Glasserton Pilot Wells, PEL 1, Gunnedah Basin

Detailed Ecological Assessment

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<tr>
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<th>Meaning</th>
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<tbody>
<tr>
<td>aff.</td>
<td>Affinity</td>
</tr>
<tr>
<td>AHD</td>
<td>Australian Height Datum</td>
</tr>
<tr>
<td>AoS</td>
<td>Assessment of Significance</td>
</tr>
<tr>
<td>API</td>
<td>Aerial Photograph Interpretation</td>
</tr>
<tr>
<td>BoM</td>
<td>Bureau of Meteorology</td>
</tr>
<tr>
<td>CEEC</td>
<td>Critically Endangered Ecological Community</td>
</tr>
<tr>
<td>CMA</td>
<td>Catchment Management Authority</td>
</tr>
<tr>
<td>DBH</td>
<td>Diameter (centimetres) at Breast Height</td>
</tr>
<tr>
<td>DECCW</td>
<td>NSW Department of Environment, Climate Change and Water</td>
</tr>
<tr>
<td>DEWHA</td>
<td>Department of Water, Heritage and the Arts</td>
</tr>
<tr>
<td>EA</td>
<td>Ecological Assessment</td>
</tr>
<tr>
<td>EEC</td>
<td>Endangered Ecological Community</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>EP&amp;A Act</td>
<td>NSW Environmental Planning and Assessment Act 1979</td>
</tr>
<tr>
<td>EPBC Act</td>
<td>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</td>
</tr>
<tr>
<td>ESCP</td>
<td>Erosion and Sediment Control Plan</td>
</tr>
<tr>
<td>FFMP</td>
<td>Flora and Fauna Management Plan</td>
</tr>
<tr>
<td>FM Act</td>
<td>NSW Fisheries Management Act 1994</td>
</tr>
<tr>
<td>ha</td>
<td>hectare</td>
</tr>
<tr>
<td>IBRA</td>
<td>Interim Biogeographic Regionalisation of Australia</td>
</tr>
<tr>
<td>KTP</td>
<td>Key Threatening Process</td>
</tr>
<tr>
<td>LGA</td>
<td>Local Government Area</td>
</tr>
<tr>
<td>Locality</td>
<td>Lands within 10km of the study area</td>
</tr>
<tr>
<td>MNES</td>
<td>Matters of National Environmental Significance</td>
</tr>
<tr>
<td>NES</td>
<td>National Environmental Significance</td>
</tr>
<tr>
<td>NPWS</td>
<td>NSW National Parks and Wildlife Service</td>
</tr>
<tr>
<td>NSWG</td>
<td>NSW Government</td>
</tr>
<tr>
<td>NV Act</td>
<td>Native Vegetation Act 2003</td>
</tr>
<tr>
<td>NW Act</td>
<td>Noxious Weeds Act 1993</td>
</tr>
<tr>
<td>PFC</td>
<td>Projected Foliage Cover</td>
</tr>
<tr>
<td>REF</td>
<td>Review of Environmental Factors</td>
</tr>
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</table>
| ROTAP        | Rare or Threatened Australian Plants (Briggs & Leigh 1995) ROTAP Codes are as follows:-
              | 2 = Geographic Range in Australia is less than 100 km
              | R = Rare
              | C = Conserved
<pre><code>          | - = Reserved population unknown |
</code></pre>
<p>| RPS          | RPS Australia East Pty Ltd |
| RRMP         | Rehabilitation and Revegetation Management Plan |
| SAMBA        | Shallow Aquifer Monitoring Bore |</p>
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
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<tr>
<td>SEPP 44</td>
<td>State Environmental Planning Policy 44 “Koala Habitat Protection”</td>
</tr>
<tr>
<td>SEWPaC</td>
<td>Department of Sustainability, Environment, Water, Population and Communities</td>
</tr>
<tr>
<td>Sp</td>
<td>Singular Species</td>
</tr>
<tr>
<td>Spp</td>
<td>Multiple Species</td>
</tr>
<tr>
<td>Ssp. or subsp.</td>
<td>Subspecies</td>
</tr>
<tr>
<td>Activity Site</td>
<td>Area directly associated with the proposed activities</td>
</tr>
<tr>
<td>Study Area</td>
<td>Area indirectly associated with the proposed activities</td>
</tr>
<tr>
<td>TEC</td>
<td>Threatened Ecological Community</td>
</tr>
<tr>
<td>TSC Act</td>
<td>NSW Threatened Species Conservation Act 1995</td>
</tr>
<tr>
<td>Var.</td>
<td>Variety</td>
</tr>
<tr>
<td>WMP</td>
<td>Weed Management Plan</td>
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1.0 Introduction

Santos QNT Pty Ltd (Santos), as operator for and on behalf of the holders of petroleum exploration licence 1 (PEL 1), is seeking approval to undertake the drilling of the pilot wells and ancillary activities on George’s Island. Three pilot wells are required to be drilled, completed and tested within PEL 1, located in the western extent of the Glasserton property, Lot 1 DP1099622, on the western side of Clift Road, (study area). Additionally, the proposal also includes the installation of a wellhead and downhole gauge in Glasserton 3 and 4 and George’s Island 3 to monitor pressure data in the target Hoskissons coal seam.

George’s Island 3 is located within Lot 27 in DP755494 at a previously approved and constructed well lease site. Access to Georges Island 3 will be required across Lot 1 DP 571743, Lot 2 DP 1099622, and land marked as a road between Lot 2 DP 1099622 and Lot 27 in DP755494, on the eastern side of Clift Road. RPS was engaged to undertake an ecological assessment to identify ecological constraints, potential impacts and mitigation measures associated with the proposed activities.

This ecological assessment accompanies the review of environmental factors (REF) prepared in accordance with the Environmental Planning and Assessment Act 1979 (NSW) and the referral to be submitted under the Environment Protection and Biodiversity Conservation Act 1999 (Cth) in relation to the proposed activities.

Numerous investigations have been undertaken in the study area. A detailed ecological assessment was carried out between 28 March and 1 April 2011, which included detailed flora and fauna surveys, targeted searches and habitat assessments. The methods used are outlined in Section 3.

1.1 Site Particulars

1.1.1 Regional Location

The study area occurs on a topographical feature referred to as George’s Island that is located approximately 40 km south of Gunnedah and approximately 35 km northwest of Quirindi in the Brigalow Belt South IBRA Bioregion and Liverpool Plains IBRA Subregion. Locally, the study area is situated within the Gunnedah LGA. George’s Island is isolated from neighbouring woodlands within the locality, the closest being Doona State Forest located approximately 5 km to the east, Spring Ridge State Forest approximately 7 km to the southwest and Breeza State Forest approximately 7.5 km to the north (see Figure 1.1). Due to George’s Island being fragmented and isolated from neighbouring woodlands, it possesses ‘island biogeography’.

1.1.2 Study Area Description

The study area is approximately 52.56 ha, a small portion of George’s Island (which encompasses approximately 428.3 ha). The study area is comprised of a mosaic of grassy woodland vegetation communities and is bounded by similar vegetation to the east, northeast and south and agricultural land to the west and northwest, as shown on Figure 1.1. The study area contains two abandoned quarries previously used for gravel extraction which have since formed two small ephemeral waterholes. The study area is accessible via Clift Road, which connects back to the Quirindi Premer Road.
1.1.3 Topography

The topography of the study area is flat to undulating with slopes in the order of 0-10 %. An east to west low lying ridge dominates the study area with a relatively flat and level area in the northwestern corner. Elevation across the study area ranges between approximately 310 m Australian Height Datum (AHD) in the northwestern corner up to approximately 330 m AHD along the southeastern corner adjacent to Clift Road.

1.1.4 Climate

The Bureau of Meteorology (BoM) weather station most representative of the study area is Quirindi Post Office. The local climate of the study area is temperate with a slightly summer dominant rainfall. The average daily maximum temperature is around 24.6°C, while the average daily minimum temperature is around 8.9°C (Bureau of Meteorology, 2011). Long-term mean annual rainfall for the locality is 684.3 mm and is known to range between 337.7 mm (lowest record 1919) to 1,149 mm (highest record 1921).

As shown in Table 1.1, based on mean temperature records, the warmest month is January and the coolest month is July. January receives the greatest rainfall and April the least, however very little variation occurs throughout an average year.

Table 1.1: Climate Statistics from Quirindi Post Office BoM Weather Station

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<tr>
<td>Mean Max Temp (°C)</td>
<td>32.2</td>
<td>31.3</td>
<td>29.3</td>
<td>24.9</td>
<td>20.5</td>
<td>16.6</td>
<td>15.9</td>
<td>17.9</td>
<td>21.5</td>
<td>25.2</td>
<td>28.4</td>
<td>31.2</td>
</tr>
<tr>
<td>Mean Min Temp (°C)</td>
<td>16.4</td>
<td>16.1</td>
<td>13.5</td>
<td>8.9</td>
<td>5.1</td>
<td>2.8</td>
<td>1.6</td>
<td>2.4</td>
<td>5.0</td>
<td>8.7</td>
<td>11.9</td>
<td>14.8</td>
</tr>
<tr>
<td>Mean Rainfall (mm)</td>
<td>80.7</td>
<td>65.5</td>
<td>53.1</td>
<td>42.1</td>
<td>44.4</td>
<td>51.3</td>
<td>48.5</td>
<td>45.4</td>
<td>46.6</td>
<td>60.7</td>
<td>64.8</td>
<td>80.9</td>
</tr>
</tbody>
</table>

1.1.5 Geology and Soils

According to the Soil Landscapes of the Curlewis 1:100,000 Map Sheet (Banks, 1994), the geology and soil landscapes of the study area are Yarraman, (ya), Goscombes Road (go) and Stafford Gap (sg), as shown on Figure 1.2. Descriptions of each soil type are provided below.

Yarraman (ya)

Landscape - level to gently inclined, extensive very broad drainage plains and floodplains on basaltic alluvium in the Goran Basin Plains. Local relief <9 m, slopes <1%, elevation range 340 - 360 m. Closed-grassland mostly cleared for agriculture (Banks, 1994).

Soils - Poorly drained giant self-mulching Grey Vertosols (Grey Clay) dominate episodically waterlogged areas with poorly drained giant Black Vertosols (Black Earths) in remaining area (Banks, 1994).

Limitations - flood hazard, localised waterlogging, permanently high, watertables, periodic waterlogging, high run-on, saline aquifer recharge zone, dryland salinity hazard, wind erosion hazard (saline areas). Soil materials with high plasticity, low wet bearing strength, high shrink-swell potential, sodic properties and low permeability and localised salinity (Banks, 1994).
Discontinuous limestone travertine (and associated calcareous marl) bands within 3 m of the surface are a severe hazard for irrigation, and impedes profile drainage (Banks, 1994).

**Goscombes Road (go)**

Landscape - broad (>500 m) very gently to gently inclined drainage plains and alluvial fans below footslopes of Permian and Triassic lithic and quartzose sandstones of the Curlewis Hills. Local relief to 60 m, slopes 1 - 5%, elevation range 290 - 380 m. Woodland and open-forest about 50 % cleared for grazing and occasional cultivation (Banks, 1994).

Soils - soils highly variable and dependent largely on lithology of catchment from which fan material has been derived. Predominantly deep (150 cm), moderately well drained Mottled-Subnatric Yellow Sodosols (yellow Solodic Soils); Brown Chromosols (Red-brown Earths); Bleached-Leptic Tenosols (Earthy Sands and Alluvial Soils). These soils are often underlain by buried soils indicating a repetitive cycle of denudation of landscapes in the surrounding catchments (Banks, 1994).

Limitations - localised flood hazard, high run on, episodic water logging, water erosion hazard and localised dryland salinity. Soil profile drainage is generally poor. Potential saline aquifer recharge zone (Banks, 1994).

**Stafford Gap (sg)**

Landscape - undulating rises to rolling hills on Triassic lithic and quartzose sandstones and conglomerates of the Curlewis Hills. Local relief to 150 m, slopes 3 – 20 %, rock outcrop <20 % sometimes forming low (<10 m) scarps, elevation range 280 - 600 m. Open- and closed-woodland approximately 40% cleared for grazing and agriculture (Banks, 1994).

Soils - highly variable, due to extreme variation in parent material. Soil types include shallow to moderately deep (40 - 150 cm), moderately well drained Red Kandosols (Red Earths), and Bleached Leptic Tenosols (Earthy Sands), and Yellow Chromosols (Yellow Podzolic Soils) on crests and upper sideslopes, with shallow to moderately deep (60 - 200 cm), moderately well drained Red Chromosols (Red-brown Earths), Yellow Chromosols (Yellow Podzolic Soils), and Mottled-Subnatric, Yellow Sodosols (yellow Solodic Soils), on lower sideslopes and along drainage lines (Banks, 1994).

Limitations - water erosion hazard, wind erosion hazard, shallow soils, rock outcrop, structural decline hazard and localised dryland salinity hazard. Soils have localised high erodibility, stoniness, hardsetting surfaces and are generally of low fertility. Saline aquifer recharge zone (Banks, 1994).

