact assessment phase of the Project, and this will determine impacts to hydrological regimes and flow on effects to wetland-dependent species such as the Australian Painted Snipe. Nevertheless, the Project area contains only minimal areas of foraging and breeding habitat for this species.

As the species is a wetland dweller it may be at risk from increased predation from pest species which gain new or increased access to the area as a result of the Project. These risks will be managed through a pest management protocol to be developed and implemented by Santos.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the Australian Painted Snipe are detailed in Section 4. These include the development and implementation of management plans for surface- groundwater and pest management measures.

### Summary

Occurrence records and analysis of available habitat do not indicate there is an important population or habitat critical to the survival of the Australian Painted Snipe within the Project area. Whilst the Project may have direct and indirect impacts to the species, these are unlikely to be significant. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

### Mammals

SCIENTIFIC NAME	COMMON NAME	EPBC STATUS	LISTING	LIKELIHOOD OF OCCURRENCE	SIGNIFICANT IMPACT LIKELY?
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	Endangered		Potential	Potential
<i>Nyctophilus corbeni</i> (formerly <i>N. timoriensis</i> )	South-eastern/Greater Long-eared Bat	Vulnerable		Known	Potential
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Vulnerable		Potential	No
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	Vulnerable		Unlikely	No
<i>Phascolarctos cinereus</i>	Koala	Vulnerable		Likely	Potential
<i>Pseudomys pilligaensis</i>	Pilliga Mouse	Vulnerable		Known	Potential
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Vulnerable		Unlikely	No

### ***Dasyurus maculatus maculatus* [south-eastern mainland population] (Spotted-tailed Quoll) – Endangered**

#### *Background – ecology and distribution*

The Spotted-tailed or Tiger Quoll (south-eastern mainland population) is listed as endangered under the EPBC Act. It occupies a range of environments within a disjunct distribution along the east coast of Australia, extending from south-eastern Queensland through NSW and Victoria to Tasmania. The species is found in a variety of habitats, including sclerophyll forest and woodlands, coastal heathlands and rainforests. Occasional sightings are made in open country, grazing lands, rocky outcrops and other treeless areas (DotE 2013f).

The Spotted-tailed Quoll is essentially terrestrial, but is also an agile climber (OEH 2014b). Nesting occurs in rock shelters, hollow logs, caves or tree hollows and they use numerous dens within the home range. Estimates of home ranges vary from 800 hectares to 20 square kilometres and

individuals may move several kilometres in a night (NPWS 1999b). One individual was tracked travelling eight kilometres in one night (Belcher et al. 2008). This species feeds on a wide variety of birds, reptiles, mammals and invertebrates and uses several 'latrines' within its territory for defecation (OEH 2014b).

The total population size of the Spotted-tailed Quoll is considered low. Expert estimates of the total population size vary, though it is likely that the total number of mature adults is greater than 2,000 and less than 10,000 (DotE 2013f).

Current threats to the Spotted-tailed Quoll include habitat loss and degradation, predation from red foxes, dingos, and domestic dogs, fire, direct killing from landholders, vehicle strike, poisoning from cane toads, and 1080 baiting from pest-control programs.

#### *Spotted-tailed Quoll within the Project area*

The Spotted-tailed Quoll occurs more frequently in coastal areas however there are scattered records west of the Project area along the Barwon River. It has been recorded in the Pilliga in the 1990s (Paull and Date 1999).

There are no existing records for the species within the Project area and the species has not been identified during field surveys. The closest records from the Atlas of NSW Wildlife are approximately 25 kilometres to the south east and 45 kilometres to the north east of the Project area.

As part of the ongoing detailed impact assessment phase of the Project, ELA mapped all vegetation within the Project area, categorised it by fauna habitat type and then allocated breeding, foraging or other habitat types based on the likely presence or use of the habitat by the species. This analysis indicated there is approximately 69,631 hectares of potential breeding habitat and an additional 10,988 of potential foraging habitat for the Spotted-tailed Quoll throughout the Project area.

The Project area contains potential habitat for the Spotted-tailed Quoll and the proximity of existing records relative to the large extent of this species' home range, suggests the species has the potential to occur within the Project area. Spotted-tailed Quoll within the Pilliga region may be considered an important population.

#### *Potential impacts and mitigation*

The Spotted-tailed Quoll has the potential to be impacted both directly and indirectly by the Project, and impacts may be significant.

Vegetation clearance will result in the removal of potential foraging and breeding habitat, the total extent of which will be determined during the detailed impact assessment phase.

Vegetation clearance will also result in habitat fragmentation. However, the Spotted-tailed Quoll is a highly mobile species with a large home range, and the scale of disturbance from the Project is unlikely to cause fragmentation of this species' habitat within the Pilliga region. Importantly, this species has been observed in cleared landscapes and is able to cross fragmented areas between vegetation remnants.

The Spotted-tailed Quoll may be directly impacted by increased mortality due to:

- Vehicle strike, as construction and operation increase activity within the Project area.
- Predation from pest species such as dogs, foxes and cats, which may increase in number and gain greater access to the Project area.
- Poisoning by baits (e.g. 1080) used in pest animal management programs.

These impacts will be minimised through appropriate control measures such as considering the potential presence of this species in pest animal management planning. Pest species may also impact the Spotted-tailed Quoll indirectly through competition. This issue will be addressed via the development and implementation of a pest management plan.

Disruption to den sites and breeding habitat may also occur during construction and operations if these features are located near to infrastructure. Micro-siting, preclearance surveys and construction/operation controls will reduce the risk of such impacts.

The Project is unlikely to increase other key threats to the Spotted-tailed Quoll such as direct killing from landholders and poisoning from cane toads.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the Spotted-tailed Quoll are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and rehabilitation of temporarily impacted areas following construction.

#### *Summary*

Occurrence records and analysis of available habitat indicate there is potential foraging and breeding habitat for the Spotted-tailed Quoll within the Project area. The Project is likely to have direct and indirect impacts to the species. These may be significant, and will be further assessed and quantified in the detailed impact assessment. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

### ***Nyctophilus corbeni* (South-eastern Long-eared Bat) – Vulnerable**

#### *Background – ecology and distribution*

The South-eastern Long-eared Bat is listed as vulnerable under the EPBC Act. Overall, this species' distribution coincides approximately with the Murray Darling Basin (DotE 2013g). It is common in the Pilliga region (OEH 2013b). Within these regions, the species inhabits a variety of vegetation types, including mallee, *Allocasuarina luehmannii* (Bull-oak) and box-eucalypt dominated communities. It is 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 (OEH 2013b).

The species roosts in tree hollows, crevices, and under loose bark. It is a slow flying agile bat, using the understorey to hunt non-flying prey, especially caterpillars and beetles, and will even hunt on the ground. Movement patterns are not well known, although roost sites have been recorded as an average of  $1.89 \pm 1.61$  kilometres (range 0.34–7.06 kilometres) from the capture point of bats (Schulz and Lumsden 2010). It appears the species requires large, intact areas of habitat to persist (Turbill et al. 2008).

There is no data on the population size for this species. The South-eastern Long-eared Bat is rare throughout most of its distribution.

Threats to this species include habitat loss and fragmentation, fire, forestry activities removing hollow bearing trees, tree hollow competition, overgrazing, predation by feral species, exposure to agrichemicals, and climate change.

#### *South-eastern Long-eared Bat within the Project area*

The South-eastern Long-eared Bat has its core distribution centred on the Pilliga region and NSW OEH considers the Pilliga region to be a distinct stronghold for this species (OEH 2014b).

This species has been previously recorded in the Project area (Milledge 2012) and as part of the ecological studies for the detailed impact assessment phase of the Project.

As part of the ongoing detailed impact assessment phase of the Project, ELA mapped all vegetation within the Project area, categorised it by fauna habitat type and then allocated breeding, foraging or other habitat types based on the likely presence or use of the habitat by the species. This analysis indicated there is approximately 69,631 hectares of potential breeding and foraging habitat for the South-eastern Long-eared Bat throughout the Project area.

The South-eastern Long-eared Bat is known to occur throughout the Pilliga region, which is considered a stronghold for this species. Therefore the South-eastern Long-eared Bat within the Project area is an important population.

#### *Potential impacts and mitigation*

The South-eastern Long-eared Bat has the potential to be impacted both directly and indirectly by the Project, and impacts may be significant.

Vegetation clearance will result in the removal of potential foraging and breeding habitat, the total extent of which will be determined during the detailed impact assessment phase.

As the species is thought to require large areas of intact habitat to persist, fragmentation due to the Project may also negatively impact the species. This species has been recorded traveling up to three kilometres in a foraging excursion (Churchill 2008), and therefore co-locating infrastructure with existing access roads, tracks or other existing linear features, siting infrastructure within currently disturbed areas (where possible) and rehabilitation of temporarily impacted areas following construction will assist in reducing impacts from fragmentation.

Disruption to foraging and roosting sites and breeding habitat may also occur during construction and operation if these features are located near infrastructure. Noise at dusk and dawn and night-time lighting are specific issues. Micro-siting, preclearance surveys and construction/operation controls will reduce the risk of such impacts.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the South-eastern Long-eared Bat are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and rehabilitation of temporarily impacted areas following construction.

#### *Summary*

The Project area contains an important population of the South-eastern Long-eared Bat. The Project is likely to have direct and indirect impacts to the species. These may be significant, and will be further assessed and quantified in the detailed impact assessment. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

### ***Chalinolobus dwyeri* (Large-eared Pied Bat) – Vulnerable**

#### *Background – ecology and distribution*

The Large-eared Pied Bat is listed as vulnerable under the EPBC Act. It is an insectivorous bat distributed from Shoalwater Bay in Queensland through to Ulladulla in NSW. Important populations for this species occur in the Hunter Valley, Sydney Basin and Southern Tablelands of NSW. There are scattered records from the New England Tablelands and North West Slopes.

The species is manoeuvrable and forages below the canopy (OEH 2013b; DotE 2014h). The preferred breeding habitat for the Large-eared Pied Bat is caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the *Hirundo ariel* (Fairy Martin). The species has been known to use hollow-bearing trees as roost sites (DotE 2014h). Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years (OEH 2013b). Breeding females have recently been recorded in sandstone caves at Coonabarabran, NSW (DotE 2014h).

This species tends to occur in small populations of around 50 individuals, particularly around sandstone escarpments and cliff lines. There is insufficient data to estimate population of the Large-eared Pied Bat, though it appears to exist in a number of small populations throughout its range (DotE 2014h).

The only confirmed threat to the Large-eared Pied Bat is disturbance and damage to primary nursery sites by flooding and animals (such as humans and goats). Potential threats to this species include clearing or timber harvesting in or around roosts, loss of foraging habitat, predation by foxes, habitat destruction by agricultural and urban development, drought, and forestry operations (DotE 2014h).

#### *Large-eared Pied Bat within the Project area*

Previous surveys have detected the Large-eared Pied Bat near the Project area in East Pilliga State Forest (NPWS 2000a; NPA 2002).

There are no existing records for the species within the Project area and the species was not identified during field surveys. The closest records from the Atlas of NSW Wildlife are approximately 10 kilometres to the south in Pilliga Nature Reserve and 25 kilometres to the north east near Mt Kaputar National Park.

As part of the ongoing detailed impact assessment phase of the Project, ELA mapped all vegetation within the Project area, categorised it by fauna habitat type and then allocated breeding, foraging or other habitat types based on the likely presence or use of the habitat by the species. This analysis indicated there is approximately 67,291 hectares of potential foraging habitat for the Large-eared Pied Bat throughout the Project area.

The Project area contains habitat that the species may utilise on occasion for foraging, however no core breeding habitat (caves) are present. Whilst the species has the potential to occur, it does not have an important population or habitat critical to the survival of the species within the Project area.

#### *Potential impacts and mitigation*

The Large-eared Pied Bat has the potential to be impacted both directly and indirectly by the Project. However, it is unlikely that these would constitute a significant impact as defined under the EPBC Act.

Vegetation clearance will result in the removal of foraging habitat, the total extent of which will be determined during the detailed impact assessment phase. It is an insectivorous species, with access to foraging resources across the entire Project area. Core breeding habitat (caves) will not be impacted by the Project.

Vegetation clearance will also result in habitat fragmentation. However, the Large-eared Pied Bat is a mobile species that tends to occur around sandstone escarpments and cliff lines. Neither these types of habitats nor breeding sites will be impacted by the Project.

Disruption to foraging habitat may occur during construction and operation if these features are located near to infrastructure. Noise at dusk and dawn and night-time lighting are specific issues. Micro-siting, preclearance surveys and construction/operation controls will reduce the risk of such impacts.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the Large-eared Pied Bat are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and rehabilitation of temporarily impacted areas following construction.

#### *Summary*

Occurrence records and analysis of available habitat does not indicate there is an important population or habitat critical to the survival of the Large-eared Pied Bat within the Project area. Whilst the Project may have direct and indirect impacts to the species, these are unlikely to be significant. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

## ***Phascolarctos cinereus* (Koala) (combined populations of QLD, NSW and ACT) – Vulnerable**

### *Background – ecology and distribution*

The Koala (combined populations of QLD, NSW and ACT) is listed as vulnerable under the EPBC Act. This species is associated with a wide range of temperate, tropical and sub-tropical forests as well as semi-arid communities. Koalas feed almost exclusively on leaves of Eucalypt species, although they have been known to forage on other genera as well (DotE 2014i).

The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW, the Koala mainly occurs on the central and north coasts with some populations to the west of the Great Dividing Range including the Liverpool Plains and the Pilliga. The Koala was briefly historically abundant in the 1890s in the Bega District on the south coast of NSW, although not elsewhere, but it now occurs in sparse and possible disjunct populations. Koalas are also known from several sites on the southern tablelands (OEH 2013). Distribution and population size has varied, with population size believed to have sharply dropped between 1930 and 1980 due to hunting, predation by the European Fox, widespread ringbarking of eucalypts and wildfire.

Koalas have large overlapping home ranges with larger home ranges present in areas of poorer quality habitat (recorded up to 135 hectares in central Queensland) (DotE 2014i).

A decline in the total population of the listed Koala population has been demonstrated across its range over the 1990-2010 period. Overall the population size of the Koala was estimated in 2010 to be 188,000 (DotE 2014i).

The main threats to the Koala are ongoing habitat loss and habitat fragmentation, vehicle strike and predation by domestic or feral dogs, drought and incidences of extreme heat and disease (DotE 2014i).

### *Koala within the Pilliga and the Project area*

At over 500,000 hectares, the Pilliga includes a diverse range of vegetation communities and associated fauna habitats across a range of soil fertilities, which are generally lower in the east and higher in the west. The north-east Pilliga (including the Project area) has been surveyed for Koalas at various times, including during periods when the Koala populations in the Pilliga were considered to have been at historical peaks. Very few koalas have ever been found in the north-east Pilliga. The vast majority of Koala records are in the central and western Pilliga, areas supported by more productive soils, fewer fires, and greater access to permanent water along major drainage lines. Conversely, the north-east Pilliga has been more frequently burnt by wildfires, has less productive soils and only one major creek system which supports few areas of permanent water.

The combination of low soil fertility, associated nutrient-poor vegetation, frequent wildfires and fewer major watercourses with permanent water are considered likely to be the key reasons why Koala populations have always been low in the Project area.

There is ongoing uncertainty about the overall Koala population size in the Pilliga. The species was thought common during the 1800s, with declines during the 1900s due to habitat degradation and hunting. More recently the population was estimated at 15,000, however this estimate is also now more than 10 years old and the Pilliga has been subject to severe drought during that period (DotE 2014i). Despite this uncertainty, it is considered that the population present is significant and DotE (2014i) recognises the Pilliga as containing an important population of Koalas.

Targeted Koala surveys across the Pilliga, led by Dr Rod Kavanagh (a recognised Koala expert), were completed over two weeks in May 2014. The objective of these surveys was to identify and locate important refuges for the Koala in the context of a general and widespread decline in the abundance of Koala throughout the region. Targeted Koala searches were conducted in 'favourable' Koala habitat, as determined by suitable vegetation types and a desktop assessment. 'Favourable' Koala habitat was generally reflective of major drainage lines in the Pilliga and typically consisted of

areas containing dominance, or near dominance of the red gums *Eucalyptus blakelyi*, *E. camaldulensis* or *E. chloroclada* (Dirty Gum) and/or near persistent waterholes. A total of 10 individual Koalas were recorded throughout the surveys. Nine individuals were observed in red gum species and one individual was observed sheltering in *Callitris glaucophylla* (White Cypress Pine) within a drainage line. Koala's were only observed within habitat along Etoo Creek and Baradine Creek in the central and west Pilliga areas. Despite targeted searches, no Koalas were observed within the Project area within the Pilliga.

As part of the ongoing detailed impact assessment phase of the Project, ELA mapped all vegetation within the Project area, categorised it by fauna habitat type and then allocated breeding, foraging or other habitat types based on the likely presence or use of the habitat by the species. This analysis indicated there is approximately 23,005 hectares of potential breeding and foraging habitat for the Koala throughout the Project area.

There is only one primary feed tree (as defined in the Approved Koala recovery plan (DECC 2008) and State Environmental Planning Policy 44 (SEPP 44)) in the Project area, namely *Eucalyptus camaldulensis* (River Red Gum) and this species has a very narrow distribution centred around Yarrie Lake in the north-west of the Project area (outside of the Pilliga). While secondary feed trees such as *Eucalyptus chloroclada*, *E. conica* (Fuzzy Box), *E. blakelyi*, *E. dwyeri* (Dwyer's Red Gum), *E. pilligaensis* (Pilliga Box) and *E. populnea* (Poplar Box) do occur in the Project area (within the Pilliga), they are generally restricted to discrete areas along drainage lines or occur as minor components to vegetation communities.

*E. chloroclada*, *E. blakelyi* and *E. conica* are largely confined to drainage lines on sandy soils, *E. dwyeri* occurs in heath on shallow sandstone, while *E. pilligaensis* and *E. populnea* occur in the north of the Project area largely outside of the Pilliga on finer textured sandy loam. *Callitris glaucophylla* is common in the north-east Pilliga and is used for daytime shelter and feeding (DotE 2014i). Other secondary food trees may also be present.

Criteria for habitat critical to the survival of the Koala are set out in Section 7 of the Draft EPBC Act referral guidelines (DotE 2013i). According to these criteria, the Project area is defined as containing habitat critical to the survival of the Koala due to:

- Records of one or more koala within 5 km of the edge of the Project area within the last 10 years.
- The Project area has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species in the canopy.
- The Project area is part of a contiguous landscape >1000 hectares.
- Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence.

While the Project area may contain habitat critical to the survival of the Koala as defined in the Draft EPBC Act referral guidelines (DotE 2013i), the paucity of historical records, lack of direct evidence from intensive surveys of the Project area over the past 5 years (including the May 2014 targeted survey) indicates that relatively few Koalas ever utilise the available habitat in the Project area. As such, while the broader central and western Pilliga are known to contain remnant populations, the north-east Pilliga is now considered unlikely to support an important population of this species.

Similar patterns of habitat usage have been found elsewhere, including regional areas on the NSW coast, where some areas of habitat are not utilised while others are occupied by Koalas at relatively high densities (Biolink 2013). It is unlikely that the north-east Pilliga has ever made a substantial contribution to the overall Pilliga Koala population.

#### *Potential impacts and mitigation*

The Koala has the potential to be impacted both directly and indirectly by the Project. Despite the occurrence of 'habitat critical to the survival of the Koala' in the Project area as defined in Draft EPBC Act referral guidelines (DotE 2013i), the low proportion of total vegetation clearing (one percent of the



native vegetation in the Project area) is considered unlikely to significantly impact on the Pilliga Koala population due to the lack of Koala occurrence and habitat utilisation in the Project area.

According to the most recent Draft EPBC Act referral guidelines from DotE (2013i), the following are the key considerations for determining the significance of impacts to Koala:

- The action could adversely affect habitat critical to the survival of the Koala; and/or
- The action could interfere substantially with the recovery of the Koala through the introduction or exacerbation of key threats in areas of habitat critical to the survival of the Koala. These key threats include:
  - Mortality from vehicle-strikes and dog attack.
  - Barriers to movement.
  - Introduction or spread of disease or pathogens.
  - Increasing the risk of high-intensity fire.
  - Degradation of habitat from hydrological change.

The Project has the potential to exacerbate key threats, as listed above. Vegetation clearance will result in the removal of potential Koala habitat, the total extent of which will be determined during the detailed impact assessment phase.

There is the potential for increased mortality of Koalas due to vehicle strike, as construction and operation increase activity within the Project area and predation from dogs (and other pest species), which may increase in number and gain greater access to the Project area, however due to the lack of Koala occurrence these impacts are considered to be low. These issues will be addressed through construction/operational controls (e.g. preclearance surveys) and the development and implementation of a pest management plan.

Vegetation clearance will also result in habitat fragmentation. However, the Koala is a mobile species with a large home range, and the scale of disturbance from the Project is unlikely to cause fragmentation of this species' habitat within the Pilliga region. Where possible, infrastructure will be co-located with existing access roads, tracks or other existing linear features, or within currently disturbed areas (where possible), and temporarily impacted areas will be rehabilitated following construction. Furthermore, canopy species occurring on the edges of infrastructure locations will be retained where possible, allowing overhanging canopy to remain.

Increased traffic within the Project area has the potential to spread weeds and pathogens, however weed and disease hygiene measures will be developed and implemented as a component of the construction and operational controls for the Project.

Loss of Koala habitat and death of individuals due to high intensity fire has the potential to be exacerbated due to the Project. A bushfire hazard and risk assessment is currently being prepared by Santos which will identify the measures to reduce the risk of fire.

Alterations to the hydrological regime of the Project area are expected to be minor. A detailed impact assessment of water resources is currently being prepared as part of the detailed impact assessment phase of the Project, and this will determine impacts to hydrological regimes and flow on effects to species such as the Koala.

Factors that are likely to reduce the severity of impacts to the Koala:

- No Koalas have been observed in the Project area in the last five years, despite targeted searches.
- Habitat that will be impacted is not considered to be of particularly notable quality as there are few areas with primary feed trees and secondary feed trees generally only occur in discrete areas.

- The Project is located in the north-east of the Pilliga, where the lowest numbers of koalas have been historically known to occur, compared with much higher koala densities in the central, southern and western extent of the Pilliga region.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the Koala are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible), rehabilitation of temporarily impacted areas following construction the development and implementation of pest management measures.

Santos is also proposing broad-scale recovery actions in the central and western Pilliga including nil-tenure feral animal control and further targeted surveys to determine habitat utilisation.

### *Summary*

The Project area contains habitat critical to the survival of the Koala, however no Koalas have been observed in the Project area in the last five years, despite targeted searches. The Project has the potential to have direct and indirect impacts to the species. These are unlikely to be significant, and will be further assessed and quantified in the detailed impact assessment. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

### ***Pseudomys pilligaensis* (Pilliga Mouse) – Vulnerable**

It is important to note that the *Pseudomys pilligaensis* (Pilliga Mouse) is now considered a southern population of the widespread *Pseudomys delicatulus* (Delicate Mouse) based on genetic analyses, morphological studies and recent surveys which revealed a continuous distribution of the Delicate Mouse to the Pilliga region (Breed and Ford 2007; Ford 2008, as cited in DotE 2014j). It is important to note that this taxonomic change has not yet been formally recognised under the EPBC Act (DotE 2014j), hence this assessment considers the Pilliga Mouse as currently listed.

### *Background – ecology and distribution*

The Pilliga Mouse is listed as vulnerable under the EPBC Act. It is restricted to the Pilliga region of New South Wales, where low-nutrient deep sand supports a distinctive vegetation type (Pilliga Scrub). The Pilliga Mouse is very sparsely distributed and appears to prefer areas with a light ground cover. Recent studies indicate that the Pilliga Mouse is found in greatest abundance in recently burnt moist gullies, areas dominated by broombush and areas containing an understorey of *Acacia burrowii* (Kurricabah) with a *Corymbia trachyphloia* (Brown Bloodwood) overstorey (Paull 2009). Consistent features of the latter two habitats are a relatively high plant species richness, a moderate to high low shrub cover, and a moist groundcover of plants, litter and fungi. Consistent features of gully habitat are 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 (OEH 2014b).

The overall population of the species is hard to estimate (DotE 2014j). Some evidence suggests there are marked population fluctuations within this species, with population estimates between 50,000 to 100,000 during boom periods (Paull and Milledge 2011).

Threats to the Pilliga Mouse include exploration, infrastructure construction and infrastructure maintenance, loss or degradation of habitat through inappropriate fire regimes, forestry operations and broombush harvesting, predation by feral cats and foxes, and competition from the common house mouse.

### *Pilliga Mouse within the Project area*

The Pilliga Mouse is found exclusively within the Pilliga scrub. The species was observed as part of previous studies (Milledge 2012) and in recent surveys as part of the ecological assessment for the detailed assessment phase of the Project and is known to occur more broadly in the Project area and Pilliga East State Forest (NPWS 2000a; NPA 2002).

Over the course of several projects associated with the environmental assessment of the Project, ELA mapped and classified all potential Pilliga Mouse habitat within the Project area as either 'primary' or 'secondary' habitat. 'Primary' habitat is considered more likely to be inhabited by the Pilliga Mouse on a more permanent basis, while the 'secondary' habitat is less likely to be readily inhabited or is likely to be more suitable after fire and/or during successful breeding years. This analysis indicated there is approximately 9,131 hectares of potential 'primary' habitat and an additional 15,318 hectares of potential 'secondary' habitat for the Pilliga Mouse throughout the Project area.

The Project area contains both an important population and habitat critical to the survival of the Pilliga Mouse.

*Potential impacts and mitigation*

The Pilliga Mouse has the potential to be impacted both directly and indirectly by the Project, and impacts may be significant.

Vegetation clearance will result in the removal of habitat critical to the survival of the Pilliga Mouse, the total extent of which will be determined during the detailed impact assessment phase.

Vegetation clearance will also result in habitat fragmentation. The species is known to undergo seasonal congregations and dispersals (NPA 2002) suggesting that the species has the ability to move significant distances and is currently doing so within an environment currently bisected by existing roads, trails and drainage lines.

Pest species may also impact the Pilliga Mouse directly through predation (dog, foxes, cats) or indirectly through competition (common house mouse). These issues will be addressed via the development and implementation of a pest management plan.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the Pilliga Mouse are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and rehabilitation of temporarily impacted areas following construction.