### 1.2 Description of the Proposed Activities

#### 1.2.1 Introduction

Santos proposes to undertake drilling, completion and testing activities to assess the coal seam gas potential of the Gunnedah Basin in PEL 1.
A REF was submitted in October 2010 and approval granted by Department of Industry and Investment (DII) on 3 December 2010, for 3 pilot wells to be located in the flat, open agricultural land of the “Glasserton” property to the east of the subject site. Due to landholder concerns with that location, an alternative pilot well program is now being proposed, which is the subject of the revised REF.

The proposal includes drilling at three sites within George's Island (Glasserton 2, 3 and 4) to obtain information on coal depths, seam thickness, continuity and permeability. Coal seams of a particular interest will be cored in selected pilot wells for geo-mechanical analysis of coal seam permeability. Drill stem testing (DST) or equivalent downhole evaluation is also undertaken on coal seams to establish reservoir pressure and give an indication of permeability.

In addition, Santos proposes to install a wellhead and downhole gauge in the Glasserton 3 and 4 wells and in an existing well (George's Island 3) located on the other side of George's Island.

In summary, the process involves:

- Preparation of a level drill pad at the three drilling locations (also referred to as “well lease areas”);
- Placement of a drilling rig and ancillary equipment at the well lease;
- Drilling of the pilot wells including (on a per well basis):
  - Drilling of surface hole;
  - Casing and cementing of surface casing;
  - Drilling of main hole;
  - Collection and analysis of drill cores (as required);
  - Conducting of wireline evaluation (as required);
  - Conducting of well tests (as required);
  - Casing and cementing of main hole; and
  - Creation of access to target formation (e.g. via undereaming of main casing).
- Completion of the wells via installation of required downhole equipment;
- Partial rehabilitation of the well leases;
- Construction of required water storage and surface facilities;
- Operation of Glasserton 2 for not less than 60 days (in total), with a maximum water output of 10 ML;
- Removal of equipment and imported materials;
- Shut-in of the wells, with rehabilitation to minimal area around each well site;
- Shallow Aquifer Monitoring Bore to remain;
- Cessation of operations of temporary water storage and load out facilities;
- Decommissioning of water storage facilities; and
- Suspension and rehabilitation as required (see Section 1.4).
Glasserton 2 will be the central well, in which a wellhead and downhole pumping assembly will be installed for the purposes of lifting water. Glasserton 3 and 4 and George's Island 3 will have a wellhead and downhole pressure gauges installed for the purposes of monitoring the effect of the removal of water from the target formation in Glasserton 2. This will involve:

- Mobilising a wireline truck (dimensions approximately equal to a Isuzu 1400 tandem axle body truck) to conduct the wellhead installation and downhole gauge installation; and
- Construction of a data logger/telemetry skid at the wellhead.

A Shallow Aquifer Monitoring Bore (SAMB) will also be drilled within the disturbed drill lease area of Glasserton 3. The drilling of the SAMB will include:

- Constructing lined drilling sumps as required and otherwise preparing an area within the Glasserton 3 lease to accommodate the drilling rig and associated vehicles;
- Drill and completing the bore using a Truck Mounted Water Bore Drilling Rig;
- Drill 8” conductor hole to 5-10m and case with PVC casing to hold back unconsolidated soils;
- Drill hole (diameter 6”) to 30m into Trinkey Formation using mud rotary and/or rotary air hammer methods as required;
- Conduct open hole logging as required;
- Conduct permeability testing as required;
- Install steel tubing in the hole (expected tubing grade is 2-3/8” 4.7# J55 EUE) with attached downhole equipment:
  - Quartz Pressure Gauges across key formations of interest; and
  - Gauge control and data lines with associated tubing clamps.
- Cement the downhole equipment in place utilising a bentonite/cement mixture;
- Install solar powered data logger and telemetry at surface; and
- Fencing off the surface monitoring systems once in place.

Water will be lifted to the surface through Glasserton 2 to complete a 60 day pump test and will be temporarily stored in a storage facility to be constructed to the south of Glasserton 2 in a disused gravel pit. Water will be transported from the Glasserton 2 wellhead via a buried pipeline to a 30m diameter bunded tank. Water will be offloaded from the tank to water tankers as required via means of a load-out facility adjacent to the tank. Water will then be transported from George's Island to an agreed licensed facility.

A scouting survey has been undertaken prior to drilling taking place to locate the three sites with an emphasis on minimisation of impacts on the environment and property operations. Santos has entered into a land access agreement for Lot 1 in DP 1099622 and a separate land access agreement with a separate landholder for Lot 27 in DP755494.
1.2.2 Site Preparation and Equipment

Various works will be required in order to prepare the subject site for the proposed activities, including preparation of the well leases, access track improvements/reinstatement and construction, as well as positioning the drill rig and associated temporary buildings on the subject site. The major equipment used on site during activities will be a drilling rig, water storage and surface facilities, civil works equipment and associated temporary buildings and vehicles. These works are summarised further in this section. Figures 3-1 to 3-3 illustrate the site layout for each of the three well leases.

During site preparation, there will be some soil disturbance as a level drill pad will need to be constructed at each proposed well lease. No earthworks will be required at George’s Island 3.

Plastic lined drilling sumps will be constructed on the Glasserton 2, 3 and 4 leases. Temporary flaring facilities will be located at each site during drilling and will be removed at the end of drilling activities. A flare will be positioned at the Glasserton 2 site for the duration of the 60 day pumping test whilst flaring facilities at the other wellbores will be used during the drilling phase only. The area to be disturbed for drilling activity varies for each of the leases and is outlined in Table 1.2.

It is not anticipated that any potential noise mitigation measures, such as noise barriers would be required, as a result of excessive noise generation during site preparation and/or well lease operation, therefore no additional surface or vegetation disturbances would be required for the provision of noise barriers to minimise potential noise impacts.

Table 1.2: Areas of disturbance and cut and fill for well leases

<table>
<thead>
<tr>
<th>Well Lease</th>
<th>Total Disturbance Area</th>
<th>Pad Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasserton 2</td>
<td>3,600 m² (0.36 ha)</td>
<td>Cut and fill will be required to establish a pad level at approximately RL 319 m AHD.</td>
</tr>
<tr>
<td>Glasserton 3</td>
<td>5,100 m² (0.51 ha)</td>
<td>Cut and fill will be required to establish a pad level at approximately RL 307.7 m AHD.</td>
</tr>
<tr>
<td>Glasserton 4</td>
<td>4,700 m² (0.47 ha)</td>
<td>Cut and fill will be required to establish a pad level of approximately RL 317.5 m AHD.</td>
</tr>
<tr>
<td>Water Storage Facilities</td>
<td>2,300 m² (0.23 ha)</td>
<td>Cut and fill will be required to provide a level pad.</td>
</tr>
</tbody>
</table>

Well Lease Construction

- The access gate on Clift Road will be upgraded and widened to allow egress of required equipment;
- Civil works equipment will be moved to site including bulldozer, excavator, grader, roller, water trucks, other trucks and support and light vehicles;
- Portable amenities will be located on site during construction;
- Any topsoil will be stripped and stockpiled. If import material is required, clean fill will be sourced for use on site;
- Required sumps will be excavated and lined with an impermeable membrane such as plastic sheeting;
- The lease area will be graded and rolled;
- A 14" steel conductor casing will be pre-installed at approximately 10m depth by the civil works crews ahead of the rig arriving on site; and
- Trimming of grass regrowth at the existing well lease area at George's Island 3.

**Access Track Improvements and Construction**

There are existing tracks which provides access to all three well lease locations and to George's Island 3 (refer Section 3.3 of the REF for further detail). Some regrading, widening and in some cases minor realignment of the existing track will be required to access Glasserton 2, 3 and 4. The following is a list of the detailed works involved.

- Minor amounts of vegetation will be removed either side of the existing access tracks. Trimming of some vegetation may also be required. Removal of any vegetation will be conducted under the supervision of an appropriately qualified ecologist. Minimum vegetation will be removed to permit access for all required equipment;
- Minor realignment of tracks may be required in places to permit equipment access to Glasserton 2, 3 and 4 (e.g. to permit long loads to traverse sharp bends);
- Re-alignment of the existing track will occur between Glasserton 3 and 4 in order to provide more efficient and direct access and to remove the need to construct an access track across black soil. The proposed new alignment is able to avoid all significant and mature trees; and
- Some parts of the track may need to be filled at some point during the project in order to provide all weather access. Should this be the case, a geotextile fabric will be used as a base to ensure that all imported fill is removed from the site at the completion of activities.

**Drill Rig Positioning and Operation**

Equipment will enter/exit the site via the main access gate from Clift Road and will be positioned on site as per the site layouts in Figures 3-1 to 3-3 of the REF. Equipment will include generator units, lighting towers, site offices, stores and other various buildings and equipment required for the duration of drilling.

It is proposed that Glasserton 2 will be drilled first, followed by Glasserton 3 and 4, with the rig being relocated following completion of drilling at each lease. Operational difficulties may require the wells to be drilled in a different order than this.

It is planned to move the rig out via the entrance route at all lease sites except Glasserton 3, where the main track passes adjacent to the lease. Both access tracks to the north and south of Glasserton 2 and west and east of Glasserton 3 will be used to facilitate the rig move. At Glasserton 4 the rig will exit the lease via the entrance track. No new tracks besides those existing and detailed in the site drawings will be used.

Rigging up/down of equipment (i.e. installation and dismantling of rig equipment) is expected to take up to 3 days per lease (3 per rig up, 3 per rig down).

Ancillary equipment will be required on site during the course of the drilling activities, including but not limited to wireline trucks, cementing trucks and well testing service company vehicles.
### 1.2.3 Access

All vehicles will access the site from Clift Road. Glasserton 2, 3 and 4 will be accessed via the existing gate on the western side of Clift Road, which will be widened to allow trucks to enter the site. George’s Island 3 will be accessed through Lot 2 via the existing gate and track on the eastern side of Clift Road.

Access to Glasserton 2, 3 and 4 will be via existing and re-aligned access tracks. The existing track is approximately 3-4 m wide and there will need to be some vegetation removal along the periphery of this track to enable the site machinery to access each of the pilot well locations. A track of maximum 8 m width is required to enable manoeuvring of the drill rigs. This width may be reduced on straight sections of track where turning is not required. The track will only be widened as necessary to accommodate the drill rig and will not exceed 8 m.

Some trimming of grassy understorey vegetation along the existing access track to George’s Island 3 and at the George’s Island 3 wellhead may be required to enable the wireline truck to enter the site and to install the downhole pressure gauge. In 2006 the track was utilised by a drill rig carrier of significantly greater dimensions than the equipment required to install the downhole pressure gauge into the existing wellhead.

Vegetation removal will be minimised and only undertaken under the supervision of a qualified ecologist.

There will need to be some slashing undertaken to provide a looped access track at the Glasserton 2 site, as per Figure 3.1 of the REF. This is required to enable the drill rig to exit the lease area upon completion of drilling. Part of this looped access track will also be used during the pilot testing as a water tanker turnaround circle.

Slashing is also proposed to provide an alternative access route to Glasserton 4 in order to avoid the black soils on the site.

### 1.2.4 Water Storage

Sufficient on site storage is required for the water lifted as a result of the proposed activities. Santos are currently negotiating with Whitehaven Coal who are licensed to take all of the lifted water at their Werris Creek Mine. The water will be trucked from site by a licensed carrier.

A number of options were considered for water storage on site, both in terms of location of the site and size of storage facilities. The selection process was again based on the principles of harm avoidance and/or minimisation. The preferred option is for a single 30 m diameter tank, to be located within the disused quarry on the south western side of the existing access track at Glasserton 2. This location minimises the need for the clearing of vegetation and earthworks will be generally restricted to areas already disturbed as a result of quarrying operations. A level pad will be constructed at approximately 321.5 m AHD.

A lined bunded area will be constructed around the tank to provide containment of the water in the event of a spill or leak from the tank. The top of bund will be at a height of approximately 323.5 m AHD to provide a bunded volume equal to 100% of the tank volume. An area of approximately 60 x 55 m will be required to accommodate the tank and bunding (refer Figure 3.5 of the REF).
I.2.5 Drilling Activities

Pilot Wells

Each site will have a specific well design ensuring compliance with relevant legislation. An open hole of nominal 311 mm diameter will be drilled through any alluvial and/or weathered material into competent rock and a blow out preventer (BOP) casing cemented in place, which will have a BOP installed on top of it. The hole will be drilled using open hole rotary drilling to a depth above the primary target coal seams. An open hole of nominal 216 mm diameter will then be drilled to a depth below the target coal seams. Appendix E of the REF includes further details in relation to the design of the pilot wells.

On penetrating target coal seams, coring and well testing may be conducted to evaluate local variations in coal seam permeability. Any testing would be performed in accordance with legislative requirements. The closest well to the proposed activities is Glasserton 1A. Glasserton 1A was fully cored through the coal bearing sequence and is located 0.3 km to the north west of the proposed central pilot well, Glasserton 2. The Glasserton pilot wells will not be fully cored, rather selected coal seams may be cored for additional geo-mechanical permeability analysis to support drill stem test (DST) (or equivalent down hole evaluation) derived permeabilities.