*Summary*

The Project area contains an important population and habitat critical to the survival of the Pilliga Mouse. The Project is likely to have direct and indirect impacts to the species. These may be significant, and will be further assessed and quantified in the detailed impact assessment. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

**Reptiles**

SCIENTIFIC NAME	COMMON NAME	EPBC STATUS	LISTING	LIKELIHOOD OF OCCURRENCE	SIGNIFICANT IMPACT LIKELY?
<i>Underwoodisaurus sphyrurus</i>	Border Thick-tailed Gecko	Vulnerable		Unlikely	No
<i>Delma torquata</i>	Collared Delma	Vulnerable		Unlikely	No
<i>Anomalopus mackayi</i>	Five-clawed Worm-skink	Vulnerable		Unlikely	No
<i>Aprasia parapulchella</i>	Pink-tailed Legless Lizard	Vulnerable		Unlikely	No

## Amphibians

SCIENTIFIC NAME	COMMON NAME	EPBC STATUS	LISTING	LIKELIHOOD OF OCCURRENCE	SIGNIFICANT IMPACT LIKELY?
<i>Litoria booroolongensis</i>	Booroolong Frog	Endangered		No	No

## Fish

SCIENTIFIC NAME	COMMON NAME	EPBC STATUS	LISTING	LIKELIHOOD OF OCCURRENCE	SIGNIFICANT IMPACT LIKELY?
<i>Maccullochella peelii</i>	Murray Cod	Vulnerable		No	No

## Flora

SCIENTIFIC NAME	COMMON NAME	EPBC STATUS	LISTING	LIKELIHOOD OF OCCURRENCE	SIGNIFICANT IMPACT LIKELY?
<i>Bertya opposens</i>	Coolabah Bertya	Vulnerable		Known	Potential
<i>Boronia granitica</i>	Granite Boronia	Endangered		No	No
<i>Cadellia pentastylis</i>	Ooline	Vulnerable		No	No
<i>Dichanthium setosum</i>	Bluegrass	Vulnerable		Unlikely	No
<i>Haloragis exalata</i>	-	Vulnerable		Unlikely	No
<i>Homopholis belsonii</i>	Belson's Panic	Vulnerable		Unlikely	No
<i>Lepidium aschersonii</i>	Spiny Peppercross	Vulnerable		Known	Potential
<i>Lepidium monoplacoides</i>	Winged Peppercross	Endangered		Known	Potential
<i>Philothea ericifolia</i>	-	Vulnerable		Unlikely	No
<i>Prasophyllum</i> sp. <i>Wybong</i> (C.Phelps ORG 5269)	a leek-orchid	Critically Endangered		Unlikely	No
<i>Rulingia procumbens</i>	-	Vulnerable		Known	Potential
<i>Swainsona murrayana</i>	Slender Darling Pea	Vulnerable		Unlikely	No
<i>Thesium australe</i>	Austral Toadflax	Vulnerable		Unlikely	No
<i>Tylophora linearis</i>	-	Endangered		Known	Potential

### ***Bertya opposens* (Coolabah Bertya) – Vulnerable**

#### *Background – ecology and distribution*

*Bertya opposens* is listed as vulnerable under the EPBC Act. It is a slender shrub or small tree, which grows to 4 metres high (Harden 1990). Flowering occurs during July and August. The primary mechanism for pollen dispersal is presumed to be wind given that the flowers lack chemical and colour attractants and the styles and anthers are exposed (NPWS 2002). *Bertya opposens* is considered to be an obligate seeder, in which standing plants are killed by fire but the species often germinates from a soil seedbank shortly afterwards (OEH 2014b).

The species occurs in a number of differing habitats, ranging from stony mallee ridges and cypress pine forests of the inland, to cliff edges in the high rainfall eastern fall areas of the Great Dividing Range. The plant is currently known from only four scattered sites in NSW, with the largest population being in Jacks Creek State Forest. NPWS (2002) and the NSW Scientific Committee (2008a) estimate that the Jacks Creek State Forest population of *B. opponens* is greater than 5 million individuals.

This species is at threat from inappropriate fire regimes, specifically if fire is less than 3 years or greater than 20 years. Other threats include clearing and fragmentation of habitat for agriculture, invasion of habitat by introduced weeds, browsing by feral goats, road and fire trail construction and maintenance, and risk of local extinction because populations are small and distribution is restricted (OEH 2014b).

#### *Bertya opponens* within the Project area

This species is known within the Project area, with records occurring primarily along the eastern boundary of the Project area.

Detailed targeted surveys for *Bertya opponens* have been undertaken within the Project area with a total of 6,715 individuals recorded. Based on the frequency of occurrence in specific habitat types, the total population of *B. opponens* within the Project area is likely to be considerably larger.

Given that there are only 4 known populations of *B. opponens*, all can be considered important populations. Therefore, the population within the Project area is also considered to be an important population.

#### *Potential impacts and mitigation*

*Bertya opponens* has the potential to be impacted both directly and indirectly by the Project, and impacts may be significant.

Vegetation clearance may result in the removal of *B. opponens* individuals and associated habitat. Additional potential habitat outside of the known population areas may also be removed. This will reduce the size of an important population and the species' area of occupancy within the Project area. The total extent of this direct impact will be determined during the detailed impact assessment phase.

Vegetation clearance may also result in habitat fragmentation. Fragmentation associated with the Project is considered unlikely to disrupt pollen dispersal pathways, but may disrupt the existing seed bank.

Disturbance from the Project may exacerbate the spread of weed species such as *Eragrostis curvula* (African Lovegrass) and *Hyparrhenia hirta* (Coolatai Grass) into areas of known and potential *B. opponens*' habitat. Weeds can impact the species both via direct competition and degradation of habitat. They may also alter fire regimes, which are important for the germination of this species. Weed management measures will be developed and implemented, along with rehabilitation of temporarily impacted areas after construction. These measures will reduce impacts of weeds species. Invasive herbivore species (e.g. goats) may impact *B. opponens* directly via grazing and trampling and indirectly through habitat degradation. Goats are already present in the Pilliga, however their numbers and extent may be increased due to the Project. These issues will be addressed via the development and implementation of a pest management plan.

Fire is important for the germination of *B. opponens*. A fire risk assessment and management plan is currently being developed, however alterations to the natural burn regime of the region may impact the germination and therefore recruitment of this species.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the *B. opponens* are detailed in Section 4. These include co-locating infrastructure

with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and undertaking rehabilitation and weed management activities.

### *Summary*

The Project area contains an important population of *Bertya opposens*. The Project is likely to have direct and indirect impacts to the species. These may be significant, and will be further assessed and quantified in the detailed impact assessment. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

### ***Lepidium aschersonii* (Spiny Peppercross) – Vulnerable**

#### *Background – ecology and distribution*

The *Lepidium aschersonii* is listed as vulnerable under the EPBC Act. It is a small perennial herb endemic to mainland southern Australia, where it is widely but patchily distributed from New South Wales to Western Australia. The species grows to about 30 cm tall, with several erect, intricately branched stems arising annually for perennial underground rootstock. Flowering occurs from spring to autumn (Harris and Smith 2000).

Increased numbers of plants have been observed during dry periods, potentially due at least in part to the increased area of bare soil available for seedling establishment (Harris and Smith 2000). The species occurs at some sites that are occasionally flooded, such as gilgai depressions, and shows some adaptation to the seasonal filling and drying of wetlands. Established plants can also apparently withstand some period of submergence.

There are an estimated 25,000–100,000 plants remaining in about 30 wild populations (Carter 2010). Within NSW these plants have a current distribution within the Brigalow Belt South, Darling Riverine Plains, Cobar Penepplain, and Riverina. One population is protected within the Brigalow Park Nature Reserve near Narrabri and the Project area. It is thought to contain many thousands of individuals (Carter 2010) and may be the largest remaining population of *Lepidium aschersonii*.

Much of its habitat has been lost to agriculture, and remaining populations are mostly small, isolated and at risk from a range of threats including grazing, weed invasion, wetland drainage and other forms of habitat destruction.

#### *Lepidium aschersonii within the Project area*

*Lepidium aschersonii* is known from the north-western portion of the Project area, with a large population in Brigalow Park Nature Reserve.

Within the Project area, there are 46 existing records of *L. aschersonii* which corresponds to 3,852 individuals (due to numerous individuals recorded at each location) (OEH 2014a). Recent surveys have identified a further 15 records of *L. aschersonii* totalling 208 individuals. Based on the frequency of occurrence in specific habitat types, the total population of *L. aschersonii* within the Project area is likely to be considerably larger.

Given that there are only 30 known populations of *L. aschersonii*, all can be considered important populations. Therefore, the population within the Project area is also considered to be an important population.

#### *Potential impacts and mitigation*

*Lepidium aschersonii* has the potential to be impacted both directly and indirectly by the Project, and impacts may be significant.

Vegetation clearance may result in the removal of *L. aschersonii* individuals and associated habitat. Additional potential habitat outside of the known population areas may also be removed. This will reduce the size of an important population and the species' area of occupancy within the Project

area. The total extent of this direct impact will be determined during the detailed impact assessment phase.

Vegetation clearance may also result in habitat fragmentation. Within the Project area, the species currently occurs exclusively in a vegetation community situated in the north of Project area in patches already fragmented by pasture land and roads. This suggests there is at least some tolerance of fragmented landscapes.

Disturbance from the Project may exacerbate the spread of weed species into areas of known and potential *L. aschersonii* habitat. Weeds can impact the species both via direct competition and degradation of habitat. Weed management measures will be developed and implemented, along with rehabilitation of temporarily impact areas after construction. These measures will reduce impacts of weeds species.

Invasive species (e.g. rabbits and pigs) may impact *L. aschersonii* directly via grazing and trampling and indirectly through habitat degradation. These species are already present in the Project area, however their numbers and extent may be increased due to the Project. These issues will be addressed via the development and implementation of a pest management plan.

Alterations to the hydrological regime of the Project area also has the potential to impact the wetter habitats of *L. aschersonii*. A detailed impact assessment of water resources is currently being prepared as part of the detailed impact assessment phase of the Project, and this will determine impacts to hydrological regimes and flow on effects to species such as *L. aschersonii*.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the *L. aschersonii* are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and undertaking rehabilitation and weed management activities.

### *Summary*

The Project area contains an important population of *Lepidium aschersonii*. The Project is likely to have direct and indirect impacts to the species. These may be significant, and will be further assessed and quantified in the detailed impact assessment. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

## ***Lepidium monoplocoides* (Winged Peppergrass) – Endangered**

### *Background – ecology and distribution*

*Lepidium monoplocoides* is listed as endangered under the EPBC Act. It is a small annual herb growing to about 20 cm tall. Flowering occurs in the spring and summer. Numbers of adult plants fluctuate from year to year with some seed probably remaining dormant in the soil for several years.

*Lepidium monoplocoides* occurs predominantly in mallee scrub in semi-arid areas (DotE 2014m). Sites are seasonally moist to water-logged with heavy, fertile soils and a mean annual rainfall of around 300 to 500 mm. The predominant vegetation is usually an open-woodland dominated by *Allocasuarina luehmannii* and/or eucalypts, particularly *Eucalyptus largiflorens* (Black Box) or *Eucalyptus populnea* (Poplar Box). The ground layer of the surrounding woodland is dominated by tussock grasses (notably *Rytidosperma* spp. and *Austrostipa* spp.), but the seasonally waterlogged sites preferred by *Lepidium monoplocoides* also support a number of moisture dependent herbs, such as *Marsilea* spp. (Nardoo).

The species is currently known from 13 locations, six in Victoria and seven in New South Wales. These are all considered important populations required for the conservation of *Lepidium monoplocoides*. Total population size is estimated <3,000 plants for each population in Victoria and New South Wales. The inconspicuous nature of the plant may have led to an under-estimation of population sizes. The magnitude of the soil seed store is also unknown, but is likely to be large.

Current major threats to the species include altered hydrology, increasing salinity, weed invasion, grazing, physical damage, and drought and climate change (Mavromihalis 2010).

### *Lepidium monoplocoides within the Project area*

*Lepidium monoplocoides* is known from the Project area. Records all occur in the north-western portion of the Project area, close to the boundary of Brigalow Park Nature Reserve.

Targeted surveys for *L. monoplocoides* have been undertaken within the Project area with a total of 268 individuals recorded. Based on the frequency of occurrence in specific habitat types, the total population of *L. monoplocoides* within the Project area is likely to be considerably larger.

All currently known populations of *L. monoplocoides* are considered to be important populations (DotE 2014m). Therefore, the population within the Project area are should also be considered an important population.

### *Potential impacts and mitigation*

*Lepidium monoplocoides* has the potential to be impacted both directly and indirectly by the Project, and impacts may be significant.

Vegetation clearance may result in the removal of *L. monoplocoides* individuals and associated habitat. Additional potential habitat outside of the known population areas may also be removed. This will reduce the size of an important population and the species' area of occupancy within the Project area. The total extent of this direct impact will be determined during the detailed impact assessment phase.

Vegetation clearance may also result in habitat fragmentation. Within the Project area, the species occurs in patches already fragmented by pasture land and roads. This suggests there is at least some tolerance of fragmented landscapes.

Disturbance from the Project may exacerbate the spread of weed species into areas of known and potential *L. monoplocoides* habitat. Weeds can impact the species both via direct competition and degradation of habitat. Weed management measures will be developed and implemented, along with rehabilitation of temporarily impacted areas after construction. These measures will reduce impacts of weeds species.



Invasive species (e.g. rabbits and pigs) may impact *L. monoplocoides* directly via grazing and trampling and indirectly through habitat degradation. These species are already present in the Project area, however their numbers and extent may be increased due to the Project. These issues will be addressed via the development and implementation of a pest management plan.

Alterations to the hydrological regime of the Project area also has the potential to impact the wetter habitats of *L. monoplocoides*. A detailed impact assessment of water resources is currently being prepared as part of the detailed impact assessment phase of the Project, and this will determine impacts to hydrological regimes and flow on effects to species such as *L. monoplocoides*.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the *L. monoplocoides* are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and undertaking rehabilitation and weed management activities.

#### *Summary*

The Project area contains an important population of *Lepidium monoplocoides*. The Project is likely to have direct and indirect impacts to the species. These may be significant, and will be further assessed and quantified in the detailed impact assessment. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

### ***Rulingia procumbens* – Vulnerable**

#### *Background – ecology and distribution*

*Rulingia procumbens* is listed as vulnerable under the EPBC Act. It is a prostrate trailing shrub endemic to NSW. The species occurs between Dubbo and Gilgandra in northern NSW, where it grows in sandy soil in conjunction with *Melaleuca uncinata* (Broombush) and Mallee Eucalypt scrub with an understory of *Calytrix tetragona*. It is also known to occur with *Eucalyptus fibrosa*, *E. albens* and *Callitris glaucophylla* communities (OEH, 2014b).

The species produces seed which is able to persist in the soil seed bank for some time. It is promoted by fire, which often results in large germination events, and is considered a pioneer species in disturbed areas such as along roadsides, stockpiles and powerline easements (TSSC, 2008).