Once each well has reached the total depth, geophysical wire-line logs will be run over the entire length of the hole to identify major stratigraphic units, intersected coal seam depth and seam thickness. Further DST (or equivalent downhole) evaluation may follow after completion of logging. A combination of steel and fibre glass casing will be run in the hole and pressure cemented ensuring total isolation of the well bore to the surrounding coal seams and any potential aquifers. The combination casing design allows fibreglass to be placed over potential future mineable coal seams whereas steel casing isolates all other non target rock types. Exemption will be sought for any incidental or unavoidable installation of steel casing over minor coal seams. The fibreglass is then under reamed over the target coal sequence providing a conduit for fluids to flow into the well bore.

Shallow Aquifer Monitoring Bore (SAMB)

The Glasserton Shallow Aquifer Monitoring Bore (SAMB) is an activity ancillary to the drilling, completion and testing of the Glasserton Pilot wells. The purpose of the SAMB activities is to obtain data regarding potential changes in shallow aquifer levels within the vicinity of the pilot test area prior to, during and following the single well pilot test activities at Glasserton.

The purpose of the SAMB activities is to provide Santos and the Regulator with data regarding potential changes in shallow aquifer levels within the vicinity of the pilot test area prior to, during and following the single well pilot test activities.

This data can then be used to objectively assess the impact on the aquifer systems due to CSG production activity and to differentiate it from potential impacts due to existing aquifer uses and natural variations.

The SAMB activities involve:
- Constructing lined drilling sumps as required and otherwise preparing an area within the Glasserton 3 drilling lease to accommodate the SAMB drilling rig and associated vehicles;
- Drill and completing a bore using a Truck Mounted Water Bore Drilling Rig;
- Drill 8” conductor hole to 5-10m and case with PVC casing to hold back unconsolidated soils;
- Drill 6” hole to 30m into Trinkey Formation using mud rotary and/or rotary air hammer methods as required;
- Conduct open hole logging as required;
- Conduct permeability testing as required;
- Install steel tubing in the hole (expected tubing grade is 2-3/8” 4.7# J55 EUE) with attached downhole equipment:
  - Quartz Pressure Gauges across key formations of interest; and
  - Gauge control and data lines with associated tubing clamps.
- Cement the downhole equipment in place;
- Install solar powered data logger and telemetry at surface; and
- Fencing off the surface monitoring systems once in place.

Access to the sites will be via the existing tracks. Vehicular activity will be minimised when the ground is soft after rain.

The number of employees present at the SAMB site is expected to be up to 10 persons. The hours of operation during the drilling will be on a 12-hour a day basis.

Drilling activities are temporary and will not have any long-term impact on the visual amenity of the area. The drilling and completion of the bore is expected to occur over a 7 day period not including lease preparation, completion operations or site restoration. Lease construction and rehabilitation activities of up to 30 days will be additional to this period and may not occur concurrently to the drilling activities.

The SAMB will be installed prior to the start of the pilot test. Formation Pore Pressure data will be continuously monitored by the SAMB and Santos will receive and record the data via the installed telemetry system. Data will be reported to stakeholders on a regular schedule which is to be agreed. No water will be lifted from the SAMB following completion so it will not be able to be used to measure water quality data.

Permeability testing is expected to be conducted up to three (3) times for the bore via the Lugeon testing method. The permeability tests are performed by isolating a specific interval with inflatable straddle packers via wireline through the drilling rods.

Prior to the start of the test, water is injected into the section isolated by the straddle packers to ensure the section to be tested is saturated. The test consists of injecting water into the isolated section at constant pressure and monitoring the water injection rate for ten minutes (or longer while the injection rate stabilises). The injection pressure is then increased in two steps with monitoring of the injection rate conducted for ten minutes as for the first part of the test. The injection pressure is then decreased in two
steps with monitoring of the injection rate for ten minutes for each step. The water injection rate is recorded at one-minute intervals during each step.

A lugeon value is calculated from the injection pressure and injection rate for each pressure step in the test. The lugeon values determined from each of the five pressure settings is then assessed to determine the flow regime in the formation (laminar, turbulent, dilation, wash-out or void filling). From this analysis a representative lugeon value, which is converted to hydraulic conductivity, is determined for the geologic unit.

1.2.6 Completions

Pilot Wells

All completion activities will be contained within the proposed lease areas and therefore no additional disturbance will be required.

Completion activities will be in two stages. The initial stage will be to install equipment into the new well to be drilled at Glasserton 2. The drilling rig will be utilised to install the downhole pump assembly and hydraulic drive head with additional support equipment to be mobilised as required.

The proposal includes the installation of a wellhead and downhole gauge in the existing George's Island 3 well and in Glasserton 3 and 4 to monitor pressure data in the target Hoskissons coal seam. This will involve mobilisation of a wireline truck (dimensions approximately equal to a Isuzu 1400 tandem axle body truck) to install the wellhead and downhole gauges and construction of a data logger/telemetry skid at the wellhead.

Completions will require 3 days to install the progressive cavity pump and approximately 1 day per well to install the pressure monitoring equipment.

SAMB

All completion activities will be contained within the proposed lease areas and therefore no additional disturbance will be required.

Completion activities will be to install monitoring equipment into the new well. These activities will occur immediately following drilling.

If at the time of completing the activities Santos choose not to continue with the monitoring, the bore will be plugged and abandoned and all land disturbances will be rehabilitated.

1.3 Operation

Upon construction of surface facilities at the site, Santos will commission the surface facilities in accordance with Santos’ EMP (refer Appendix F of the REF). A review of the completed surface facilities will be undertaken by a Gunnedah Basin Project Execution operations team.
The operational phase of the activities will involve lifting water from Glasserton 2 via a hydraulically driven Progressive Cavity Pump. Water and any associated gas lifted to the surface will be processed through a separator, which allows the water and gas to naturally separate in a pressure vessel. Any gas from the separator will be flared as required under legislation. Water from the separator will enter a transfer tank with a transfer pump delivering the lifted water to the water storage facility. Water trucks will cart water from the storage facility to a licensed facility at Whitehaven Coal. During this process Glasserton 3, Glasserton 4, and George’s Island 3 will monitor the pressure within the target coal seam. Shallow Aquifer Monitoring Bores will also measure pressures in the formations above the target coal seam.

The activities will have a Supervisory Control and Data Acquisition (SCADA) system, allowing operations to be monitored and controlled by Santos. The pilot wells will also have automated shutdown systems triggered by the exceedance of preset operating windows designed to prevent environmental, health or safety risk.

1.4 Cessation of Operations and Rehabilitation

1.4.1 Wells

Following completion of not less than 60 days of pumping, the SAMB, Glasserton 2, 3 and 4 wells, as well as George’s Island 3 will be shut-in and suspended. This process is slightly different for each well and will entail activities as follows:

- The SAMB is effectively abandoned to fluid flow in the subsurface from the time of drilling (the bore is cemented to surface) so this well will be maintained in its operational state following the initial 60 day pump test;
- At George’s Island 3 and Glasserton 3 and 4 the tubing and annulus valves will continue to be isolated at the wellhead and the well suspended with the downhole equipment in place and continuing to monitor data whilst the well is suspended. The tubing and annular pressure gauges will be monitored to ensure the well is effectively shut-in;
- At Glasserton 2 the Blow-Out Preventer in the pumping wellhead will be secured against the PCP rod string, the annulus and tubing valves will be isolated at the wellhead and the downstream valve will be shut on the riser. The separator will be depressurised and emptied of fluid; and
- For all sites regular checking and maintenance of the wellheads and water storage facilities will be conducted by Gunnedah Operations. Physical checking of the sites will occur on a monthly interval as a minimum and more frequently as required. Monitoring of the data output from the SCADA telemetry system will be performed on a daily basis by the Gunnedah Operations team.

Glasserton 2, 3, 4 and George’s Island 3 wells are proposed to be shut in (using the procedures outlined above) and suspended in accordance with relevant legislation. The lease facilities (telemetry system, separators, flaring system etc.) are proposed to be removed. Downhole completions will remain in the wells and the area around each wellhead will be rehabilitated back to an area of approximately 5m x 5m around each wellhead. These remaining areas immediately surrounding the wellheads are proposed to be maintained by the Operator as suspended petroleum well leases in accordance with legislative requirements. Isolation padlocks will be installed on wellhead valves to protect against vandalism and gas
monitoring will be conducted at each suspended well on each site visit to check for leaks. The SAMB is proposed to remain in an operational state.

Once the drilling and testing activities are complete, any surplus compound area is proposed to be rehabilitated to an area of approximately 5 m x 5 m around each well head with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. All rehabilitation works would be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

Rehabilitation is to be undertaken within regulatory timeframes. All private tracks used during operations are generally returned to their pre-operations state, or to a condition agreed by the landholder.

1.4.2 Water Storage Area

The temporary water load out facilities and water tanker turnaround circle will be decommissioned and removed from site. The area they impacted on will be rehabilitated.

The water tank and associated bunding and liner are proposed to remain in place for potential landholder or other use.

1.4.3 Duration

Assuming a commencement date in the third quarter of 2011, it is expected that all activities including rehabilitation will be finalised by mid 2012. Table 1.3 details the expected duration of activities associated with the proposal.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Expected Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lease Build</td>
<td>30 days</td>
</tr>
<tr>
<td>Drilling</td>
<td>30 days</td>
</tr>
<tr>
<td>Completion</td>
<td>10 days</td>
</tr>
<tr>
<td>Lease Surface Facilities, Water Flowline and Water Storage Build</td>
<td>100 days</td>
</tr>
<tr>
<td>SAMB (including 30 days rehabilitation)</td>
<td>37 days</td>
</tr>
<tr>
<td>Operation</td>
<td>60 non-consecutive days</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>120 days</td>
</tr>
</tbody>
</table>

1.4.4 Staff and Hours of Operation

The number of employees present on the site at any one time is expected to be up to 40 persons at the well leases, 10 persons at the SAMB and 10 persons at George's Island 3 during installation of monitoring equipment. It is not proposed to provide a workers camp on the site, with off-shift drilling crews to be located in nearby accommodation with travel to and from site to be provided.
The hours of operation during the drilling, construction and work over activities will be on a 24-hour a day basis. Construction operations will occur in a daytime shift. Personnel movements to site outside of these hours will be minimised but may be necessary due to emergency situations or specific activities (e.g. service companies entering and leaving site).

### 1.4.5 Chemicals

A number of chemicals are planned to be utilised to facilitate the efficient and safe drilling of the wells in line with best oilfield practice. These chemicals are typical of those generally used in oilfield activities. They will be used either to deliver the wells as planned or will be held in contingency to handle unplanned scenarios (e.g. stuck pipe, excessive mud losses etc.). Chemicals include:

- AMC Aus-Ben
- AMC Aus-Gel
- AMC Aus-Plug
- AMC PAC L
- AMC PAC R
- API Bentonite
- Barite
- Caustic Soda (Rheochem)
- Cement
- Citric Acid (Rheochem)
- Frascseal Fine, Medium
- Idcide-20
- JK-261
- Kwikseal (Fine/Medium/Coarse)
- Maxigel
- Potassium Chloride (Rheochem)
- Quickseal (Fine/Medium/Coarse)
- Rheoben NT
- Rheolube
- Rheoplug
- Rheo-X-Sweep
- Salt (Rheochem)
- SAPP (Rheochem)
- Trugel 13-A
- Xanthan Gum (XC)

The MSDS information for all of these chemicals can be found on the Santos web site ([http://www.santos.com/exploration-acreage/gunnedah-basin-gas/fact-sheets-msds.aspx](http://www.santos.com/exploration-acreage/gunnedah-basin-gas/fact-sheets-msds.aspx)). The fluids are water based (not synthetic or oil based) and recycled for reuse as much as possible during the drilling process.

### 1.5 Scope of the Study

The objectives of this ecological assessment were to undertake a detailed assessment of the proposed activities sites, identify potential ecological impacts associated with the proposed activities and recommend appropriate mitigation measures to minimise potential ecological impacts.

The scope of works for this ecological assessment was:

- Assess the extent, condition and of the vegetation communities present;
- Complete targeted searches for threatened flora species;
- Identify declared noxious weed species;
- Determine if any of the vegetation communities present constitute the definitions of regionally significant ecological communities such as Threatened Ecological Communities (TEC) under the EPBC Act and Endangered Ecological Communities (EEC) under the TSC Act;
- Carry out a detailed trapping program (Elliott traps, cage traps, funnel traps, nocturnal searches, call-playback, Anabat etc), targeted searches and compilation of a fauna list;
- Assess the habitat types of the study area and their value for supporting native flora and fauna, including significant species;
- Assess fauna movement corridors and pathways;
- Identify constraints associated with the ecological features of the study area in a legislative and planning context, in particular those areas containing TEC and EEC;
- Undertake a targeted assessment of the proposed well locations;
- Identify potential impacts associated with the wells; and
- Recommend appropriate mitigation measures to minimise potential impacts.

### 1.6 Terminology

In addition to the terms and abbreviations outlined at the beginning of this report, the following definitions (Table 1.4) are used throughout this report (refer to Figure 1.3):

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locality</td>
<td>Any area within a 10 km radius of George’s Island</td>
</tr>
<tr>
<td>George’s Island</td>
<td>The naturally vegetated, elevated area within the Liverpool Plains known as ‘George’s Island’.</td>
</tr>
<tr>
<td>Study Area</td>
<td>The 52.56 ha (approx.) investigation area situated to the west of Clift Road.</td>
</tr>
<tr>
<td>Activity Site</td>
<td>The actual development footprint of the proposed works and ≤ 4 metres.</td>
</tr>
<tr>
<td>Development Footprint</td>
<td>The proposed well lease sites, water storage and the access track widening</td>
</tr>
</tbody>
</table>

### 1.7 Qualifications

Qualified RPS ecologists undertook the field surveys and subsequent reporting. Staff qualifications and experience are presented in Table 1.5.
<table>
<thead>
<tr>
<th>Name</th>
<th>Position/ Project Role</th>
<th>Qualifications</th>
<th>Relevant Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert Harrison</td>
<td>Senior Ecologist - Fauna field surveys and reporting</td>
<td>Bachelor of Ecological Agriculture, University of Sydney</td>
<td>5+ years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Master of Environmental Management, University of New England</td>
<td></td>
</tr>
<tr>
<td>Paul Finn</td>
<td>Senior Ecologist – Fauna field surveys and reporting</td>
<td>Bachelor of Science (Honours), Griffith University</td>
<td>5+ years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PhD Ecology, Griffith University</td>
<td></td>
</tr>
<tr>
<td>Paul Hillier</td>
<td>Senior Ecologist – Flora field surveys and reporting</td>
<td>Bachelor of Environmental Science, University of Newcastle</td>
<td>7+ years</td>
</tr>
<tr>
<td>Arne Bishop</td>
<td>Field Ecologist – Flora field surveys and reporting</td>
<td>Bachelor of Environmental Science/Landscape Architecture, University of Canberra</td>
<td>5 + years</td>
</tr>
<tr>
<td>Brad Dreis</td>
<td>Senior Ecologist Team Leader – Site visit and peer review</td>
<td>Bachelor Environmental Management (Honours), Griffith University</td>
<td>7+ years</td>
</tr>
<tr>
<td>Matt Doherty</td>
<td>Manager Ecology &amp; GIS/ Technical Director (Ecology) – site visit and peer review</td>
<td>Bachelor of Landscape Management and Conservation</td>
<td>8+ years</td>
</tr>
</tbody>
</table>
I.8 Licensing and Certification

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2011);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2012);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2013); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2011).
Figure 1.1
Aerial of Study Area and Regional Location
Figure 1.2
Soil Landscapes of the Study Area (Banks, 1994)
Legend

- Study Area (52.56 ha)
- Well Leases (1.34 ha)
- Water Handling Facility (0.26 ha)
- Track Widening
- Road Re-alignment
- Existing Track

Figure 1.3 Selected Well Lease and Water Handling Facility Footprints
2.0 Legislative Context

The proposed activities are subject to State and Commonwealth legislation and legislative instruments as outlined below.

2.1 Commonwealth Legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) provides that a person proposing to take an action that the person thinks may be a "controlled action" must refer the proposal to the Minister for Sustainability, Environment, Water, Population and Communities (Minister). A "controlled action" is an action that:

- Will have or is likely to have a significant impact on:
  - World heritage areas;
  - National heritage places;
  - Ramsar wetlands of international importance;
  - Commonwealth listed threatened species and communities;
  - Commonwealth listed migratory species;
  - Commonwealth marine areas;
  - The environment on Commonwealth land; and
  - Great Barrier Reef Marine Park;
- Is undertaken by the Commonwealth and will have or is likely to have a significant impact on the environment;
- Is undertaken by any person on Commonwealth land and will have or is likely to have a significant impact on the environment; or
- Is a nuclear action.

These are referred to as "matters of national environmental significance" (MNES). The EPBC Act sets out the process for identifying and listing the MNES including listed threatened species and listed migratory species.

If the Minister decides that the proposed action is a controlled action, then the approval of the Minister is required under the EPBC Act.

A person proposing to take an action that the person thinks is not a controlled action may refer the proposal to the Minister for the Minister's decision whether or not the action is a controlled action. The proposed pilot wells and associated activities are not expected to have, or be likely to have, a significant impact on MNES including, in particular, listed threatened species or listed migratory species under the
EPBC Act. The proposed activities will be referred on the basis that they do not constitute a controlled action.

2.2 NSW State Legislation

2.2.1 Environmental Planning and Assessment Act 1979


Development is required to be assessed under Part 5 of the EP&A Act if the relevant environmental planning instruments provide that the development does not require consent or is not exempt development and the development is either carried out by a determining authority or requires the approval of a determining authority.

The proposed activities fall within the local government area (LGA) of Gunnedah Shire. The subject site is zoned 1(a) Rural (Agricultural Protection) under the Gunnedah Local Environmental Plan 1998 (NSW) (Gunnedah LEP). The proposed activities are permissible with development consent under the Gunnedah LEP. However, State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (NSW) (Mining SEPP) applies to the activities. The Mining SEPP aims "to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of [New South Wales]". Clause 6 of the Mining SEPP provides that development for the purposes of petroleum exploration may be carried out without development consent. Clause 6 applies despite the provisions of the Gunnedah LEP. This has the effect that the proposed activities are required to be assessed under Part 5 of the EP&A Act.

A determining authority, for the purposes of this activity, is defined in Part 5 to include a public authority whose approval is required before an activity may be carried out. The Assistant Director, Environment of the Department of Primary Industries and the New South Wales Office of Water will be determining authorities for the purposes of Part 5 of the EP&A Act because their approval is required for the proposed development under the legislation administered by these determining authorities.

Determining Authorities

Under Part 5 of the EP&A Act, a determining authority is required to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

Additionally, clause 228 of the Environmental Planning and Assessment Regulation 2000 (NSW) sets out the factors that must be taken into account concerning the impact of an activity on the environment.

The determining authorities are required to consider whether the proposed activity is likely to significantly affect the environment or threatened species, populations or ecological communities, or their habitats to determine whether an EIS or SIS is required. In deciding whether there is likely to be a significant effect
on threatened species, populations or ecological communities or their habitats, section 5A of the EP&A Act requires the following factors to be taken into account (the "seven part" test of significance):

1. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

2. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

3. In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
   (i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
   (ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

4. In relation to the habitat of a threatened species, population or ecological community:
   (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
   (ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activities, and
   (iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

5. Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

6. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

7. Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

This ecological assessment has been prepared to assist the determining authorities in meeting their obligations under the EP&A Act. In particular, the "seven part" test has been applied to the proposed pilot well activities in Appendix D. This ecological assessment concludes that the proposed pilot well activities are not likely to significantly affect the environment or threatened species, populations or ecological communities or their habitats.

**State Environmental Planning Policy No. 44 – Koala Habitat Protection**

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) aims "to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline".
Schedule 1 of SEPP 44, which lists the LGAs to which SEPP 44 applies, includes the Gunnedah LGA. SEPP 44 applies to local councils determining development applications under Part 4 of the EP&A Act. Although SEPP 44 does not apply in relation to the assessment of development under Part 5 of the EP&A Act, it has been considered in the preparation of this REF.

SEPP 44 requires that before granting development consent under Part 4 of the EP&A Act for development on land over 1 hectare in area, a consent authority must form a view as to whether the land is "potential" or "core" koala habitat. Potential koala habitat is defined as:

areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

Core koala habitat is defined as:

an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

Where core koala habitat is found to occur, SEPP 44 requires that a site-specific koala plan of management be prepared.

George's Island is known to support a population of Koalas. Three Koalas were observed within the subject site during field surveys undertaken as part of the ecological assessment. Evidence of Koalas, including scats and scratches on tree trunks, was observed.

As discussed in Section 5.5, it has been determined that George's Island provides suitable core breeding habitat for the Koala, and therefore constitutes Core Koala Habitat. Santos has prepared a Koala Plan of Management, which is available in Appendix F.

2.2.2 Threatened Species Conservation Act 1995

The objects of the Threatened Species Conservation 1995 (NSW) (TSC Act) include:

- To conserve biological diversity and promote ecologically sustainable development;
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities;
- To protect the critical habitat of those threatened species, populations and ecological communities that are endangered; and
- To ensure that the impact of any action affecting threatened species, populations and ecological communities preventing the extinction and promoting the recovery of threatened species, populations and ecological communities is properly assessed.

The TSC Act provides the procedure for the listing of threatened species, populations and ecological communities and key threatening processes in New South Wales and the preparation and implementation of recovery plans and threat abatement plans.
The TSC Act also provides the mechanism for applying for and obtaining licences to take actions which will or is likely to result in harm to any animal that is a threatened species, population or ecological community, the picking of any plant which is part of a threatened species, population or ecological community, damage to critical habitat or damage to habitat of a threatened species, population or ecological community where such actions require a licence to be obtained.

As discussed in Sections 4.3.2 and 4.5.6, there are ten fauna species, one flora species and one EEC listed under the TSC Act that are relevant to the proposed activities and all species have thus undergone the seven-part test to determine whether significant impacts to these species are likely.

### 2.2.3 National Parks and Wildlife Act

Part 8A of the National Parks and Wildlife Act 1974 (NPW Act) regulates the undertaking of activities which may impact on threatened species, populations and ecological communities listed under the TSC Act and their habitats. The NPW Act provides that a person must not harm any animal that is a threatened species, population or ecological community, pick any plant which is part of a threatened species, population or ecological community, damage any critical habitat or damage any habitat of a threatened species, population or ecological community without a licence being obtained under the NPW Act or TSC Act or unless another exception applies.

The NPW Act provides that these requirements do not apply if the action was essential for the carrying out of an activity in accordance with an approval of a determining authority under Part 5 of the EP&A Act where the determining authority has complied with Part 5.

### 2.2.4 Key Threatening Processes

A key threatening process is defined under the TSC Act as ‘a process that threatens, or that may threaten, the survival or evolutionary development of a species, population or ecological community. Threatening processes that adversely affect threatened species, populations or ecological communities, or possibly cause others that are not currently threatened; to become threatened may be eligible for listing as a key threatening process (KTP).

As discussed in Section 5.4, KTPs relevant to the proposed activities include those listed on the TSC Act and EPBC Act and include the following:

- Invasion of native plant communities by exotic perennial grasses;
- Competition and grazing by the feral European rabbit;
- Bushrock Removal;
- Clearing of native vegetation;
- Loss of hollow bearing trees; and
- Loss of dead trees and dead wood.
2.2.5 Native Vegetation Act 2003

The *Native Vegetation Act 2003* (NV Act) sets a framework for:

- Encouragement of revegetation and rehabilitation of land with appropriate native vegetation;
- Providing incentives for landholders to undertake management of native vegetation on their properties; and
- An end to broad scale clearing, unless it improves or maintains the environment.

The NV Act provides three categories of native vegetation including regrowth, protected regrowth and remnant vegetation with clear definitions.

The NV Act provides greater flexibility and incentives for landholders to manage native vegetation sustainably. The Act gives effect to the Government's commitment to ending broad scale clearing unless it improves or maintains environmental outcomes.

Under section 25(g), the NV Act does not apply to any clearing that is part of an activity carried out by a determining authority within the meaning of Part 5 of the EP&A Act where the determining authority has complied with Part 5. Under section 25(m), the NV Act does not apply to any clearing authorised under the *Petroleum (Onshore) Act 1991* (NSW).

2.2.6 Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* (NW Act) is a NSW government instrument outlining the definition, declaration, and control of noxious weeds throughout the State. Local government bodies have the responsibility to ensure that the Act is complied with within their boundaries.

For a plant to be declared a Noxious Weed it must be considered to pose a serious threat to humans, agriculture and/or the environment. There must also be consideration given to the feasibility of control and enforcement of those methods. Plants are declared noxious by order of the Minister for Agriculture.

Landowners or occupiers have obligations under the NW Act to control any declared weed on their property. Council is required to conduct inspections of private properties to check compliance with the NW Act and Noxious Weed Officers have the authority to issue control notices for any breach. The weeds currently listed as noxious in the Gunnedah control area are listed in the declaration.
3.0 Methodology

3.1 Desktop Assessment

Relevant environmental documents, databases, maps and legislation (Federal, State and Local) were reviewed to identify potential development constraints as well as significant ecosystems and species that may potentially occur in study area. The following databases and maps were reviewed:

- The EPBC Act Protected Matters Search Tool (Department of Sustainability, Environment, Water, Population and Communities (SEWPaC), 2010) (Appendix A);
- Review of threatened fauna and flora records contained in the Department of Environment, Climate Change and Water (DECCW) Atlas of NSW Wildlife (accessed 19th December 2010) within a 10 km radius of the study area;
- NSW DLWC, NSW NPWS, NSW State Forests (2003), Joint Vegetation Mapping Project – Brigalow Belt South Bioregion;
- AH&A Ecology (2010a), Santos Pty Ltd Gunnedah Coal Gas Seam Project George’s Island;
- RPS (2011), George’s Island Ecological Assessment (preliminary report); and
- Aerial photography.