The main threats to the species include loss and fragmentation of habitat, clearance of roadside vegetation, and inappropriate fire and grazing regimes (TSSC, 2008).

#### *Rulingia procumbens within the Project area*

*Rulingia procumbens* is known to occur within the Project area. Records all occur in the south-eastern portion of the Project area and this species has also been recorded further south within the Pilliga East State Conservation Area.

Detailed targeted surveys for *R. procumbens* have been undertaken within the Project area with a total of 1,389 individuals recorded. Based on the frequency of occurrence in specific habitat types, the total population of *R. procumbens* within the Project area is likely to be considerably larger.

The population of *R. procumbens* within the Project area is considered an important population.

#### *Potential impacts and mitigation*

*Rulingia procumbens* has the potential to be impacted both directly and indirectly by the Project, and impacts may be significant.

Vegetation clearance may result in the removal of *R. procumbens* individuals and associated habitat. Additional potential habitat outside of the known population areas may also be removed. This will reduce the size of an important population and the species' area of occupancy within the Project

area. This species occurs in roadside areas within the Project area, and these areas will be preferentially developed to reduce overall disturbance of currently intact habitat areas. The total extent of this direct impact from clearing will be determined during the detailed impact assessment phase.

Vegetation clearance may also result in habitat fragmentation. Within the Project area, the species is currently found in the south of Project area, which is less fragmented than other areas.

Frequent fires (more often than 7 years) are considered a threat to this species. A fire risk assessment and management plan is currently being developed, however it is unlikely that an increased frequency of fire will result from the Project.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the *R. procumbens* are detailed in Section 4. These include undertaking rehabilitation and weed management activities.

### *Summary*

The Project area contains an important population of *Rulingia procumbens*. The Project is likely to have direct and indirect impacts to the species. These may be significant, and will be further assessed and quantified in the detailed impact assessment. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

## ***Tylophora linearis* – Endangered**

### *Background – ecology and distribution*

*Tylophora linearis* is listed as endangered under the EPBC Act. It is a slender, almost hairless twiner, which is known only from NSW and Queensland (OEH 2013b). In NSW, it is found in the Barraba, Mendooran, Temora and West Wyalong districts in the northern and central western slopes. Records include Crow Mountain near Barraba, Goonoo, Pilliga West, Cumbil, and Eura State Forests, Coolbaggie Nature Reserve, Goobang National Park, and Beni Conservation Area.

The species grows in dry scrub and open forest. It has been recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa*, *E. sideroxylon*, *E. albens*, *Callitris endlicheri*, *C. glaucophylla* and *Allocasuarina luehmannii*. It also grows in association with *Acacia hakeoides*, *A. lineata*, *Melaleuca uncinata*, *Myoporum* species and *Casuarina* species. The species flowers in spring, with flowers recorded in November or May with fruiting probably 2 to 3 months later.

Where the species occurs, it has been recorded in very low abundances (OEH 2013b). No data are available to estimate the size of several of the known population and estimates are also complicated by difficulties in positively identifying plants that may not be flowering at the time of survey.

The main identified threats to *Tylophora linearis* include forestry activities, disturbances such as grazing and fire, and invasion of habitat by introduced weeds, such as Lantana (*Lantana camara*) (DECC 2005).

### *Tylophora linearis within the Project area*

*Tylophora linearis* is known from the Project area. Records occur primarily within the Pilliga and this species has also been recorded within the Pilliga East State Conservation Area and Pilliga East State Forest.

Detailed targeted surveys for *T. linearis* have been undertaken within the Project area with a total of 402 individuals recorded. Individual records of *T. linearis* included all stems within a 5 m radius of the record as *T. linearis* is known to sucker from beneath the ground with shoots in close proximity likely to represent only a few different plants (NSW Scientific Committee 2008). Based on the frequency of occurrence in specific habitat types, the total population of *T. linearis* within the Project area is likely to be considerably larger.

The population of *T. linearis* within the Project area is considered an important population.

*Potential impacts and mitigation*

*Tylophora linearis* has the potential to be impacted both directly and indirectly by the Project, and impacts may be significant.

Vegetation clearance may result in the removal of *T. linearis* individuals and associated habitat. Additional potential habitat outside of the known population areas may also be removed. This will reduce the size of an important population and the species' area of occupancy within the Project area. Vegetation clearance may also result in habitat fragmentation. The total extent of these impacts will be determined during the detailed impact assessment phase.

Disturbance from the Project may exacerbate the spread of weed species into areas of known and potential *T. linearis* habitat. Weeds can impact the species both via direct competition and degradation of habitat. Weed management measures will be developed and implemented, along with rehabilitation of temporarily impact areas after construction. These measures will reduce impacts of weeds species.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to the *T. linearis* are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and undertaking rehabilitation and weed management activities.

*Summary*

The Project area contains an important population of *Tylophora linearis*. The Project is likely to have direct and indirect impacts to the species. These may be significant, and will be further assessed and quantified in the detailed impact assessment. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

**Ecological Communities**

THREATENED ECOLOGICAL COMMUNITY	EPBC STATUS	LISTING	LIKELIHOOD OF OCCURRENCE	SIGNIFICANT IMPACT LIKELY?
Brigalow ( <i>Acacia harpophylla</i> dominant and co-dominant)	Endangered		Known	Potential
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered		No	No
Weeping Myall Woodlands	Endangered		Known	Potential
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered		No <sup>#</sup>	No
Grey Box ( <i>Eucalyptus microcarpa</i> ) Grassy Woodlands and Derived Native Grasslands of south-eastern Australia	Endangered		No	No
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered		No	No
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	Endangered		No	No
New England Peppermint ( <i>Eucalyptus nova-anglica</i> ) Grassy Woodlands	Critically Endangered		No	No

# The assemblage of species present and associated soils types in the Project area do not support this threatened ecological community

## **Brigalow (*Acacia harpophylla* dominant and co-dominant)**

### *Background – ecology and distribution*

Brigalow (*Acacia harpophylla* dominant and co-dominant) is listed as endangered under the EPBC Act. The Brigalow ecological community is a low woodland or forest community dominated by *Acacia harpophylla* (Brigalow), with pockets of *Casuarina cristata* (Belah) and *Eucalyptus populnea* subsp. *bimbil* (Poplar Box) (DotE 2014o). The canopy tends to be quite dense and the understorey and ground cover are only sparse. The height of the tree layer varies from 9 m in low rainfall areas (averaging around 500mm per annum) to around 25 m in higher rainfall areas (averaging around 750 mm per annum).

The listed Brigalow ecological community extends from south of Charters Towers in Queensland, in a broad swathe east of Blackall, Charleville and Cunnamulla, south to northern New South Wales near Narrabri and Bourke. In NSW, the TEC is found in the Brigalow Belt South Bioregion and as isolated occurrences in the Darling Riverine Plains and Nandewar Bioregions.

Brigalow vegetation is usually associated with deep gilgaied clays, sedentary clays, miscellaneous deep clays and loamy red soils. The soils usually have a clay field-texture throughout the profile, are relatively fertile and tend to have a high salt content. In NSW, Brigalow is associated with red, brown and grey clays, red and grey earths and red-brown earths.

The Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community retains a national distribution of 804,264 hectares (NPWS 2002). In western NSW (Moree/Narrabri), the Brigalow ecological community is considered to consist of patches generally 100 to 300 hectares in area (NPWS 2002).

The Brigalow ecological community is threatened by any activities that further reduce its extent, cause a decline in the condition of the vegetation, or impede its recovery. The most considerable current threats are clearing, fire, plant and animal pests, and lack of knowledge. Weed invasion and overgrazing by native fauna are both promoted by the high levels of fragmentation (DotE 2014o).

### *Brigalow (*Acacia harpophylla* dominant and co-dominant) within the Project area*

The presence of the Brigalow (*Acacia harpophylla* dominant and co-dominant) community in the Project area has been confirmed, with a large number of fragmented patches occurring within the north of the Project area. There is currently 2,468 hectares of Brigalow (*Acacia harpophylla* dominant and co-dominant) within the Project area. Of this total 2,468 hectares, 2,447 hectares qualified as EPBC Brigalow within the Brigalow Belt South. The additional 21 hectares did not meet the EPBC requirements, however, still meets the TSC Act requirements, as 'Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions'.

### *Potential impacts and mitigation*

Brigalow (*Acacia harpophylla* dominant and co-dominant) has the potential to be impacted both directly and indirectly by the Project, and these impacts may be significant.

Vegetation clearance will result in the removal of Brigalow (*Acacia harpophylla* dominant and co-dominant), and will reduce the area of occupancy and extent of this TEC. The total extent of this direct impact will be determined during the detailed impact assessment phase.

Vegetation clearance will also result in habitat fragmentation. Within the Project area, Brigalow (*Acacia harpophylla* dominant and co-dominant) is highly fragmented in its current form and is comprised of a mix of regrowth and remnant woodland or forest in various condition. Further fragmentation of the community is considered a key threat to the TEC.

The TEC is also currently impacted by edge effects, which are exacerbated by the highly fragmented nature of remnant patches. Disturbance from the Project may exacerbate the spread of weed species into areas of known and potential Brigalow habitat. Weeds can impact the TEC both via direct competition and degradation of habitat. Invasive pasture grasses (e.g. Buffel Grass) also present a

major threat to Brigalow, as they alter the fire regime. Weed management measures will be developed and implemented, along with rehabilitation of temporarily impact areas after construction. These measures will reduce impacts of weeds species.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to Brigalow (*Acacia harpophylla* dominant and co-dominant) are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and undertaking rehabilitation and weed management activities.

### *Summary*

The Project area contains approximately 2,447 hectares of Brigalow (*Acacia harpophylla* dominant and co-dominant). The Project is likely to have direct and indirect impacts to this TEC. These may be significant, and will be further assessed and quantified in the detailed impact assessment. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

## **Weeping Myall Woodlands**

### *Background – ecology and distribution*

Weeping Myall Woodland is listed as endangered under the EPBC Act. This community occurs as sparse monotypic stands of *Acacia pendula* (Weeping Myall) on inland alluvial plains west of the Great Dividing Range in NSW and Queensland (DOE, 2014p). The community typically occurs on flat areas with occasional gilgai on black, brown, red-brown or grey clays. While the community is dominated by Weeping Myall, other species of tree and shrub do co-occur on occasion. The understory is usually dominated by an open layer of grasses such as *Rytidosperma spp.* (Wallaby Grasses), *Astrelba spp.* (Mitchell Grass) and *Dichanthium sericeum* (Queensland Blue Grass) as well as an open shrub layer including a range of Chenopod species such as Salt Bushes, Bluebushes and Goosefoots, which form an ecologically important component of the community.

The Weeping Myall TEC was once distributed throughout large portions of western NSW and has been historically cleared across a large portion of its range such that less than 10% of the pre-1750 extent of the community remains (DEWHA 2009). Very few sizable remnants of the community remain across its range, with most patches being highly fragmented. Estimates of the remaining area are thought to be between 190-330,000 hectares (TSSC 2008).

Weeping Myall Woodlands are under threat from continued clearance for cropping and agriculture due to the highly fertile soils that the community occurs on. Continuing threats to the community also include fragmentation, overgrazing, weed invasion and herbivory by the caterpillars *Ochrogaster lunifer* (Bag-Shelter Moth), clearing and lopping for fodder, and dieback of the chenopod shrub layer (TSSC 2008).

### *Weeping Myall Woodlands within the Project area*

The presence of the Weeping Myall Woodlands has been confirmed in the Project area, with a small number of localised patches occurring within the northwest of the Project area. Within the Project area, 33 hectares of vegetation qualified as EPBC Weeping Myall Woodlands. An additional 3 hectares did not meet the EPBC requirements, however, still meets the TSC Act requirements for the Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions community.

### *Potential impacts and mitigation*

Weeping Myall Woodlands has the potential to be impacted both directly and indirectly by the Project, and these impacts may be significant.

Vegetation clearance may result in the removal of Weeping Myall Woodlands, and if this occurs it will reduce the area of occupancy and extent of this TEC. Vegetation clearance may also result in habitat fragmentation. The total area of Weeping Myall Woodland within the Project area is very small (33

hectares in a total Project area of approximately 98,000 hectares) and impacts to this TEC may be avoided. However, the total extent of this direct impact will be determined during the detailed impact assessment phase.

Disturbance from the Project may exacerbate the spread of weed species into areas of known and potential Weeping Myall Woodlands habitat. Weeds can impact the TEC both via direct competition and degradation of habitat. Weed management measures will be developed and implemented, along with rehabilitation of temporarily impact areas after construction. These measures will reduce impacts of weeds species.

Management and mitigation measures that will reduce potential impacts across the Project area and are applicable to Weeping Myall Woodlands are detailed in Section 4. These include co-locating infrastructure with existing access roads, tracks or other existing linear features or disturbed areas (where possible) and undertaking rehabilitation and weed management activities.

#### *Summary*

The Project area contains only 33 hectares of Weeping Myall Woodlands. The Project may have direct and indirect impacts to this TEC. These may be significant, and will be further assessed and quantified in the detailed impact assessment. Avoidance, management and mitigation measures will be implemented throughout construction and operation of the Project to minimise impacts to this species.

### **3.1 (e) Listed migratory species**

#### **Description**

A total of 11 listed migratory species were identified from the search undertaken using the DotE PMST as having the potential to occur within the Project area, with 3 additional migratory species included based on previous surveys. A full listing of these species is provided below. All are birds.

#### **Nature and extent of likely impact**

In this referral, potential impacts to migratory birds have been considered within the context of two key concepts commonly applied under the EPBC Act for migratory species (DEWHA 2009):

- Important habitat.
- Ecologically significant proportion of the population.

Where neither of these two features of a migratory species are present, impacts are generally not considered an issue under the EPBC Act (DEWHA 2009a).