3.2 Preliminary Flora and Fauna Survey

A preliminary ecological assessment was carried out by RPS on 20 December 2010 to:

- Verify the results of the desktop assessment;
- Ground-truth vegetation communities;
- Undertake a fauna habitat assessment and incidental fauna observations;
- Undertake targeted searches for evidence of Koala (Phascolarctos cinereus);
- Identify potential habitat for potentially occurring significant species as listed under the EPBC and Threatened Species Conservation Act 1995 (TSC Act); and
- Search for weed species.

Five survey sites were selected across George’s Island, three of which were surveyed in more detail as part of this EA, to obtain spatial coverage and sample local variations in the vegetation and habitat (Figure 3.1).
3.3 **Flora Survey**

### 3.3.1 Vegetation Survey and Mapping

Flora surveys and vegetation mapping works carried out for the site are as follows:

- Review previous flora assessment undertaken over the site (RPS, 2010);
- Delineation of vegetation communities using Aerial Photography Interpretation (API) and groundtruthing;
- General flora surveys were conducted and included walking transects within each vegetation community as well as the consideration of the site in line with methodology such as ‘Random Meander Technique’ described by Cropper (1993). Vegetation communities were determined based on structure, floristic composition, topography and soil type;
- Targeted flora surveys were conducted in areas of suitable habitat, for threatened species identified during preliminary assessments as having potential to occur on site via quadrat and transect survey;
- Assessment of the potential for the derived vegetation communities to constitute EEC’s as listed within the TSC Act and/or the EPBC Act was also undertaken. The floristic composition, geomorphologic characters and geographic distribution were considered when determining whether an EEC was present.

### 3.3.2 Threatened / Significant Flora Survey

A list of potentially occurring threatened/significant flora species from the locality (10 km radius) was compiled, which included threatened species (Endangered or Vulnerable) and EEC’s listed under the TSC Act, those species listed under the EPBC Act, ROTAP listed flora species (Briggs and Leigh 1996), as well as any other species deemed to be of local importance (Tables 5.1 and 5.2).

Targeted flora surveys were undertaken for identified threatened species in areas of suitable habitat. Threatened species detected were mapped using a Trimble GeoXH GPS with sub-metre accuracy after post processing.

### 3.3.3 Quadrat Surveys

The percentage cover of groundcover species was sampled within the proposed disturbance areas and surrounds. The main purpose of quadrat sampling was to gain data on species percentage covers within representative areas of each impact area. Additionally, quadrats were used to intensify targeted searches within those areas to be impacted by the proposed activities.

### 3.4 Fauna Survey

Fauna surveys were undertaken by two RPS ecologists between 28th March and 1st April 2011. Fauna surveys were primarily focused in and around each survey area where the development footprints are proposed, as shown in Figure 3.1, however the entire 52.56 ha study area was covered during the survey.

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The survey effort for each faunal group and targeted surveys for threatened species, are described in Table 3.1.

The fauna survey was primarily designed to determine fauna diversity of the study area, as well as identify threatened and/or migratory species listed under the TSC Act and/or EPBC Act that have the potential to occur within the study area, and as such was based on an assessment of suitable habitats and each species known distribution range.

The potential for threatened fauna species listed on the TSC Act and/or EPBC Act to occur within the study area was based on an assessment of habitat suitability and species known distribution range.

The fauna field surveys aimed to:

- To build on existing information from the preliminary ecological assessment (RPS, 2011a) in regards to threatened fauna species;
- Identify and describe the commonly occurring and listed terrestrial species and communities known or likely to be present in the study area, and assess which species or communities may be affected by the proposed activities;
- Identify the presence or potential presence of threatened and migratory fauna species and populations listed under the TSC Act, FM Act and/or EPBC Act;
- Describe habitats that may be directly or indirectly affected by the proposed activities and assess the value of the habitats available to threatened fauna species within each survey area and surrounding 52.56 ha study area; and
- Describe the type, location, size and condition of habitats available for threatened species and provide details of the distribution and condition of similar habitats in adjacent lands.

<table>
<thead>
<tr>
<th>Target Fauna</th>
<th>Survey Techniques</th>
<th>Survey Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibians</td>
<td>Targeted habitat searches (diurnal and nocturnal)</td>
<td>2 survey locations – 1 person hours</td>
</tr>
<tr>
<td></td>
<td>Waterhole spotlight survey</td>
<td>1 survey locations - 2 person hours</td>
</tr>
<tr>
<td>Reptiles</td>
<td>Diurnal targeted habitat searches</td>
<td>3 survey locations – 2 person hour/ survey</td>
</tr>
<tr>
<td>Mammals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small and medium ground dwelling</td>
<td>Trapline A – 20 Elliot As and three Elliot Bs</td>
<td>4 trap nights</td>
</tr>
<tr>
<td></td>
<td>Trapline B – 19 Elliot As and three Elliot Bs</td>
<td>4 trap nights</td>
</tr>
<tr>
<td></td>
<td>Trapline C – 18 Elliot As and four Elliot Bs</td>
<td>4 trap nights</td>
</tr>
<tr>
<td></td>
<td>Habitat and resource assessment</td>
<td>3 survey areas</td>
</tr>
<tr>
<td></td>
<td>Spotlight surveys</td>
<td>4 survey locations - 1.5 person hours/ survey</td>
</tr>
<tr>
<td>Large terrestrial</td>
<td>Habitat and resource assessment</td>
<td>3 survey areas</td>
</tr>
<tr>
<td></td>
<td>Spotlight surveys</td>
<td>4 survey locations - 1.5 person hours/ survey</td>
</tr>
<tr>
<td>Arboreal Mammals</td>
<td>Spotlight surveys</td>
<td>4 survey locations - 1.5 person hours/ survey</td>
</tr>
<tr>
<td></td>
<td>Searches for scratches and signs (e.g. scratches and sap-feeding incisions on trunks).</td>
<td>3 survey areas (opportunistically)</td>
</tr>
</tbody>
</table>
### Target Fauna

<table>
<thead>
<tr>
<th>Survey Techniques</th>
<th>Survey Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microbats</td>
<td>3 survey locations – 3 survey nights at each survey area</td>
</tr>
<tr>
<td>Echolocation call detection using Anabat recorders</td>
<td></td>
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<tr>
<td>Mega-chiropteran bats</td>
<td>4 survey locations - 1.5 person hours/ survey</td>
</tr>
<tr>
<td>Spotlight surveys</td>
<td></td>
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</tbody>
</table>

### Birds

<table>
<thead>
<tr>
<th>Survey Techniques</th>
<th>Survey Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diurnal Birds</td>
<td>3 survey areas</td>
</tr>
<tr>
<td>Habitat and resource assessment;</td>
<td></td>
</tr>
<tr>
<td>Dawn and dusk set area searches in representative habitats</td>
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<td>Call identification.</td>
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<tr>
<td>Nocturnal Birds</td>
<td>3 survey areas</td>
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<tr>
<td>Habitat and resource assessment</td>
<td></td>
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<tr>
<td>Call playback and call identification</td>
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</tbody>
</table>

#### 3.4.1 Fauna Trapping

Three trap lines were established where practical within or adjacent to each of the three survey area A, B and C, as depicted in Figure 3.1. Elliot and cage traps were laid within each trap line. Trap lines are shown in Figure 3.1.

The trap lines consisted of the following:

- Trapline A – 20 Elliot A and three Elliot B type traps;
- Trapline B – 19 Elliot A and three Elliot B type traps; and
- Trapline C – 18 Elliot A and four Elliot B type traps.

Traps were baited with a mixture of rolled oats, peanut butter, honey and vanilla essence and left in place for a total of four nights.

A total of two cage traps and three snake funnels were strategically placed within the vicinity of each survey area and were left for a total of four nights. Cage traps were baited with chicken pieces and apples. Both the cage traps and snake funnel traps were relocated at least once to spread the trapping survey effort.

#### 3.4.2 Incidental Scats, Tracks and Traces

Incidental records of fauna tracks and scats were collected during the execution of other field survey tasks such as herpetofauna searches and habitat assessments. Scats of feral animals often provide important information on native species present in the area and were also collected. Furthermore, incidental records of scratches and feed scars, Squirrel Glider (*Petaurus norfolcensis*), on trees were recorded during surveys to help identify arboreal species presence within the study area.
3.4.3 **Spotlighting**

Spotlight searches for nocturnally active mammals, as well as birds and herpetofauna including dedicated listening periods for fauna vocalisations, were carried out over four nights throughout the study area using 55 watt spotlights. Species were identified by observation under spotlight or by call identification.

Each survey involved a series of transects conducted on foot at approximately 1 km/h in and around each survey area. Spotlighting was also undertaken along walking and vehicle tracks (Figure 3.1) and in adjacent woodland areas.

Surveys commenced 1½ hours after dusk and targeted areas with hollow bearing trees to detect arboreal mammals, forest owls and bats emerging from diurnal roosts to forage. Aquatic habitats were also targeted to detect amphibians. Amphibians, mammals and nocturnal birds were identified by observation under spotlight or by vocalisations heard whilst spotlighting.

3.4.4 **Diurnal Bird Surveys**

Systematic diurnal bird surveys for Commonwealth and State listed threatened and/or migratory species were undertaken to target those bird species that were considered likely to occur within the study area.

Diurnal bird surveys were conducted using one hour, one-hectare searches, as shown on Figure 3.1. Surveys were conducted in the early morning and late afternoon when birds are typically most active. All bird species heard or sighted during the surveys were recorded. Incidental sightings of birds during other field survey activities were also noted.

Diurnal bird surveys also included searches for habitat features of relevance for particular threatened species, including searching for evidence of bird presence, such as pellets, nests, whitewash and large hollows (owls).

3.4.5 **Call Playback**

Call playback surveys were conducted over four consecutive nights for the Barking Owl (*Ninox connivens*) (five call playback episodes), Masked Owl (*Tyto novaehollandiae*) (eight call playback episodes) and Squirrel Glider (two call playback episodes). Call playback survey locations are shown on Figure 3.1.

Surveys involved call playing for five minutes followed by a listening period of five minutes (undertaken separately for each species), and a final listening period of approximately 10 minutes. Calls were played through a portable MP3 player connected to a 15-watt megaphone. Potential roost sites in the immediate area were then scanned for 10 minutes using spotlights.

3.4.6 **Active Searches**

Active searches were undertaken in the proximity of survey areas and whilst moving between survey areas, with an aim of detecting threatened fauna.
Ground-dwelling Mammals

An active search for ground-dwelling mammals was focused around key habitat features, such as extensive grassy ground cover for the Black-striped Wallaby (*Macropus dorsalis*) and fallen woody debris, hollow logs and burrows that offer potential suitable shelter for other ground dwelling mammals (Bandicoots, native rats etc.). Evidence of mammal diggings was also noted as indicators of habitat use.

Koalas

Spot surveys targeting the presence of Koala (*Phascolarctos cinereus*) were completed in appropriate vegetation communities. This technique involves identifying mature feed trees (Yellow Box, White Box, Bimble Box) and shelter trees (White Cypress Pine), and completing searches under nearby relevant trees for scratches and presence, as well as spotlighting.

Amphibians

Diurnal and dusk searches of suitable habitat for frog species were undertaken around waterholes, as shown on Figure 3.1. Surveys included a visual search for individuals within the vegetation and surface rock around the waterholes. Spotlighting for frogs was undertaken around waterholes and adjacent vegetation. Incidental records of frog species heard or sighted during other surveys were noted. General habitat features were recorded in conjunction with the surveys.

Targeted searches for the amphibians were not undertaken as suitable habitat does not occur in the study area.

Reptiles

Reptile surveys involved active searches of the study area and survey areas to identify potential breeding and foraging habitat for reptile species, including in particular the Border Thick-tailed Gecko (*Underwoodisaurus sphyrurus*) and Pale-headed Snake (*Hoploccephalus bitorquatus*), which may potentially occur in the study area, as well as all fossorial species, including skinks, blind snakes, and other snakes.

Survey techniques employed included:

- Diurnal searches for sheltering or basking reptiles;
- Rock, log and debris rolling; and
- Spotlight surveys for nocturnally active species (e.g. Border Thick-tailed Gecko).

3.4.7 Anabat Detection

The Anabat survey targeted the following microbat species:

- Large eared Pied Bat (Chalinolobus dwyeri);
- Little Pied Bat (Chalinolobus picatus);
Eastern Freetail-bat (Mormopterus norfolkensis);
Greater Long-eared Bat (Nyctophilus timoriensis); and
Yellow-bellied Sheathtail-bat (Saccolaimus flaviventris).

It is likely that these species may occur in the study area. One Anabat SD1 detection unit was placed in suitable flyways within or adjacent to each of the survey areas. Positioning was focused on natural flyways below the canopy (survey area A), open grassed areas between woodland trees (survey area B) and above the open water of the large waterhole (survey area C), which typically provide an abundance of microbat foraging resources (insects). The Anabat was set before dusk and retrieved each morning after sunrise. Anabat survey locations are shown on Figure 3.1.