Five terms for the likelihood of occurrence of species and communities are used and are defined as follows:

“Known”	= the species has been observed within the project area
“Likely”	= a medium to high probability that a species uses the project area
“Potential”	= suitable habitat for a species occurs within the project area, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
“Unlikely”	= a very low to low probability that a species uses the project area
“No”	= habitat within the project area and in the vicinity is unsuitable for the species

There are 14 migratory species which have the potential to occur within the Project area. Of these, seven are known to occur (Fork-tailed Swift, Great Egret, Cattle Egret, White-bellied Sea Eagle, White-throated Needletail, Rainbow Bee-eater, and Satin Flycatcher). The majority of these species may use the Project area in a transient manner.

SCIENTIFIC NAME	COMMON NAME	EPBC STATUS LISTING	LIKELIHOOD OF OCCURRENCE	SIGNIFICANT IMPACT LIKELY?
<i>Anthochaera phrygia</i>	Regent Honeyeater	Endangered, Migratory	Potential	No
<i>Apus pacificus</i>	Fork-tailed Swift	Migratory	Known	No
<i>Ardea modesta</i>	Eastern Great Egret	Migratory	Known	No
<i>Ardea ibis</i>	Cattle Egret	Migratory	Known	No
<i>Calyptorhynchus banksii</i>	Red-tailed Black-Cockatoo	Endangered, Migratory	Unlikely	No
<i>Gallinago hardwickii</i>	Latham's Snipe, Japanese Snipe	Migratory	Potential	No
<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle	Migratory	Known	No
<i>Hirundapus caudacutus</i>	White-throated Needletail	Migratory	Known	No
<i>Lathamus discolor</i>	Swift Parrot	Endangered, Migratory	Potential	No
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable, Migratory	Unlikely	No
<i>Merops omatus</i>	Rainbow Bee-eater	Migratory	Known	No
<i>Monarcha melanopsis</i>	Black-faced Monarch	Migratory	Unlikely	No
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Migratory	Known	No
<i>Rhipidura rufifrons</i>	Rufous Fantail	Migratory	Unlikely	No

Each of the migratory species considered has a broad natural distribution and is found in a large variety of areas throughout Australia. Any impacts on these species as a result of the Project are therefore expected to be minor (if any), highly localised and restricted to individual animals. In addition, the Project area does not represent important habitat or support an ecologically significant proportion of any population of the purely migratory species listed below, indicating that the threshold for significant impact will not be met.

Detailed consideration of the potential for significant impact under the EPBC Act for each migratory species considered known or likely to occur within the Project area is provided in below.

The Regent Honeyeater, Swift Parrot and Australian Painted Snipe, which are listed as threatened and migratory, are addressed above in section 3.1 (d).

A number of surveys have been undertaken within the Pilliga region to help understand the values of the area to birds. These surveys varied in methodology and purpose, but as a whole provide an appropriate set of information to understand the potential presence of migratory birds.

The table below provides an analysis of the potential presence of important habitat or an ecologically significant proportion of the population for each species. Key information used to determine the potential importance of the Project area includes:

- General information for each species in relation to distribution, habitat requirements, population and potential threats.
- Site specific information for the Pilliga Project area including the results of surveys and habitat use.

SPECIES	PRESENCE IN AUSTRALIA	PRESENCE WITHIN THE PILLIGA REGION	IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PROPORTION OF A POPULATION	IS THE PROJECT AREA LIKELY TO CONTAIN IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PORTION OF A POPULATION?
<p>White-Bellied Sea Eagle <i>Haliaeetus leucogaster</i></p>	<p>Global distribution from India and Sri Lanka, east to southern China, and south through South-East Asia, the Philippines, Wallacea and New Guinea.</p> <p>Not globally threatened and considered to be a common species throughout much of its range.</p> <p>Estimated global population of more than 10,000 individuals of which approximately 10–20% estimated to occur within Australia.</p> <p>Found in coastal habitats and near to terrestrial wetlands in tropical and temperate regions of mainland Australia.</p> <p>Breeding pairs mainly occur along the east coast.</p> <p>Generally forages over large expanses of open water.</p> <p>Main threats are habitat loss and disturbance from human activity.</p> <p>(DotE 2014q)</p>	<p>Known to occur within the Project area – observed during ecological surveys at a large dam in the north-east of the Project area.</p> <p>Habitat analysis indicates there is approximately 100 hectares of foraging habitat for this species within the Project area.</p>	<p>Important habitat is likely to include known nest sites for the species. Known nest sites are usually located in tall forest bordering a water body which could be used for foraging.</p> <p>Ecologically significant portion of the population in south-eastern Australia is considered to be 4 pairs.</p>	<p>Unlikely</p>
<p>Fork-tailed Swift <i>Apus pacificus</i></p>	<p>Non-breeding visitor.</p> <p>Broad distribution across Australia.</p> <p>Almost exclusively aerial.</p> <p>No known threats in Australia.</p> <p>(DotE 2014r)</p>	<p>Known to occur within the Project area – observed multiple times during ecological surveys.</p> <p>Habitat analysis indicates there is approximately 80,619 hectares of foraging habitat for this species</p>	<p>Abundance of this species has not been quantified within Australia, however, there are records of up to 90,000 individuals occurring in a single flock on rare occasions. As the species is not known to utilise key areas specifically for foraging, and does not breed in Australia, no important habitat or an</p>	<p>Unlikely</p>



SPECIES	PRESENCE IN AUSTRALIA	PRESENCE WITHIN THE PILLIGA REGION	IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PROPORTION OF A POPULATION	IS THE PROJECT AREA LIKELY TO CONTAIN IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PORTION OF A POPULATION?
		within the Project area.	ecologically significant portion of the population can be identified.	
White-throated Needletail <i>Hirundapus caudacutus</i>	Non-breeding visitor. Broad distribution across the east coast of Australia. Almost exclusively aerial. No known threats in Australia. (DotE 2014s)	Known to occur within the Project area – observed during ecological surveys. Habitat analysis indicates there is approximately 80,619 hectares of foraging habitat for this species within the Project area.	Abundance of this species has not been quantified within Australia. As the species is not known to utilise key areas specifically for foraging, and does not breed in Australia, no important habitat or an ecologically significant portion of the population can be identified. The species may show an affinity for forested sites.	Unlikely
Eastern Great Egret <i>Ardea modesta</i>	Wide spread in Australia in a variety of wetland habitats. Australian population estimated at 25,000 to 100,000. Most important populations occur in the Northern Territory. (DotE 2014t)	Known to occur within the Project area. Habitat analysis indicates there is approximately 9,585 hectares of foraging habitat for this species within the Project area.	Breeding colonies of the species occur throughout the coastal regions of Northern Australia, but are also known to occur in south-west Queensland, the Darling Riverine Plains, the Riverina NSW and Victoria. These populations are considered to be important populations of the species.  The species typically breeds in colonies containing hundreds to thousands of pairs. Any site which contains a population of more than one hundred pairs is likely to contain an ecologically significant portion of the population. Using 0.1% of the total population as a threshold that would equate to 250 individuals.	Unlikely

SPECIES	PRESENCE IN AUSTRALIA	PRESENCE WITHIN THE PILLIGA REGION	IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PROPORTION OF A POPULATION	IS THE PROJECT AREA LIKELY TO CONTAIN IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PORTION OF A POPULATION?
<p>Cattle Egret <i>Ardea ibis</i></p>	<p>Highly mobile, wide ranging migratory species that has been recorded throughout most of Australia.</p> <p>Population for Australia, New Guinea and New Zealand is estimated at 100,000 birds . (DotE 2014u)</p> <p>Found in open, grassy areas, such as pastures, meadows, marshes, flood plains and swamps.</p> <p>Has a preference for freshwater and is rarely found near marine environments.</p> <p>A diurnal feeder which commonly associates with native grazing mammals or domesticated livestock (and may follow farm machinery to capture disturbed prey). (Birdlife International 2014a)</p>	<p>Known to occur within the Project area.</p> <p>Habitat analysis indicates there is approximately 9,585 hectares of foraging habitat for this species within the Project area.</p>	<p>Important breeding populations occur between Newcastle and Bundaberg on the east coast as well as within major inland wetlands such as the Macquarie Marshes. The species typically breeds in colonies containing hundreds to thousands of pairs. Any site which contains a population of several hundred pairs is likely to contain an ecologically significant portion of the population.</p> <p>Important habitat for the species is likely to included substantial inundated forests or wooded swamps such as mangroves, <i>Melaleuca</i> swamps or eucalypt/lignum swamps known to support a breeding colony of the species as the species utilises inundated trees as nest sites.</p>	<p>Unlikely</p>

SPECIES	PRESENCE IN AUSTRALIA	PRESENCE WITHIN THE PILLIGA REGION	IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PROPORTION OF A POPULATION	IS THE PROJECT AREA LIKELY TO CONTAIN IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PORTION OF A POPULATION?
Rainbow Bee-Eater <i>Merops ornatus</i>	<p>Widely distributed throughout Australia and eastern Indonesia.</p> <p>Occurs across most of mainland Australia; although extent of occurrence and areas of occupancy are not well understood.</p> <p>The total Australian population size has not been estimated although it is thought to be reasonably large based on reporting rates (over 30,000 recorded sightings since 1998).</p> <p>Usually occurs in cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water.</p> <p>Feeds on insects and less commonly earthworms, spiders and tadpoles.</p> <p>Primary threat in north eastern Australia is the cane toad which feeds on eggs and nestlings and displaces nesting birds.</p> <p>(DotE 2014w)</p>	<p>Known to occur within the Project area – numerous observations during ecological surveys.</p> <p>Habitat analysis indicates there is approximately 66,901 hectares of breeding habitat and an additional 10,887 hectares of foraging habitat for this species within the Project area.</p>	<p>Abundance of this species has not been quantified within Australia. As the species is not known to utilise key areas specifically for forage or breeding, no important habitat or an ecologically significant portion of the population can be identified.</p> <p>The species is known to nest in loose colonies, and the species is known to show some degree of site fidelity returning to the same sites to breed.</p> <p>Important habitat for the species may include areas which are known to contain breeding sites for a large number of individuals (&gt;300), or sites to which the species shows strong site fidelity.</p>	<p>Unlikely</p>

SPECIES	PRESENCE IN AUSTRALIA	PRESENCE WITHIN THE PILLIGA REGION	IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PROPORTION OF A POPULATION	IS THE PROJECT AREA LIKELY TO CONTAIN IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PORTION OF A POPULATION?
<p>Satin Flycatcher <i>Myiagra cyanoleuca</i></p>	<p>Inhabits heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, will use coastal areas on migration flights. (DotE 2014v)</p> <p>Occurs along the east coast of Australia and PNG from far northern Queensland to Tasmania, including south-eastern South Australia. Not a commonly seen species, especially in the far south of its range, where it is a summer breeding migrant. (Birdlife International 2014b)</p>	<p>Known to occur within the Project area – numerous observations during ecological surveys.</p> <p>Habitat analysis indicates there is approximately 66,901 hectares of foraging habitat for this species within the Project area.</p>	<p>The species is known to breed in areas of south-eastern Australia above 600m, and usually nests in loose colonies. The species shows a high site fidelity for breeding and has been known to utilise the same tree on different years, showing a preference for mature forests. Important habitat for the species is considered likely to include mature forests containing heavily vegetated gullies which contain breeding records of the species, and suitable habitat within known migration pathways.</p>	<p>Unlikely</p>

SPECIES	PRESENCE IN AUSTRALIA	PRESENCE WITHIN THE PILLIGA REGION	IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PROPORTION OF A POPULATION	IS THE PROJECT AREA LIKELY TO CONTAIN IMPORTANT HABITAT OR AN ECOLOGICALLY SIGNIFICANT PORTION OF A POPULATION?
<p>Latham's Snipe <i>Gallinago hardwickii</i></p>	<p>Occur in temperate and tropical regions of Australia, as a single, dispersed non-breeding population.</p> <p>Entire global population is thought to migrate to Australia for the Australian summer.</p> <p>Highly mobile and move readily between sites as conditions change.</p> <p>In Australia, Latham's Snipe occur in permanent and ephemeral wetlands, usually in areas of open, freshwater wetlands with low, dense vegetation.</p> <p>Can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity. These habitats are most commonly used when the birds are on migration.</p> <p>The foraging habitats of Latham's Snipe are characterised by areas of mud (either exposed or beneath a very shallow covering of water) and some form of cover (e.g. low, dense vegetation).</p> <p>The species roost on the ground near and sometimes in their foraging areas.</p>	<p>Potential to occur within very small portions of the Project area.</p> <p>Habitat analysis indicates there is approximately 100 hectares of potential foraging and breeding habitat for this species within the Project area.</p>	<p>Important habitat for the Latham's Snipe is defined as habitat that supports greater than 18 individuals, and which is a naturally occurring freshwater wetland with suitable adjacent vegetation cover such as tussock grasses, lignum or macrophytes.</p>	<p>Unlikely</p>

### **3.1 (f) Commonwealth marine area**

#### **Description**

N/A

#### **Nature and extent of likely impact**

The Project is not in or near a Commonwealth Marine Area.

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### **3.1 (g) Commonwealth land**

#### **Description**

There are five (5) Commonwealth lands in the vicinity of the Project area:

- Commonwealth Trading Bank of Australia.
- Communications, Information Technology and the Arts – Australian Telecommunications Commission.
- Communications, Information Technology and the Arts – Australian Postal Corporation.
- Communications, Information Technology and the Arts – Telstra Corporation Limited.
- Education, Science and Training – CSIRO.

#### **Nature and extent of likely impact**

The above properties do not fall within the Project area, and the Project would not impact on these Commonwealth lands.

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### **3.1 (h) The Great Barrier Reef Marine Park**

#### **Description**

N/A

#### **Nature and extent of likely impact**

Not applicable. The Great Barrier Reef Marine Park is located approximately 700 kilometres to the north-east of the Project area.