**Anabat Analysis Methodology**

Greg Ford of Balance Environmental undertook Anabat analysis of all bat calls and provided an analysis summary report. Due to the high level of variability and overlap in call characteristics, a conservative approach was taken when analysing calls.

Species names used in the Anabat analysis summary follow Churchill (2008), (Ford, 2011).

Call identification was based on published call descriptions for New South Wales (Pennay et al 2004) and on reference calls collected from southern Queensland and northern New South Wales (Ford, 2011). Determination of species' identification was further refined by considering probability of occurrence based on distributional information presented in Churchill (2008) and Van Dyck & Strahan (2008), (Ford, 2011).


**Microbat Habitat Survey**

Incidental records of potential roost habitat (hollow bearing trees) for threatened bat species were recorded and diurnal habitat searches were undertaken to identify potential roost habitats. These surveys were based on the presence of appropriate food and roosting trees or indirect evidence, such as bat guano.

Spotlighting for megachiropteran bats (e.g. flying foxes and larger insectivorous bats) while listening for vocalisations was undertaken in conjunction with spotlighting for other mammals.

**3.4.8 Fauna Habitat Assessment**

The fauna habitat assessment involved collecting data on the nature and condition of habitats, detailing specific resources and features of relevance for native fauna, such as tree-hollows, logs, rocky outcrops, fallen timber, leaf litter, grassy groundcover, shrub strata, foraging substrates, summer-flowering eucalypts and mistletoe. In addition, indirect evidence of fauna (i.e. scats, feathers, fur, tracks, dens, nests, scratches, chew marks and owl wash) was recorded.
General fauna habitat assessments were focused on the three survey areas, where vegetation is likely to be removed as a result of the proposed activities. Specific resources such as shelter, basking, roosting, nesting and foraging sites for amphibians, bats, birds, arboreal mammals, ground-dwelling mammals and reptiles were noted.

Results of the habitat assessments were used to appropriately locate nocturnal owl, bat, arboreal mammal, and reptile and amphibian surveys.

**Tree Hollows**

Hollow-bearing trees provide a valuable and potentially limiting resource for some native fauna for nesting and roosting. Hollow bearing trees were noted where observed at each survey area.

### 3.5 Survey Limitations

It should be noted that the detectability of plants and the ability to accurately identify plants to species level may vary greatly with the time of year, prevailing climatic conditions and the presence of reproductive material (e.g. flowers, fruit, and seed capsules). Consequently, the survey conducted for the study area should not be regarded as conclusive evidence that certain protected plants do not occur within the study area; however every effort has been made to detect these species in habitats that were considered suitable.

All fauna surveys are subject to inherent limitations in the detection success of targeted species. These limitations often result in a degree of false-absence records (i.e. a species is present, but not detected). It is important, therefore, that the limitations to fauna surveys are identified and the fauna survey results are viewed with these constraints in mind. The limitations to the fauna surveys conducted in the study area included:

- The survey period not coinciding with the period that some migratory or nomadic species occur in the locality;
- Species with large home ranges (e.g. owls and raptors) not present in this part of their home range during the survey period;
- The difficulty in detecting certain species during the survey period (e.g. cryptic species, species present in the study area at very low densities, and trap-shy species);
- Biological factors such as sex, age-class, and breeding biology, which may influence species’ habitat use and detectability during different times of the year;
- The lack of suitable climatic conditions necessary for the presence and/or detectability of certain species (e.g. amphibians following heavy rainfall); and
- Despite the apparent deficiencies, suitable coverage of the study area was accomplished, in particular the likely occurrence of species was assumed, based on habitat assessments, previous local records, seasonality, predicted faunal movements of locally occurring threatened species in combination with the local knowledge and experience of the authors.
In response to the abovementioned limitations the precautionary approach has been adopted; as such ‘assumed presence’ of known and expected threatened species, populations and ecological communities has been made where relevant to ensure a holistic assessment.
Figure 3.1  
Survey Effort and Survey Areas
4.0 Results

4.1 Weather

Weather conditions during the survey period were generally warm and dry to slightly humid with both clear and overcast skies as well as some very light rainfall. The average temperature across the week was approximately 17.9°C ranging between averages of 16.8°C and 19.4°C, with a minimum of 9.8°C and a maximum of 29.4°C (BoM, 2011). A very light shower occurred on 30th March and may not have even technically registered as rainfall. Approximately 116 mm of rainfall had occurred at Quirindi leading up to the survey since the start of the year. Refer to Table 1.1.

4.2 Literature Review and Database Search Results

4.2.1 Literature Review

The literature review of the Santos Ecological Assessment and Review of Environmental Factors, undertaken by Alison Hunt and Associates Pty Ltd (AH&A) in 2010, provides background information relating to the overarching ecology of George’s Island and its historical land use.

The AH&A assessment describes George's Island as being slightly elevated (by approximately 30 m) from the surrounding plains. Soil varies across George's Island from gravelly red to friable brown / black soils and there are no watercourses or discernible drainage lines. It goes on to state that the elevated nature of George’s Island above the surrounding landscape associated with the Liverpool Plains has prevented George’s Island from being completely cleared for intensive agricultural land use and that subsequently, George's Island forms an isolated 'island' of vegetation within an otherwise cleared landscape (AH, 2010a).

In regards to flora, the AH&A assessment details how only fifty-four plant species were recorded across the study area, with 88% of the recorded species being native. Nine non-native species were comprised of introduced pasture species and species that are agricultural weed species. It also mentions how, in general, species represented in the ground cover were common throughout (AH&A, 2010a).

No fauna surveys were undertaken as part of the AH&A assessment, however it discusses how George’s Island may provide habitat for a range of native fauna, even though from a vegetation perspective, not all of the vegetation communities across the study area are necessarily of high conservation significance (e.g. Bimble Box open grassy woodland, White Cypress Pine open woodland) and that these areas have the potential to provide important habitat for native fauna (AH, 2010a).

The AH&A Review of Environmental Factors mentions how George's Island had been selectively logged in the past even though much of the canopy remains intact. It also mentions how grazing over many years has eliminated the majority of the native shrubs and ground cover species except for those native species that are grazing tolerant (AH&A, 2010b).

The above findings of Alison Hunt and Associates are consistent with what was observed by RPS within the study area and across the remainder of George’s Island. In that even though past disturbances may have structurally modified vegetation communities and may have partially reduced the availability of
habitat resources across George’s Island. The vegetation communities and habitats that are extrapolated
across George’s Island provide an important resource for native biota that is likely to occur or is known to
occur across the George’s Island ‘island’ and within the locality. Overall George’s Island is likely to
support a similar level of biodiversity and abundance of species as the study area.

The Curlewis Joint Venture Vegetation Mapping (DoP, 2001) and associated GIS data was also
reviewed. Analysis of the vegetation mapping indicates that George’s Island includes approximately
196.5 ha of White Box-Yellow Box-Blakely’s Red Gum grassy woodland, 181.7 ha of Bimble Box
Woodland and 50.1 ha of *Callitris glaucophylla* Woodland. The mapping over the entire George’s Island
was not able to be ground-truthed due to access restrictions. Although analysis of aerial photographs
indicates that there are some inaccuracies within the Curlewis vegetation mapping, the data is generally
accurate at the scale at which the study was undertaken.

### 4.2.2 Preliminary Ecological Assessment

The preliminary ecological assessment consisted of flora surveys, targeted searches and habitat
assessments as a means to identify threatened biota and/or their habitats (RPS, 2011a).

Flora surveys consisted of six 20 x 20 m quadrats and general threatened flora searches within 100 m of
each quadrat. This method generated a flora species list for each quadrat and a description of the
dominant flora species at each location.

Targeted searches aimed to identify threatened and/or migratory species listed under the EPBC Act that
are predicted to occur with a 10 km radius of the study area, as well as threatened species listed under
the TSC Act that have been previously recorded within a 10 km radius of the study area. Targeted
searches for evidence of Koala activity were also undertaken at randomly selected known Koala feed tree
species within each survey area.

### 4.2.3 Environmental Protection and Biodiversity Conservation

A search using the EPBC Act protected matters search tool revealed 20 threatened fauna species,
comprising five birds, one frog, one fish, ten mammals (including three bats), three reptiles and twelve
threatened flora species listed under the EPBC Act that are predicted to occur within the locality of the
study area.

In addition, eleven migratory bird species (one of which is also listed as threatened) were revealed as
predicted to occur within the locality of the study area. Four EECs listed under the EPBC Act are also
predicted to occur within the locality of the study area. The results of the database search are shown in
Appendix A.

The EPBC Act Protected Matters Report (SEWPaC, 2010) (see Appendix A) has identified four TECs as
potentially occurring in the study area. These include:

- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and
  southern Queensland;
- White Box-Yellow Box-Blakely’s Red Gum grassy woodland and derived native grassland;
- Grey Box (Eucalyptus microcarpa) grassy woodlands and derived native grasslands of south-eastern Australia; and
- Weeping Myall Woodlands.

One additional TEC that did not appear in the results of the protected matters search tool, but did appear in the search of the Liverpool Plains (Part B) Catchment Management Authority (CMA) Sub-region was ‘The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin’, which is listed as an EEC under the EPBC Act.

No World Heritage properties, National Heritage properties, Ramsar wetlands or Commonwealth marine environments occur in the study area or would be affected by the activity. The closest significant wetland to the study area is Goran Lake. This wetland is not listed as a Ramsar wetland. However, it is listed as a nationally important wetland. Goran Lake provides viable breeding and foraging habitat for listed migratory species. The proposed activities are unlikely to impact upon any migratory species and/or their habitats that occur at Goran Lake, due to the distance between the activity site and Goran Lake, the unlikely occurrence of groundwater drawdown and the expected short timeframe of the proposed activities.

A full list of threatened and migratory species obtained from the protected matters search tool is available in Table 5.1 for flora and fauna species, and Table 5.2 for migratory species. Each table describes the conservation status, habitat requirements and likelihood of occurrence of each listing. A review of the specific habitat requirements of these species, and the habitat present within the study area and its surrounds allowed a number of these species and/or EECs to be eliminated as having nil, or low likelihood of occurrence in the study area.

### 4.2.4 Threatened Species Conservation Act

The results of the DECCW wildlife atlas database search revealed three threatened flora species and 34 threatened fauna species, comprising 17 birds, 15 mammals (including five bats) and two reptiles, previously recorded within a 10 km radius of the study area.

There are nine Endangered Ecological Communities listed under the TSC Act present in the Liverpool Plains (Part B) Catchment Management Authority (CMA) Sub-region. These include:

- Artesian Springs Ecological Community;
- Cadellia pentastyli (Ooline) community in the Nandewar and Brigalow Belt South Bioregions;
- Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions;
- Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions;
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions;
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregions;
- Native Vegetation on Cracking Clay Soils of the Liverpool Plains;
- Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions; and
- White Box Yellow Box Blakely’s Red Box Gum Woodland.

A full list of threatened species obtained from the DECCW database search is available in Table 5.1. The table describes the conservation status, habitat requirements and likelihood of occurrence of each listing. A review of the specific habitat requirements of these species, and the habitat present within the study area and its surrounds allowed a number of these species and/or EECs to be eliminated as having nil, or low likelihood of occurrence in the study area.

4.3 Flora Survey Results

4.3.1 Vegetation Communities

Five vegetation communities were observed within the study area. These communities were:

- White Box / Yellow Box / Blakely’s Red Gum Grassy Woodland;
- Plains Grass Grassland;
- Bimble Box Woodland;
- Silver-leaved Ironbark Woodland; and
- Cleared / Disturbed Land.

A detailed description of these vegetation communities is provided below, while the location and extent of these communities is shown in Figure 4.1. A detailed flora species list is included in Appendix B.
White Box (E. albens), Yellow Box (E. melliodora), Blakely’s Red Gum (E. blakelyi) Grassy Woodland

Plate 4.1: White Box, Yellow Box, Blakely’s Red Gum Grassy Woodland

**Description:** This vegetation community occurs over the majority of the study area along the mid-slopes. Its structure has moderately sized well spaced trees with a sparse shrub layer and a dense and diverse generally grassy ground layer.

**Canopy Layer:** 18 to 22 m – a patchy to moderate 15 – 50 % projected foliage cover (PFC). Dominant species include; *Eucalyptus albens* (White Box), *Eucalyptus melliodora* (Yellow Box), *Eucalyptus blakelyi* (Blakely’s Red Gum) and *Callitris glaucophylla* (White Cypress).

**Sub Canopy Layer:** 4 to 15 m – 3 to 5 % PFC. Dominant species were juvenile canopy species, as well as *Callitris glaucophylla*, *Alectryon oleifolius* (Western Rosewood) and *Geijera parviflora* (Wilga).

**Shrub Layer:** 1 to 3 m – 2 to 5 % PFC. Dominant shrub species included; *Lycium ferocissimum* (African Boxthorn), *Sclerolaena birchii* (Galvanized Burr) and *Olearia elliptica* (Sticky Daisy Bush).

**Ground Layer:** 0.2 m to 1.5 m – variable 75 to 90 % PFC. Dominant species included; *Austrostipa verticillata* (Slender Bamboo Grass), *Austrostipa scabra* subsp. *scabra* (Speargrass), *Aristida ramosa* (Purple Wiregrass), *Chloris truncata* (Windmill Grass), *Bothriochloa decipiens* (Redleg Grass) and *Wahlenbergia communis* (Tufted Bluebell).
**Condition:** This vegetation community occupies approximately 37.83 ha of the study area and has a variable condition depending on location and previous disturbances. The majority of the native vegetation within the study area appears to have been lightly grazed at some time. Moderate levels of selective logging have historically been undertaken throughout the study area, which has assisted the establishment of locally dominant patches of *C. glaucophylla* throughout this community. Most of the native vegetation within the study area shows good levels of recruitment. In general this vegetation community is in good condition, maintaining a moderate level of native diversity and low levels of exotic species and thus resilience.

**Classification:** This vegetation community corresponds with the Endangered Ecological Community (EEC) known as White Box - Yellow Box - Blakely’s Red Gum Woodland which is listed within the schedules of the TSC Act. This vegetation community is also commensurate with the federally listed threatened community known as White Box - Yellow Box - Blakely’s Red Gum Grassy Woodland and Derived Grasslands. This community is listed as Critically Endangered within the schedules of the EPBC Act.

Quadrat analysis and random meander were used to scientifically map and describe this community. Further justification for the classification of this community is provided in Section 4.3.3 and Section 4.3.4.

**Plains Grass (*Austrostipa aristiglumis*) Grassland**

![Plains Grass Grassland](Plate%204.2%3A%20Plains%20Grass%20Grassland)
Description: This vegetation community occurs within the north-west of the study area. It is located on the Black Soil of the Liverpool Plains.

Canopy Layer: 18 to 22 m – sparse <5 % PFC. Solely comprised of *Eucalyptus populnea* (Bimble Box).

Sub Canopy Layer: Nil.

Shrub Layer: 0.2 to 0.4 m – sparse <5 % PFC. Scattered occurrences of *Neptunia gracilis* (Native Sensitive Plant) were recorded throughout the grasslands.

Ground Layer: 0.2 to 2 m – dense 90 to 100 % PFC. The dominant species was *Austrostipa aristiglumis* (Plains Grass). Several other native species were recorded in much lower densities, including *Einadia hastata* (Berry Saltbush), *Dichelachne micrantha* (Short-hair Plume Grass), *Panicum effusum* (Hairy Panic), *Podolepis capillaries* (Invisible Plant) and *Sclerolaena muricata* (Black Rolypoly). Exotic species recorded included *Polygonum aviculare* (Wire Weed) and *Pyracantha crenatoserrata*.

Condition: The condition of this vegetation community is likely to have been reduced in the past by agricultural practices, including grazing, which has resulted in a loss of species diversity. The value of this community if further reduced by its small size (approximately 2.85 ha) and lack of connectivity to similar areas of vegetation due to surrounding intensive grazing and cropping.

Classification: This vegetation community does not constitute the definition for the Endangered Ecological Community (EEC) known as *Native Vegetation on Cracking Clay Soils of the Liverpool Plains*, which is listed within the schedules of the TSC Act. Furthermore, this vegetation community does not constitute the definition for the Critically Endangered Ecological Community (CEEC) known as *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland*, which is listed within the schedules of the EPBC Act. This was determined in light of there being only one indicative native grass species identified in this community, and not the required three indicative native grass species, as outlined in the EPBC Act classification for this TEC.

Quadrat analysis and random meander was used to scientifically map and describe this community.
Bimble Box (*Eucalyptus populnea*) Woodland

**Description:** This vegetation community occurs within the eastern parts of the study area on the lower slopes. The community covers 8.38 ha.

**Canopy Layer:** 18 to 22m – a patchy to moderate 25 - 40% PFC. The dominant species being *E. populnea*. *E. albens* was recorded in lower densities within this area.

**Sub Canopy Layer:** 4 to 15 m – 5 to 20 % PFC. Dominant species were *C. glaucophylla* and juvenile canopy species.

**Shrub Layer:** 1 to 3 m – 1 to 2 % PFC. Dominant shrub species included; *L. feroxissimum*, *S. birchii* with sparse occurrences of *G. parviflora*.

**Ground Layer:** 0.2 to 1.5 m – variable 75 to 90 % PFC. Dominant species included; *A. aristiglumis*, *B. decipiens* and *A. scabra* subsp. *scabra*.

**Condition:** This vegetation community occurs along the lower slopes in the north and north-west of the study area. The majority of the native vegetation within the study area appears to have been lightly grazed at some time. Most of the native vegetation within the study area shows good levels of recruitment. In general this vegetation community is in good condition, maintaining with a moderate level of native diversity and low levels of exotic species.
Classification: This vegetation community does not constitute any community that is listed within the schedules of the TSC Act or EPBC Act.

Silver-leaved Ironbark (*Eucalyptus melanophloia*) Woodland

![Silver-leaved Ironbark Woodland](Plate 4.4: Silver-leaved Ironbark Woodland)

Description: This vegetation community occurs within the east of the study area on the upper slopes on shallow silty clay loams.

Canopy Layer: 16 to 20 m – a patchy to moderate 20 – 40 % PFC. Dominant species included; *Eucalyptus melanophloia* (Silver-leaved Ironbark) and *C. glaucophylla*. *E. albens* was recorded in lower densities within this area.

Sub Canopy Layer: 4 to 15 m – 3 to 5 % PFC. Dominant species were *C. glaucophylla*, juvenile canopy species and scattered occurrences of *Acacia salicina* (Cooba).

Shrub Layer: 1 to 3m – 1 to 2 % PFC. Dominant shrub species included; *L. feroxissimum*, *S. birchii* with sparse occurrences of *G. parviflora*.

Ground Layer: 0.2 to 1.5 m – variable 75 to 90 % PFC. Dominant species included; *A. scabra* subsp. *scabra*, *Sporobolus elongatus* (Slender Rat's Tail Grass), *B. decipiens* and *C. truncata*.

Condition: This vegetation community occurs along the lower slopes in the north and north-west of the site, covering an area of 2.9 ha. The majority of the native vegetation within the study area appears to have been lightly grazed at some time. Most of the native vegetation within the study area shows good
levels of recruitment. In general this vegetation community is in good condition, maintaining with a moderate level of native diversity and low levels of exotic species.

**Classification:** This vegetation community does not constitute any community that is listed within the schedules of the TSC Act or EPBC Act.

**Cleared / Disturbed Land**

![Plate 4.5: Cleared / Disturbed Land](image)

**Description:** This vegetation community is only associated with the disused quarry situated toward the east of the study area.

**Canopy Layer:** Nil.

**Sub Canopy Layer:** 4 to 15 m – 3 to 5 % PFC. Dominant species were juvenile canopy species, namely *E. melanophloia* and *C. glaucophylla*

**Shrub Layer:** Nil.

**Ground Layer:** 0.1 to 0.5 m – 5 to 15 % Projected Foliage Cover (PFC). Dominant species included *B. decipiens*, *C. truncata* and *Entolasia stricta* (Wiry Panic). Introduced species including *Coryza sumatrensis* (Tall Fleabane) and *Trifolium angustifolium* (Narrow-leaf Clover) were recorded throughout this community. *Juncus sarophorus* was noted to occur in highest densities within the wet lower lying parts of this area, surrounding the dams.
**Condition:** This vegetation community, covering an area of 0.6 ha, has a very low ecological value due to its previous use as a quarry. As such, the soils are very shallow and are sparsely vegetated throughout.

**Classification:** This vegetation community does not constitute any community that is listed within the schedules of the TSC Act or EPBC Act.

### 4.3.2 Significant Flora Species

Using the EPBC Act Protected Matters Search Tool and the Atlas of NSW Wildlife database, twelve threatened flora species listed under the EPBC Act were identified as potentially occurring in the study area locale (10 km buffer). Eleven of these species are also listed under the TSC Act. The likelihood of occurrence of these flora species was assessed based on broad habitat type and species distribution and is outlined in Table 6.1. No threatened flora species were identified in the study area.
**Legend**

- Study Area
- Bimble Box Woodland
- Box – Gum Grassy Woodlands and Derived Grasslands (CEEC) / (EEC)
- Cleared / Disturbed land
- Waterhole/ Dam
- Plains Grass Grassland (CEEC) / (EEC)
- Silver-leaved Ironbark Woodland

**Figure 4.1**
Vegetation Mapping
4.3.3 TSC Act Box Gum Woodland Assessment

Under the TSC Act, White Box Yellow Box Blakely’s Red Gum Woodland EEC can exist in a number of states. Intact stands that contain diverse upper and mid-storeys and ground layers are rare. Modified sites include the following:

- Areas where the main tree species are present ranging from an open woodland formation to a forest structure, and the ground layer is predominantly composed of exotic species; and
- Sites where the trees have been removed and only the grassy groundlayer and some herbs remain.

Identification guidelines have been provided for this community (NPWS 2002). The area of vegetation, which has been mapped as ‘Box – Gum Grassy Woodlands and Derived Grasslands’ in Figure 4.1, has been assessed against these guidelines in Table 4.1.

<table>
<thead>
<tr>
<th>Table 4.1: TSC Act Box Gum Woodland Listing Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Box Gum Woodland</strong></td>
</tr>
<tr>
<td>1. The study area is in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands or NSW South Western Slopes Bioregions – proceed to 2.</td>
</tr>
<tr>
<td>1* The study area is outside the above bioregions</td>
</tr>
<tr>
<td>2. There are no native species in the understorey, and the study area is unlikely to respond to assisted natural regeneration</td>
</tr>
<tr>
<td>2* The study area is otherwise – proceed to 3</td>
</tr>
<tr>
<td>3. The study area has trees – proceed to 4.</td>
</tr>
<tr>
<td>3* The study area is treeless, but is likely to have supported White Box, Yellow Box or Blakely’s Red Gum prior to clearing – proceed to 5</td>
</tr>
<tr>
<td>4. White Box, Yellow Box or Blakely’s Red Gum, or a combination of these species, are or were present</td>
</tr>
<tr>
<td>4* White Box, Yellow Box or Blakely’s Red Gum have never been present</td>
</tr>
<tr>
<td>5. The study area is predominantly grassy</td>
</tr>
<tr>
<td>5* The understorey of the study area is dominated by shrubs excluding pioneer species</td>
</tr>
</tbody>
</table>
In reference to the NSW NPWS Identification Guidelines for White Box Yellow Box Blakely’s Red Gum Woodland EEC, the results of the field survey determined that this woodland vegetation, as mapped in Figure 4.2, does fit the NSW Scientific Committee Final Determination of this EEC. This is due to the canopy comprising of White Box, Yellow Box or Blakely’s Red Gum with an understorey comprised of some of the native species listed in the determination.

4.3.4 EPBC Act Box Gum Woodland Assessment

The criteria for a woodland to qualify as White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland and Derived Grassland) Critically Endangered Ecological Community (CEEC) under the EPBC Act are slightly different to the NSW determination. Under the EPBC Act, remnants can exist in one of three states:

- An overstorey of Eucalypt trees exists, but there is no substantial native understorey.
- A native understorey exists, but the trees have been cleared.
- Both a native understorey and an overstorey of Eucalypts exist in conjunction (DEH 2006).

The Threatened Species Scientific Committee considers that areas in which an overstorey exists without a substantially native understorey are degraded and are no longer a viable part of the ecological community. Although some native species may remain, in most of these areas the native understorey is effectively irretrievable. In order for an area to be included in the listed ecological community, a patch must have a predominantly native understorey (DEH 2006).

Vegetation communities with the potential to be the locally occurring White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland and Derived Grassland) EPBC Act listed Critically Endangered Ecological Community, were analysed in detail by using the criteria in Table 4.2 below.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
<th>Does the study area meet the criteria?</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is or was previously, at least one of the most common overstorey species White Box, Yellow Box or Blakely’s Red Gum (or Western Grey Box or Coastal Grey Box in the Nandewar Bioregion)?</td>
<td>Yes (for 37.83 ha of the study area)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Does the ‘patch’ have a predominately native understorey?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Is the patch 0.1 ha or greater in size?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>4a</td>
<td>Are there 12 or more native understorey species present (excluding grasses)?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>4b</td>
<td>Does the study area contain at least one important species?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Is shrub cover less than 30% across the entire remnant</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.2: EPBC Act Box Gum Woodland Listing Criteria
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
<th>Does the study area meet the criteria?</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Where sites do not meet the criteria 4a and 4b, is the patch 2 ha or greater in size?</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Does the 2 ha patch have 40 or more trees with a DBH &gt;40cm? (i.e. 20 per hectare)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td></td>
<td><strong>NA</strong></td>
<td></td>
</tr>
<tr>
<td>7b</td>
<td>In the 2 ha area, are there mature trees and natural generation (&gt;5cm DBH) of dominant overstorey Eucalypts (WB, YB, BRG)?</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td></td>
<td><strong>NA</strong></td>
<td></td>
</tr>
</tbody>
</table>

In consideration of the above criteria, the Box Gum Woodland identified in the study area fits the EPBC Act criteria for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

### 4.3.5 Noxious and Environmental Weeds

Of the 106 flora species identified during the survey 23 were introduced species.