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### **3.1 (j) Water resources in relation to coal seam gas and large coal mining development**

The EPBC Act was amended in June 2013, to provide that water resources are a matter of national environmental significance, in relation to coal seam gas and large coal mining development. This is directly relevant to the Project and as such impacts to water resources within the Project area have been addressed below.

For the purposes of this assessment, a water resource is defined as surface water or ground water, or a watercourse, lake, wetland (whether or not it currently has water in it) or aquifer; including all aspects of the water resource including water, organisms and other components and ecosystems that contribute to the physical state and environmental value of the water resource (*Commonwealth Water Act 2007*).

*Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments - impacts on water resources* state that an action is likely to have a significant impact on a water resource if there is a real or not remote chance or possibility that it will directly or indirectly result in a change to the hydrology or water quality of a water resource that is of sufficient scale or intensity as to reduce the current or future utility of the water resource for third party users, including environmental and other public benefit outcomes, or to create a material risk of such reduction in utility occurring. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of

the environment which is impacted. It also depends upon the intensity, duration, magnitude and geographic extent of the impacts.

An assessment of water resources within the Project area was undertaken to assess impacts from Santos' Coal Seam Gas Exploration Appraisal Program. The description of water resources and nature of impacts below is based on this assessment. A further, more detailed assessment of the intensity, duration, magnitude and geographic extent of impacts to water resources within the Project area is currently underway and will be completed as part of the detailed impact assessment phase of the Project.

## Description

### *Surface water resources*

The Project is located within the Namoi River Catchment which forms part of the Murray-Darling Basin and covers an area of approximately 42,000 square kilometres stretching from Woolbrook in the east to Walgett in the west. It is bounded to the east by the Great Dividing Range, to the north by the Gwydir catchment, to the south by the Castlereagh, Macquarie and Hunter Catchments and to the west by the Barwon-Darling catchment. The Project is mainly located in the Lower Namoi sub-catchment which commences at Narrabri.

Details of the surface water resources within the Project area, their sensitivity and current condition (as currently known) are provided below.

FEATURE	SENSITIVITY	DESCRIPTION
Namoi River	High – feature has high quality and rarity on a regional or national scale	The water in the heavily regulated Namoi River is of high quality and is utilised for stock, domestic and irrigation purposes. The water system is unique to the region. The losing nature of the system in the vicinity of the Project area suggests that it contributes to the groundwater within the Namoi Alluvium.
Bohena Creek	Medium – feature has high quality and rarity on a local scale	The ephemeral nature of Bohena and Jacks Creek support moderately to very disturbed ecosystems. The attributes of the creek systems are considered to be important on a local scale but abundant regionally. The ephemeral nature of the creeks means that they are not used for water supply.
Jacks Creek		
Mollee Creek	Low – feature has medium quality and rarity on a local scale	The ephemeral nature of Mollee Creeks is likely to support moderately to very disturbed ecosystems. The creek is likely to have very low value ecologically or for water supply purposes.
Mt Pleasant Creek	Low – feature has medium quality and rarity on a local scale	The ephemeral nature of the existing creek network is likely to support moderately to very disturbed ecosystems. The characteristics of the creek systems are common within the region. The ephemeral nature of the creeks means that they are not used as water sources for water supply.
Cowallah Creek	Low – feature has medium quality and rarity on a local scale	These tributaries are headwaters of the Bohena Creek. They are minor ephemeral creek systems, which include very limited remnant pools. They have very low value ecologically or for water supply purposes
Spring Creek		
Yellow Spring Creek		
Bibblewindi Creek		
Un-named minor tributaries	Very low – feature has low quality and rarity on a local scale	

The Namoi State of the Catchment Report (2010) identifies one surface water dependent ecosystems (SWDE) within the Project area, namely Yarrie Lake which occurs in the north-west of the Project area. The next nearest SWDEs are:

- The Lagoons (wetland billabong) approximately 17 km to the east of the Project area.
- Narrabri Lagoon (wetland billabong) approximately 6 km to the north-east of the Project area.

There are no other large standing water bodies within the Project area.

*Groundwater resources*

The Project area is located within both the Permo-Triassic Gunnedah Basin (containing the target seams for CSG development) and the south eastern fringes of the Coonamble Embayment, a southerly extension of the overlying Surat Basin.

The Project is underlain directly by unconsolidated alluvium overlying outcrops of the Jurassic and Cretaceous strata. These strata consist of the Keelindi Beds which overly Pilliga Sandstone and form part of the Coonamble Embayment, a southerly extension of the Surat Basin, and consequently the lowest intake beds of the Great Artesian Basin (GAB). These GAB sediments are underlain by the Gunnedah Basin strata including the Triassic Deriah, Napperby and Digby Formations.

The groundwater sources of highest value (significant transmissive units) within the Project area are:

- Superficial sediments of unconsolidated alluvium primarily the Namoi alluvium although other thinner alluvium does exist.
- The Pilliga Sandstone.

In addition a number of minor groundwater sources (less significant transmissive units) have been identified within the region, these are:

- The Late Triassic-Early Jurassic Garrawilla Volcanics.
- The Late Permian Clare Sandstone (of the Black Jack Group).

The coal seams (including the target coal seams) will also be included in the full impact assessment due to their relatively high conductivity in comparison with adjacent strata. Whilst they are not significant groundwater sources in terms of water supply, they can be considered significant transmissive units in the context of produced water extraction.

FEATURE	SENSITIVITY	DESCRIPTION
Bohena Creek Alluvium	Medium – feature has high quality and rarity on a local scale	Groundwater from this source may be abstracted for local use Supports Pilliga Terrestrial GDE Groundwater will have moderate recharge rates however recovery periods are likely to be relatively short as the aquifer is unconfined
Namoi alluvium	Medium – feature has high quality and rarity on a local scale	Locally this groundwater source is used predominantly for stock and domestic abstractions within the Project area. Regionally the Namoi alluvium is targeted directly by the irrigation industry and large volumes are extracted annually.
Pilliga Sandstone	Medium – feature has high quality and rarity on a local scale	This groundwater source is used predominantly for stock and domestic abstractions within the Project area The groundwater system is locally unique due to having few equivalents and forms part of the GAB The groundwater source is partially confined and therefore has low recharge rates and relatively long recovery periods



FEATURE	SENSITIVITY	DESCRIPTION
Garrawilla Volcanics	Low – feature has medium quality and rarity on a local scale	Water quality generally unknown but considered likely to be unsuitable for use  No known abstractions due to its depth  The attributes of the groundwater system are likely to be relatively commonly found however recharge rates are very low and recovery is also likely to be limited
Clare Sandstone	Very low – feature has low quality and rarity on a local scale	Water quality generally poor due to the presence of minor coals and unsuitable for any use  No known abstractions due to its depth and quality  The attributes of the groundwater system are likely to be relatively commonly found however recharge rates are very low and recovery is likely to be limited
Coal seams including the target formation	Very low – feature has low quality and rarity on a local scale	Water quality highly saline and unusable for any purpose  Attributes of this system are commonly found and widely distributed  The nature and depth of this formation results in its lack of use as a water resource
Groundwater Dependent Ecosystems, springs and wetlands	High – feature has high quality and rarity on a regional or national scale	High priority GDEs exist at Eather, Hardys and Mayfield springs  GDEs are likely to be used by threatened/migratory species, as described in relevant sections above  Adopting the precautionary principle, it is assumed that these GDEs are of high sensitivity
Stygofauna populations	High – feature has high quality and rarity on a regional or national scale	Stygofauna communities may exist in the unconsolidated alluvium within the Project area. Given the depth of the proposed CSG wells, their separation from the alluvium, geological features between, the significant irrigation extraction directly from the alluvium, their sensitivity has been designated as low

Groundwater use within the Project area is limited. This is attributed both to land use constraints arising from the Project area largely coinciding with the footprint of the Pilliga and lower bore yields associated with the consolidated rock units.

It is understood from the NSW Office of Water (NOW) bore database PINEENA and limited bore inventory data obtained within PEL238 that there are no extractions from formations deeper than the Pilliga Sandstone. The majority of bores are utilised for stock and domestic purposes. A town water supply is provided from abstraction bores in Narrabri, to the north of the Project area.

The target strata for CSG extraction are the principal coal seams of the Maules Creek Formation, which is not currently utilised for water supply due to depth, poor water quality and availability of better quality groundwater near the surface.

Compared with the assessment conducted in accordance with the Significant Impact Guidelines for the Exploration and Appraisal Program, an assessment of the Project indicates that the duration and wider geographic extent of depressurisation of groundwater head within the coal seams and adjacent strata will cause a significant impact to the groundwater resources of the Gunnedah-Oxley Basin. However, due to the depth of the target coal seams, low hydraulic conductivity of the target strata and poor hydraulic continuity with overlying strata, the overlying groundwater features of greater sensitivity (Pilliga Sandstone, alluvium) are highly unlikely to experience significant impact.

**3.2 Nuclear actions, actions taken by the Commonwealth (or Commonwealth agency), actions taken in a Commonwealth marine area, actions taken on Commonwealth land, or actions taken in the Great Barrier Reef Marine Park**

3.2 (a)	Is the proposed action a nuclear action?	X	No
			Yes (provide details below)

**If yes, nature & extent of likely impact on the whole environment**

3.2 (b)	Is the proposed action to be taken by the Commonwealth or a Commonwealth agency?	X	No
			Yes (provide details below)

**If yes, nature & extent of likely impact on the whole environment**

3.2 (c)	Is the project to be taken in a Commonwealth marine area?	X	No
			Yes (provide details below)

**If yes, nature and extent of likely impact on the whole environment (in addition to 3.1(f))**

3.2 (d)	Is the proposed action to be taken on Commonwealth land?	X	No
			Yes (provide details below)

**If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(g))**

3.2 (e)	Is the proposed action to be taken in the Great Barrier Reef Marine Park?	X	No
			Yes (provide details below)

**If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(h))**

**3.3 Other important features of the environment**

**3.3 (a) Flora and fauna**

The results of all environmental assessments undertaken in the Project area since 2005 have been used to describe the existing environment.

In addition to EPBC Act listed species, a number of threatened species listed on the NSW *Threatened Species Act 1995* (TSC Act) have been recorded in the Project area:

- *Calyptorhynchus lathami* (Glossy Black-cockatoo).
- *Cercartetus nanus* (Eastern Pygmy-possum).
- *Chalinolobus picatus* (Little Pied Bat).
- *Chthonicola sagittatus* (Speckled Warbler).
- *Circus assimilis* (Spotted Harrier).

- *Daphoenositta chrysoptera* (Varied Sittella).
- *Falco subniger* (Black Falcon).
- *Glossopsitta pusilla* (Little Lorikeet).
- *Grantiella picta* (Painted Honeyeater).
- *Hieraaetus morphnoides* (Little Eagle).
- *Hoplocephalus bitorquatus* (Pale-Headed Snake).
- *Lophoictinia isura* (Square-tailed Kite).
- *Macropus dorsalis* (Black-striped Wallaby).
- *Melanodryas cucullata cucullata* (Hooded Robin (south-eastern form)).
- *Merops ornatus* (Rainbow Bee-eater).
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat).
- *Neophema pulchella* (Turquoise Parrot).
- *Ninox connivens* (Barking Owl).
- *Petaurus norfolcensis* (Squirrel Glider).
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler (eastern subspecies)).
- *Saccolaimus flaviventris* (Yellow-bellied Sheathtail-Bat).
- *Stagnopleura guttata* (Diamond Firetail).
- *Tyto novaehollandiae* (Masked Owl).
- *Vespadelus troughtoni* (Eastern Cave Bat).

Several exotic fauna species have also been recorded, including: *Vulpes vulpes* (Red Fox), *Felis catus* (Feral Cat), *Oryctolagus cuniculus* (European Rabbit), *Sus scrofa* (Feral Pig), *Lepus europaeus* (Brown Hare) and *Capra hircus* (Goat).

In addition to EPBC Act listed species, the following threatened flora species listed on the TSC Act have been recorded in the Project area:

- *Diuris tricolor* – vulnerable (under TSC Act).
- *Myriophyllum implicatum* – critically endangered (under TSC Act).
- *Polygala linariifolia* – endangered (under TSC Act).
- *Pomaderris queenslandica* – endangered (under TSC Act).
- *Pterostylis cobarensis* – vulnerable (under TSC Act).

A small number of invasive exotic flora species have been identified in the Project area, including *Xanthium occidentale* (Noogoora Burr) and *Hyparrhenia hirta* (Coolatai Grass).

### 3.3 (b) Hydrology, including water flows

Details of the hydrology are provided in Section 3.1(j), in relation to impacts to water resources from coal seam gas and large coal mining development.

### 3.3 (c) Soil and Vegetation characteristics

PEL 238 is located in the central portion of the Gunnedah Basin where Jurassic and Cretaceous Surat Basin sediments unconformably overlie Permo-Triassic Gunnedah Basin sediments. The Gunnedah Basin covers an area of more than 15,000 square kilometres and is defined in structural terms as being bounded to the east by the Hunter-Mooki Thrust Fault System and the New England Fold Belt, and to the west by the Lachlan Fold Belt onto which the Gunnedah Basin sediments gradually onlap.

The Gunnedah Basin consists of Early Permian to Late Triassic aged consolidated sediments of shallow marine and fluvial origin. These sediments are underlain by basement rocks of the Lachlan Fold Belt. Basement rocks of the New England Fold Belt abut the eastern boundary of the Gunnedah Basin.

The most important Gunnedah Basin structure within the Project area is the Bohena Trough. The Bohena Trough contains two well-developed coal measures, which are the primary natural gas targets for the Project.

The Project area is dominated by sandy soils associated with undifferentiated alluvium and deeper weathered sandstone. It is situated within outcropping Pilliga Sandstone recharge zones of the Great Artesian Basin. Due to the sandy soils, and subsequent high infiltration rates, precipitation would infiltrate the soil and then into the underlying sediments. Most stream sediment within this landscape is derived from Pilliga Sandstone plateaus, or as a result of reworking of the broad outwash plain.

Soil nutrient mapping by NSW OEH confirms the low fertility in the Project area, with the bulk of the Project area showing 'moderately low' as the inherent soil fertility classification, with areas to the north of the forest being of 'moderate' inherent soil fertility.

### 3.3 (d) Outstanding natural features

The Project area spans several state forests including the Pilliga East State Forest, Bibblewindi State Forest, and Jacks Creek State Forest. It is also located within improved and irrigated pasture, cropping and grazing land. The Pilliga as a whole is recognised as an important area for biodiversity in NSW west of the Great Dividing Range.

### 3.3 (e) Remnant native vegetation

Biometric Vegetation Types (BVTs) are a higher order vegetation class used in regional biodiversity planning in NSW. 13 BVTs have been mapped in the Project area (Table 1).

**Table 1: Biometric Vegetation Types within the Project area**

BVT ID	BVT	Total area mapped (hectares)
NA102	Belah woodland on alluvial plains in central-north NSW (Benson 55)	685.45
NA117	Brigalow - Belah woodland on alluvial often gilgaied clay soil mainly in the Brigalow Belt South Bioregion (Benson 35)	6,696.48
NA121	Broombush shrubland of the sand plains of the Pilliga region, subtropical sub-humid climate zone (Benson 141)	1,402.3
NA124	Brown Bloodwood - cypress - ironbark heathy woodland in the Pilliga region of the Brigalow Belt South Bioregion	30,951.37
NA126	Carbeen woodland on alluvial soils (Benson 71)	15.03
NA141	Fuzzy Box on loams in the Nandewar Bioregion and northern Brigalow Belt South Bioregion (Benson 202)	590.35
NA143	Green Mallee scrub on sandstone rises in the Brigalow Belt South Bioregion (Benson 179)	20.33
NA160	Mugga Ironbark - Pilliga Box - pine- Bulloak shrubby woodland on Jurassic Sandstone of outwash plains (Benson 255)	367.4
NA179	Pilliga Box - Poplar Box- White Cypress Pine grassy open woodland on alluvial loams mainly of the temperate (hot summer) climate zone (Benson 88)	6,891.91
NA193	River Red Gum riverine woodlands and forests in the Nandewar and Brigalow Belt South Bioregions (Benson 78)	10.49
NA197	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion	8,691.25
NA219	Weeping Myall open woodland of the Darling Riverine Plains and Brigalow Belt South Bioregions (Benson 27)	209.26
NA227	White Cypress Pine - Bulloak - ironbark woodland of the Pilliga area of the Brigalow Belt South Bioregion	23,986.89
Other	Includes cleared, creek bed, dams and improved pasture	14,718.13
<b>Total</b>		<b>95,236.64</b>

Within these BVTs, there are four endangered ecological communities (as listed under the TSC Act), and two threatened ecological communities (as listed under the EPBC Act). These are shown below in Table 3.

**Table 2: Endangered and Threatened Ecological Communities**

EEC	TSC ACT AREA (HECTARES) <sup>#</sup>	EPBC ACT AREA (HECTARES)
Weeping Myall Woodlands (EPBC Act) Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (TSC Act)	36.00	32.52
Brigalow ( <i>Acacia harpophylla</i> dominant and co-dominant) (EPBC Act) Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (TSC Act)	2,467.97	2,447.35
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions (TSC Act)	590.35	N/A
Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions (TSC Act)	15.03	N/A
<b>Total</b>	<b>3,109.35</b>	<b>2,479.87</b>

# TSC Act area includes the EPBC Act area

### 3.3 (f) Gradient (or depth range if action is to be taken in a marine area)

The land has been described as gently undulating around 280 metres (Australian Height Datum).

### 3.3 (g) Current state of the environment

The vegetation within the Project area has been variously affected by a long history of forestry, fires and small-scale agriculture. Forestry tracks (both formal and informal) form a fragmented network across the Project area; however, there are large patches (>1,000 hectares) of contiguous vegetation which have not been dissected by forestry. Areas which have remained long unburnt (>10 yrs) generally support large hollow-bearing trees.

Currently eight land use classes have been mapped within the Project area. The predominant land use is native vegetation/forestry, constituting 75 % of the total Project area. The second most dominant land use is 'grazing' with a combined 24 %. Notably of this 24 %, DNG constitutes 10 % and the remainder consists of cropping or improved pasture.

**Table 3: Land use within the Project area**

LAND USE	TOTAL AREA MAPPED (HECTARES)
Cleared	1,425.25
Creek Bed	148.35
Dam	100.1
Grazing - DNG	9,484.83
Grazing - Other - Cropping	4,972.18
Grazing - Other - Improved Pasture	3,627.2
Grazing - Other - Previous Evidence of Pasture Improvement	4,445.05
Native Vegetation / Forestry	71,033.68
Total	95,236.64

The vegetation within the Project area is generally considered to be in good condition. Few weeds are present within the area (refer to 3.3 (a)), and mainly occur within riparian zones. Generally, vegetation around the existing well pads, areas that have undergone logging and existing access road shows a higher level of disturbance.

The Project area supports a number of introduced fauna species (refer to 3.3 (a)) which are variously affecting the biodiversity values in the Project area through predation and competition.

Riparian zones show low levels of erosion.

### **3.3 (h) Commonwealth Heritage Places or other places recognised as having heritage values**

There are no Commonwealth heritage places located within the Project area and there are no other known places of heritage value.

### **3.3 (i) Indigenous heritage values**

The Project is located within the boundaries of the Narrabri and Wee Waa Local Aboriginal Land Councils (LALCs), and wholly within the area of the Registered Native Title Claimants - the Gomeroi People.

During the development of the Preliminary Environmental Assessment (GHD 2014) a search of the Office of Environment and Heritage Aboriginal Heritage Information Management System (AHIMS) database was undertaken in September 2013 to determine whether there are any Aboriginal sites within the Project area or vicinity (i.e. within 5 kilometres of the Project area boundary).

The database search results indicate that 160 registered Aboriginal sites have been recorded in the vicinity of the Project area. The database search results are presented in Table 4.

Of these 160 Aboriginal sites, 22 are located within the Project area. These include 14 modified trees, 7 artefacts and 1 grinding groove site. There are likely to be Aboriginal heritage sites within the Project area that have not been recorded within the AHIMS.

**Table 4: AHIMS database search results**

<b>ITEM</b>	<b>NO. RECORDED IN VICINITY OF PROJECT</b>
Aboriginal ceremony/dreaming	1
Artefact	135
Burial	1
Grinding groove	2
Habitation structure	2
Hearth	2
Modified tree	16
Shell	1
Total	160

The surface and sub-surface disturbance may have the potential for direct and indirect impacts on items of Aboriginal cultural heritage. The strategy for the protection and management of Aboriginal cultural heritage is to work with the relevant Aboriginal parties to develop an integrated and comprehensive management framework for cultural heritage that will apply for the life of the Project.

Additionally, Santos is currently undertaking an audit of all Aboriginal cultural heritage, including information held by the Narrabri LALC. An analysis of the information identified through the audit will

be undertaken in collaboration with the Registered Native Title party, Narrabri LALC and OEH. The audit will provide key information for the zone mapping.

In addition to the data audit, Santos proposes to undertake the following activities as part of the impact assessment phase:

- Identification, notification and registration of Aboriginal people who hold cultural knowledge relevant to the Project area.
- Provide registered Aboriginal parties with information about the scope of the Project and the proposed cultural heritage assessment process.
- Undertake consultation in regards to gathering cultural information, research methods and management options. This information will inform zone mapping to guide field development, construction and operation during production.
- Targeted field surveys to ground-truth historic site data, and assessment of locations of potential cultural heritage significance.
- Assessment of potential impacts and appropriate mitigation measures in relation to the Project.

In contrast to many local resource developments which are required to clear and excavate large areas of land in specific locations, the Project has greater flexibility in siting of infrastructure, and in particular, wells and gas and water gathering lines. As such, consultation with key Aboriginal stakeholders will focus on the development of a robust cultural heritage management framework that will guide the micro-siting of infrastructure at the time of construction. Field development would be undertaken in consultation with the relevant Aboriginal stakeholders and would seek to minimise impacts, as far as practicable, on Aboriginal heritage.

The Santos Cultural Heritage Standards and supporting systems would ensure compliance with:

- The management framework developed with the Aboriginal stakeholders.
- All legislative requirements, in a manner that is comprehensive, documented and auditable.

The Cultural Heritage Management Framework will include appropriate response management protocols and systems for landscapes, sites and objects as identified in the mapping and will be finalised prior to construction commencing.

### **3.3 (j) Other important or unique values of the environment**

The Project area is located within Pilliga East State Forest, Jacks Creek State Forest, Bibblewindi State Forest and private freehold land.

### **3.3 (k) Tenure of the action area**

The Project area is held under a number of different tenures including:

- Crown land including State Forest, travelling stock reserves (TSRs) and State Conservation Area.
- Crown Land Road Reserve (both Crown Roads and Narrabri Shire Council).
- Private land (freehold) owned by Santos and other land holders.

### **3.3 (l) Existing land/marine uses of area**

The Project would be wholly located within the Narrabri LGA. Land use in the Narrabri LGA is dominated by primary production, including agriculture and forestry (54.7%). Other land uses comprise rural residential development (18.7%), native vegetation (14.6%), irrigated plants consisting predominantly of cotton (11.1%), intensive animal husbandry (0.2%) and extractive industries (0.1%).

The majority of the Project would be located in an area designated as either RU1 (Primary Production) or RU3 (Forestry) under the Narrabri Local Environment Plan 2012. Brigalow Park Nature Reserve, which is surrounded by the Project area though excluded from the Project footprint, is designated E1 (National Parks and Nature Reserves). Land designated as RU1 (Primary Production) consists predominantly of agricultural land supporting dry-land cropping and pastoral (livestock) activities. Land designated as RU3 (Forestry) includes the Pilliga East State Forest, Bibblewindi State Forest and Jacks Creek State Forest. These state forests are designated Crown Lands under the Forestry Act 1916.

State forests and conservation areas in the region are administered under the *Brigalow and Nandewar Community Conservation Area Act 2005*, which designates the area into Community Conservation Areas (CCAs). The purpose of CCAs is to reserve land for conservation, protect areas of natural and cultural heritage significance to Aboriginal people, sustainable forestry and mining and other appropriate uses. Pilliga East State Forest, Bibblewindi State Forest and Jacks Creek State Forest located within the Project area are managed as Zone 4 CCAs, in accordance with the *Forestry Act 2012*. Zone 4 CCAs are managed specifically for forestry, recreation and mineral extraction (NSW EPA 2013). State forests within the Project area and vicinity are also used for recreational activities such as bird watching and bushwalking, and hunting.

The New England North West SRLUP (DPI, 2012) represents one component of the NSW Government's broader Strategic Regional Land Use Policy which comprises multiple initiatives to address land use conflict in regional areas, particularly focused on managing coal and natural gas issues. The SRLUP maps areas of strategic agricultural land. Strategic agricultural land includes both land with unique natural resource characteristics, known as BSAL, and clusters of significant agricultural industries that are potentially impacted by natural gas or mining development, known as Critical Industry Clusters (CICs).

The Project falls within the area regulated by the New England North West SRLUP. However, regional broad scale mapping of strategic agricultural land within the SRLUP indicates that the Project would not fall within any mapped BSAL (DPI 2012 and 2013). Further, the Project would not be located on or near any mapped CICs, as no CICs have been identified in the New England North West region (DPI, 2012). Due to the regional scale of the mapping, it is important that site-specific verification is undertaken. Therefore, a site verification application would be prepared to determine if the Project area meets the BSAL site criteria as defined by the SRLUP Interim protocol for site verification and mapping of biophysical strategic agricultural land (GHD 2014).

Open cut coal mines including Maules Creek, Narrabri, and Boggabri exist in the Narrabri LGA. There are also a number of petroleum titles within and around the Project, all held by Santos.

### **3.3 (m) Any proposed land/marine uses of area**

There are no other proposed uses of the Project area, other than those that currently occur and the referred action.



## 4 Measures to avoid or reduce impacts

A number of avoidance, mitigation and management measures will be undertaken as part of the Project in order to minimise potential impacts to MNES, as outlined below.

### ***Avoidance measures***

The design and location of infrastructure for the Project will make maximum use of areas within or adjacent to existing disturbance. This strategy will continue to reduce the overall extent of clearing required and to date has substantially avoided increasing the level of existing fragmentation and edge effects within the landscape. This strategy includes:

- Preparation of a field development protocol which considers threatened species, ecological communities and their potential habitats and prioritising them for avoidance.
- The development of field clearance procedures for all necessary project clearing to ensure that all infrastructure is appropriately located for minimal impact on MNES.
- The lateral well design has minimised surface disturbance and helped avoid the need for hydraulic fracturing (fracking).
- Routes for linear infrastructure such as gas and water gathering systems will use existing roads, access tracks and disturbance corridors wherever possible. Further micro-alignment may be undertaken to minimise impacts on known ecological constraints such as threatened species and hollow-bearing trees, if practicable.
- Construction of the gas and water gathering systems will use a 'plough-in' technique where possible as this reduces the width of the corridor required for construction, minimises disruption to top soil, and minimises the need for traditional trenching and dewatering of open trenches.

### ***Mitigation and management measures***

The following key measures will be implemented to mitigate and manage potential impacts to MNES potentially occurring within the Project area:

- A weed and pest management plan will be developed and implemented to address issues of weed introduction and feral animal infestations within the Project area.
- A feral animal control strategy will be developed which will address feral animal control at a landscape scale.
- A water management plan will be developed and implemented, to address issues associated with hydrological changes and water quality impacts for both surface and groundwater.
- A bushfire hazard and risk assessment will be developed and implemented.
- Pre-clearance surveys of areas of potential habitat for all MNES described in Section 3.1(d) will be undertaken by suitably qualified ecologists to re-locate (where possible) fauna and habitat features prior to clearing.
- Appropriate construction and operational controls will be developed and implemented (i.e. construction and operational management plans) to address issues such as sediment and erosion control, exclusion fencing, signage and site inductions.
- Development and implementation of protocols to record vegetation clearance and ensure it is within the approved overall limits.

### ***Rehabilitation***

Rehabilitation of the impacted areas will occur as soon as practicable and in a number of stages:

- Following the construction and installation of infrastructure, portions of the sites will undergo immediate rehabilitation. More than half of the clearing associated with the well pads and the gas and water gathering systems will be rehabilitated.

- Following the decommissioning of infrastructure, full rehabilitation of sites will be undertaken.

The areas rehabilitated will be determined by a range of factors including safety, security and bush fire asset protection requirements. Along the gas and water gathering systems, up to 60% of the corridors will be rehabilitated as soon as practicable following the installation of infrastructure to reduce the level of habitat fragmentation.

### ***Current rehabilitation of previous exploration activities***

Rehabilitation of existing exploration and appraisal activities is currently being undertaken. These activities provide a benchmark for understanding the potential reduction in impact as a result of rehabilitation works identified for the Project.

Santos has commenced a program of rehabilitation works throughout PEL 238 and PAL 2. Rehabilitation works include:

- Reducing the size of existing well leases back to the minimum area required for operations.
- Plugging and abandoning, according to legislative requirements, wells that are no longer required for exploration and appraisal and rehabilitating associated well leases.
- Rehabilitating a number of water storage ponds that are no longer required for exploration and appraisal activities.

Actions undertaken during the clearing of vegetation include stockpiling 'waste' timber from felled trees not suitable for forestry activities, fallen logs and bush rock for later use in habitat restoration; low vegetation is slashed and mulched on site; and topsoil is striped and stockpiled. Rehabilitation actions include replacing topsoil, re-installing habitat features such as fallen timber and bush rock, natural re-establishment of slashed and cleared native vegetation, and direct seeding where required.

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

Rehabilitation works associated with the Project will follow the methods developed for the existing exploration and appraisal activities.

Santos has identified approximately six hectares of vegetation dieback which has resulted from the actions of the previous operator (Eastern Star Gas). The affected areas occur within the White Cypress Pine – Bullock – Ironbark woodland of the Pilliga area of the Brigalow Belt South Bioregion BVT adjacent to areas cleared for infrastructure. Santos has progressed rehabilitation of these areas in consultation with the NSW Government.

To date, rehabilitation of approximately 28 hectares of land, including the vegetation dieback areas, has commenced.

### ***Offsetting***

Following the application of all reasonable measures to avoid and mitigate impacts to MNES, any residual significant impacts to the species/communities will be offset in a single consolidated biodiversity offset package developed in accordance with the NSW Biodiversity Offsets Policy for Major Projects.

# 5 Conclusion on the likelihood of significant impacts

## 5.1 Do you THINK your proposed action is a controlled action?

- |                                     |                           |
|-------------------------------------|---------------------------|
| <input type="checkbox"/>            | No, complete section 5.2  |
| <input checked="" type="checkbox"/> | Yes, complete section 5.3 |

## 5.2 Proposed action IS NOT a controlled action.

NA

## 5.3 Proposed action IS a controlled action

### Matters likely to be impacted

<input type="checkbox"/>	World Heritage values (sections 12 and 15A)
<input type="checkbox"/>	National Heritage places (sections 15B and 15C)
<input type="checkbox"/>	Wetlands of international importance (sections 16 and 17B)
<input checked="" type="checkbox"/>	Listed threatened species and communities (sections 18 and 18A)
<input type="checkbox"/>	Listed migratory species (sections 20 and 20A)
<input type="checkbox"/>	Protection of the environment from nuclear actions (sections 21 and 22A)
<input type="checkbox"/>	Commonwealth marine environment (sections 23 and 24A)
<input type="checkbox"/>	Great Barrier Reef Marine Park (sections 24B and 24C)
<input type="checkbox"/>	Protection of the environment from actions involving Commonwealth land (sections 26 and 27A)
<input type="checkbox"/>	Protection of the environment from Commonwealth actions (section 28)
<input type="checkbox"/>	Commonwealth Heritage places overseas (sections 27B and 27C)
<input checked="" type="checkbox"/>	Water resources, in relation to coal seam gas and large coal mining developments ('water trigger') (sections 24D and 24E)

As detailed above, the Project has the potential to impact on several threatened flora and fauna species, TECs, as well as water resources. Consequently, Santos believes the Project is a controlled action.

The total extent to which impacts will be realised depends on a number of factors, which will be determined during a detailed impact assessment phase. Santos is committed to minimising impacts to MNES as much as practicable during the construction and operation of the Project and where complete avoidance is not possible, management and mitigation measures will be implemented.

## 6 Environmental record of the responsible party

	Yes	No
<p><b>6.1 Does the party taking the action have a satisfactory record of responsible environmental management?</b></p> <p>See also further information in section 6.2 below.</p>	X	
<p><b>6.2 Has either (a) the party proposing to take the action, or (b) if a permit has been applied for in relation to the action, the person making the application - ever been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources?</b></p> <p>Santos Limited acquired Eastern Star Gas Limited (ESG) on 17 November 2011. The applicant, Santos NSW (Eastern) Pty Ltd, is a subsidiary of ESG and became a wholly owned subsidiary of Santos Limited on its acquisition of ESG on 17 November 2011.</p> <p>In July 2012 ESG was issued two penalty infringement notices (PINs) for pollution incidents which occurred at the Bibblewindi Water Treatment Facility prior to November 2011. The details of these PINs are as follows:</p> <ul style="list-style-type: none"> <li>• Pollution of Bohena Creek on 11 March 2010 due to discharge of permeate, from the reverse osmosis (RO) plant at Bibblewindi, with electrical conductivity levels above background</li> <li>• Pollution of Bohena Creek on 25 November 2010 due to discharge of permeate, from the RO plant at Bibblewindi, with electrical conductivity levels above background.</li> </ul> <p>In June 2013 proceedings were commenced in the Land and Environment Court against Santos NSW (Eastern) Pty Ltd for breaches of the <i>Petroleum (Onshore) Act 1991</i> (NSW) for past reporting failures in relation to natural gas operations in the Pilliga in north west NSW. Santos NSW (Eastern) Pty Ltd is a subsidiary of ESG and became a wholly owned subsidiary of Santos Limited on its acquisition of ESG on 17 November 2011. Santos NSW (Eastern) Pty Ltd was fined \$52,500 after pleading guilty to the charges..</p> <p>On 11 February 2014, Santos NSW (Eastern) Pty Limited was issued with a PIN in respect of water pollution from Bibblewindi Pond 3.</p> <p>The RO plant at Bibblewindi Water Treatment Facility ceased operation on 15 December 2011. Santos has been progressively rehabilitating the areas affected by the incidents and progressing alternative arrangements for managing existing produced water stored at Bibblewindi Pond 3. State approval has been granted to transfer water currently stored at this facility to the Leewood Produced Water Facility.</p> <p>With respect to proceedings relating to other Santos entities, on 10 September 2003, the Moonie Pipeline Company Pty Ltd, a Santos controlled entity, pleaded guilty to a charge under Section 437(2) of the Queensland Environmental Protection Act 1994 related to an oil spill at Lytton on 18 March 2003. The Moonie Pipeline Company Pty Ltd was fined \$300,000 with no</p>	X	

conviction recorded.		
<p><b>6.3 If the party taking the action is a corporation, will the action be taken in accordance with the corporation's environmental policy and planning framework?</b></p> <p>The Project will be planned and carried out in accordance with Santos' Environmental Policy (attached).</p>	X	
<p><b>6.4 Has the party taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act?</b></p> <p>Santos NSW (Eastern) Pty Ltd referred the Energy NSW Coal Seam Gas Exploration and Appraisal Program under the EPBC Act in June 2013. The outcome of this referral was not a controlled action if undertaken in a particular manner decision (Reference number 2013/6918)</p> <p>ESG also referred a number of actions which were subsequently withdrawn. These include:</p> <ul style="list-style-type: none"> <li>• Eastern Star Gas Limited/Energy generation and supply (non-renewable)/25 km SW of Narrabri, 80km NNE of Coonabarabran/NSW/Narrabri Coal Seam Gas Field Development (Reference number 2011/5914)</li> <li>• Eastern Star Gas Limited/Energy generation and supply (renewable)/Coolah to Newcastle/NSW/Gas Transmission Pipeline (Reference number 2011/5917)</li> <li>• Eastern Star Gas Limited/Energy generation and supply (non-renewable)/43 and 45 Greenleaf Road, Kooragang Island, Newcastle/NSW/Newcastle LNG export facility (Reference number 2011/5915)</li> <li>• Eastern Star Gas Limited/Energy generation and supply (non-renewable)/Pipeline extends 285-294 km between Wellington and Narrabri/NSW/Narrabri to Wellington gas transmission pipeline (Reference number 2011/5913).</li> </ul> <p>With respect to other Santos entities, a number of actions involving onshore and offshore petroleum exploration and production activities have been referred under the EPBC Act including:</p> <ul style="list-style-type: none"> <li>• Santos Limited/Energy generation and supply (non-renewable)/Central Southern Queensland/QLD/Santos GLNG Gas Field Development Project, QLD (Reference number 2012/6615)</li> <li>• Santos Ltd/Energy generation and supply (non-renewable) area around Emerald, Injune, Taroom and Roma townships/WLD/Coal Seam Gas Field Development for Natural Gas Liquefaction Park Curtis Island (Reference number 2008/4058)</li> <li>• Santos Ltd/Energy generation and supply (non-renewable)/Curtis Island, Near Gladstone/QLD/Development of a Natural Gas Liquefaction Park (Reference number 2008/4057)</li> <li>• Santos Ltd/Exploration (mineral, oil and gas - marine)/Browse Basin/WA/Offshore Gas Exploration Drilling Campaign (Reference number 2012/6384)</li> </ul>	X	

- |  |  |  |
|--|--|--|
| <ul style="list-style-type: none"><li>• Santos Offshore Pty Ltd /Exploration (mineral, oil and gas - marine)/Within Commonwealth Waters of the Joseph Bonaparte Gulf/WA/Fishburn2D Marine Seismic Survey (Reference number 2012/6659)</li><li>• Santos Limited/Energy generation and supply (non-renewable)/152km North of Dampier, Western Australia/Commonwealth Marine/Fletcher-Finucane Development, WA26-L and WA191-P (Reference number 2011/6123)</li><li>• Santos Limited/Exploration (mineral, oil and gas - marine)/76km north of Barrow Island, WA/Commonwealth Marine/Santos Winchester three dimensional seismic survey- WA-323- P &amp; WA-330-P (Reference number 2011/6107)</li><li>• Santos QNT Pty Ltd/Energy generation and supply (non-renewable)/40km South of Gunnedah/NSW/George's Island Pilot Wells Development (Reference number 2011/6022).</li><li>•</li></ul> |  |  |
|--|--|--|

# 7 Information sources and attachments

(For the information provided above)

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## 7.2 Reliability and date of information

All information relied on in the compilation of this document has been sourced from reliable, established sources, such as reputable specialist consulting firms and government agencies. The most up-to-date information available has been provided.

## 7.3 Attachments


	✓ attached	Title of attachment(s)
<b>You must attach</b> figures, maps or aerial photographs showing the Project locality (section 1)	✓	Included in section 2
figures, maps or aerial photographs showing the location of the Project in respect to any matters of national environmental significance or important features of the environments (section 3)		Detailed mapping of the location of MNES is currently underway. This will be provided during the detailed impact assessment phase.
<b>If relevant, attach</b> copies of any state or local government approvals and consent conditions (section 2.5)		N/A
copies of any completed assessments to meet state or local government approvals and outcomes of public consultations, if available (section 2.6)		Currently under preparation.
copies of any flora and fauna investigations and surveys (section 3)		Numerous flora and fauna investigations have been used to prepare this referral.  A comprehensive ecological impact assessment document will be prepared during the detailed impact assessment phase which will detail the results from surveys undertaken within the Project area from 2005 to date.
technical reports relevant to the assessment of impacts on protected matters that support the arguments and conclusions in the referral (section 3 and 4)		Numerous technical reports have been used to prepare this referral.  A comprehensive ecological impact assessment and water resources assessment will be prepared during the detailed impact assessment phase which will assess the potential impacts of the Project on MNES.
report(s) on any public consultations undertaken, including with Indigenous stakeholders (section 3)		N/A

## 8 Contacts, signatures and declarations

### Project title:

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#### 8.1 Person proposing to take action

Name Neale House  
Title Manager Environment and Water - Energy New South Wales  
Organisation Santos NSW (Eastern) Pty Ltd  
ACN / ABN (if applicable) 009 321 662 / 11 009 321 662  
Postal address Level 16, 40 Creek Street, Brisbane QLD 4000  
Telephone 07 3838 3861  
Email Neale.House@santos.com  
Declaration I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct.  
I understand that giving false or misleading information is a serious offence.  
I agree to be the proponent for this action.  
I acknowledge that I may be liable for fees related to my proposed action following the introduction of cost recovery under the EPBC Act.  
Signature  Date 28/10/14

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#### 8.2 Person preparing the referral information

Name Martin Sullivan  
Title Manager Hunter Region  
Organisation Eco Logical Australia Pty Ltd  
ACN / ABN (if applicable) 87 096 512 088  
Postal address PO Box 1056, Newcastle NSW 2300  
Telephone 02 4910 0125  
Email [martinsullivan@ecoaus.com.au](mailto:martinsullivan@ecoaus.com.au)  
Declaration I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct.  
I understand that giving false or misleading information is a serious offence.  
Signature  Date 28/10/14

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