Of these 23 introduced species one is listed as a noxious weed, namely *Opuntia stricta* (Prickly Pear). Under the provisions of the *Noxious Weeds Act* 1993, Prickly Pears (except *Opuntia ficus-indica*) are classed as a Class 4 weed. This means that the growth and spread of the plant must be controlled according to the measure specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.

### 4.4 Flora Summary

Five vegetation communities were observed within the study area, namely White Box / Yellow Box / Blakely's Red Gum Grassy Woodland, Plains Grass Grassland, Bimble Box Woodland, Silver-leaved Ironbark Woodland and Cleared / Disturbed Land. The White Box / Yellow Box / Blakely’s Red Gum community is listed as Endangered under the TSC Act and Critically Endangered under the EPBC Act.

All areas of the site have been impacted in the past by past logging and agricultural practices, predominately grazing.

### 4.5 Habitat Assessment

#### 4.5.1 Fauna Habitats of the Study Area

Large areas of the study area provides habitat for a range of fauna species. These habitats consist of, and provide, various quality (condition) habitats and resources (e.g. foraging and breeding niches) for native flora and fauna, including:

- Small, medium and large tree hollows;
- Flowering Eucalypts;
Fallen / felled timber, including hollow-bearing logs;
- Waterholes;
- Coarse leaf litter;
- Shrubs and other dense ground layer and under-storey vegetation; and
- Roost trees.

Three distinct habitat types were identified in the study area. In addition to the floristic composition of these habitat types and the food resources which they may provide to native fauna species (e.g. fruiting and/or flowering trees, water), each of these three broad habitat types may also contain elements which fulfill a range of requirements for various native fauna species. For example, elements such as fallen woody debris/logs, hollow bearing trees, flowering plants, waterholes and bushrock, fulfil important foraging, sheltering and nesting requirements for amphibians, birds, reptiles and mammals. The following sections outline the key habitat value and characteristics of each habitat type within the study area and adjacent lands.

4.5.2 Habitat Descriptions and Distribution

The habitat types identified during the ecological assessment are described below. For the purpose of this assessment, the study focused primarily on the areas within or adjacent to each of the proposed Glasserton Well Lease sites and associated access roads, as shown on Figure 5.1. The survey locations are shown on Figure 3.1.

Observations were also made of adjacent lands associated with George’s Island that surround the 52.56 ha study area, including the woodland vegetation on the opposite side of Clift Road and the grassy woodland vegetation associated with grazing land, as shown on Figure 5.1. The habitat types within the study area and adjacent lands associated with George’s Island are described below.

Woodland

The woodland vegetation of the study area consists of Woodland with a moderately sparse mid-storey, except for dense patches of White Cypress Pine (*Callitris glaucophylla*). The woodland habitat occupies approximately 48.66 ha of the study area, as shown on Figure 5.1. This habitat type occupies approximately (1.55 ha) of land that is to be potentially impacted by the proposed activities.

This habitat type has undergone past disturbances associated with periodic livestock grazing resulting in a structurally modified understorey. Grazing has reduced plant diversity within the understorey, encouraged some weed invasion and may, in some areas of the study area, be limiting the natural regeneration of Eucalypt canopy species, resulting in the dominance of White Cypress Pine within these areas. Accordingly the condition rating of this habitat is moderate to good, even though it has undergone past disturbances, the fauna habitat values of this habitat type have not been significantly reduced.

Hollow bearing Eucalypts were common throughout most of the woodland vegetation and ranged between approximately two to nine hollow-bearing trees per hectare recorded at the representative habitat assessment sites. These hollows range from small to large in size and provide breeding habitat for numerous native birds, mammals and reptiles, including several threatened species, such as Squirrel...
Glider (*Petaurus norfolcensis*), Greater Long-eared Bat (*Nyctophilus timoriensis*), Barking Owl (*Ninox connivens*) and Little Lorikeet (*Glossopsitta pusilla*). Several small and medium sized bird nests were also observed throughout the woodland vegetation.

Eucalypt canopy species recorded in the study area included two Koala feed tree species, Bimble Box and White Box, as listed under Schedule 2 of SEPP 44. These flowering canopy species, as well as Silver Ironbark, provide foraging resources for nectar reliant bird species, such as the White-plumed Honeyeater (*Lichenostomus penicillatus*) that was abundant in numbers and Little Wattlebird (*Anthoeca chrysoptera*), as well as Parrots, such as Red-rumped Parrot (*Psephotus haematonotus*), Musk Lorikeet (*Glossopsitta concinna*) and Little Lorikeet (*Glossopsitta pusilla*).

The understorey was observed to be generally moderate to sparse in density; however localised patches of dense White Cypress Pine provide ideal foraging, sheltering and breeding opportunities for a variety of native birds, such as Eastern Yellow Robins (*Eopsaltria australis*), Willie Wagtail (*Rhipidura leucophrys*), Rufous Fantail (*Rhipidura rufifrons*), Fairy-wrens (*Malurus* sp.) and Thornbills (*Acanthiza* sp.).

A relatively dense groundcover was dominated by native grasses with occasional fallen timber and loose surface rock providing additional habitat resources for small to medium sized mammals and reptiles. These features provide a range of functional opportunities for terrestrial fauna. Fallen timber provides shelter and breeding habitat for many native reptiles and mammals. The dense grass cover provides foraging resources for reptiles, small birds and mammals.

Rabbit (*Oryctolagus cuniculus*) burrows were observed across the majority of the study area in moderate densities. Abandoned burrows may provide some denning and sheltering resources for native ground dwelling mammals and reptiles.

**Grassland**

The grassland habitat occupies approximately 2.85 ha of the study area has undergone significant past disturbances associated with agricultural land use (grazing, pasture improvement and possibly past cropping). This habitat type occupies approximately (0.08 ha) of land that is to be potentially impacted by the proposed activities.

Some scattered mature Eucalypt trees are present in this area but are at low densities. The condition rating of this vegetation community is poor due to a high presence of introduced species and a low presence of indigenous species resulting from prolonged livestock grazing (cattle and/or sheep), subsequently providing relatively low habitat values for most native fauna.

Foraging and breeding resources are limited in this habitat type and may only be suitable for mammals (e.g. rodents, rabbits and foxes) and reptiles (snakes and lizards) that may use the grasslands for breeding, herbivory and predation. Birds such as the Eastern Rosella (*Platycercus eximius*) and Galah (*Eolophus roseicapilla*) were observed foraging in this habitat type.

**Waterhole**

One ephemeral waterhole occurs where the former quarry is located, as shown on Figure 5.1. This waterhole is relatively shallow and may only hold water for short periods of the year or during the wetter
months of a given season. In regards to native biota, this waterhole provides a watering point, as was evident from signs of macropod and feral Pigs (*Sus scrofa*). However, it possesses no significant habitat values for amphibians.

### 4.5.3 Habitats in Adjacent Lands associated with George’s Island

#### Woodland

On the opposite side of Clift Road to the east and to the north of the study area, there is approximately 191 ha (delineated via API) of adjacent woodland, which in regards to habitat values, is similar to the woodland vegetation of the study area, as shown on Figure 5.1. This woodland habitat was observed to contain the same type of habitat resources and habitat values as the woodland found within the study area and due to its larger extent provides a greater area of like habitat for native biota. Even though Clift Road divides these two areas of woodland habitat (road fragmentation of approximately 10 m), there still remains an effective degree of connectivity and the passage between both areas would be achievable to most of the fauna species recorded in the study area.

#### Grassy Open Woodland

The study area (52.56 ha), is surrounded by grassy open woodland habitat to the north, west and south that occupies approximately 170 ha (delineated via API) of George’s Island, as shown on Figure 5.1. This habitat is associated with agricultural land that is actively grazed by sheep and/or cattle, and as a result has little to no understorey present.

This habitat is comprised of scattered Eucalypt trees, some of which are hollow bearing, that are in varying densities across their distribution. The groundcover is comprised of a mixture of native and exotic grass, herb and forb species. Lower volumes of woody debris and bushrock occur in this habitat type as it would be routinely removed by the landholders (farmers) to allow for pasture improvement and machinery access. Farm dams are also associated with this habitat and as such provide watering points for native fauna.

This vegetation has lower habitat values than the woodland vegetation of the study area, in that it has a reduced amount of foraging, breeding, roosting and sheltering resources present. However it does still provide these habitat resources and would be actively utilised by many of the species recorded in the study area, in particular bird species. In this regard, this habitat provides a valuable extension to the more valuable habitat types associated with George’s Island.

#### Crop Land

Beyond the open grassy woodland and woodland habitat types surrounding the study area, there is an extensive area of agricultural cropland. Annual cropping and some pasture improvement are actively practiced within this part of the wider study area. This landscape, even though it has been significantly modified, provides foraging resources for insectivorous microbat and bird species; however it is unlikely to provide any other foraging resources. It is also unlikely to provide any breeding, roosting or sheltering resources apart from the odd hollow bearing tree that may occur in isolation.
4.5.4 Habitat Resources in Adjacent Lands

As discussed in Section 4.2.1, even though past disturbances may have structurally modified vegetation communities and may have partially reduced the availability of habitat resources across George’s Island. The vegetation communities and habitats that are extrapolated across George’s Island provide an important resource for native biota that is likely to occur or is known to occur across the George’s Island ‘island’ and within the locality. Overall George’s Island is likely to support a similar level of biodiversity and abundance of species as the study area.

Hollow Bearing Trees and Logs

The woodland vegetation adjacent to the study area on the opposite side of Clift Road possesses a similar abundance of hollow bearing trees and fallen logs as the study area. In this regard, the adjacent woodland habitat provide a similar abundance of roosting and breeding resources for birds, reptiles and arboreal mammals, as the woodland habitats of the study area, however these resources are more extensive in association with the larger area that is occupied by the adjacent woodland. Hollow bearing trees and logs are also present in the adjacent grassy woodland habitats but are less frequent.

Foraging Resources

The foraging resources of adjacent lands, in particular woodland and grassy woodland habitats, provide a more extensive area of foraging resources for native fauna then that of the study area. This is due to how much area (ha) of the George’s Island they occupy in contrast to the study area.

Bushrock and Fallen Woody Debris

There is a similar distribution of bushrock and fallen woody debris in the woodland habitat adjacent to the study area on the opposite side of Clift Road. In this regard, the adjacent woodland habitat provide a similar abundance of sheltering and breeding resources for small to medium sized ground dwelling mammals and reptiles, as the woodland habitats of the study area, however these resources are more extensive in association with the larger area that is occupied by the adjacent woodland. Bushrock and fallen woody debris is also present in the adjacent grassy woodland habitats but are less frequent.

Roosting, Nesting and Breeding Resources

Visual inspections of the adjacent woodland habitats on the opposite side of Clift Road revealed a continuation of similar roosting, nesting and breeding resources as the study area. The adjacent grassy woodland habitats also provide these resources but to a lesser degree. Again it must be restated that these habitat resources are associated with a more extensive area of vegetation.

Connectivity to Habitats in Adjacent Lands

The study area is contiguous with a moderately large remnant patch of woodland that occurs over the greater George’s Island. However, George’s Island is isolated from neighbouring woodlands, with the closest being Doona State Forest located approximately 5 km to the east. Other areas of native
vegetation in the locality of the study area include Spring Ridge State Forest approximately 7 km to the southwest and Breeza State Forest approximately 7.5 km to the north.

Land clearing for agricultural land use across the surrounding plains has fragmented George’s Island from neighbouring areas of vegetation. However, George’s Island may provide a temporary refuge for highly mobile transient species, such as birds, microbats and medium to large mammals, some larger reptiles may also undertake such movements.

As previously discussed, George’s Island contains the same habitat features (hollow bearing trees, fallen logs and woody debris, rocky outcrops and habitat types), as the study area. In effect it is a continuation of the same habitat features in similar densities and spatial distribution as that of the study area.

In regards to vegetation communities, George’s Island was observed to contain the same vegetation communities as the study area. These vegetation communities that occur across the remainder of George’s Island are likely to be at a similar ratio of coverage as was mapped within the study area. This is likely because the study area provides a good representation of the rest of George’s Island in regards to topography, land use, soil type and degree of past disturbance.
Figure 4.2
Habitats within the Study Area and Adjacent Lands
4.5.5 Fauna Results

The five day/four night fauna surveys revealed the presence of two amphibians, 47 birds, 19 mammals (including ten microbats) and five reptiles. Two threatened species and two migratory species listed under the TSC Act and/or EPBC Act were recorded in the study area. The locations of these recordings are shown on Figure 4.3. The limited faunal results may be the result of the ‘island biogeography’ that is associated with George’s Island.

Birds

During this survey, 47 bird species were recorded in the study area, one of which was an introduced species Common Starling (**Sturnus vulgaris**). The relatively moderate number of birds recorded can be attributed to the study area’s isolation from larger areas of native vegetation (State Forests) to the north, east and southwest. In this regard the study area may act as a stepping stone between these larger areas of habitat for bird species, especially those which are more nomadic or transient in their behaviour.

Of the 47 bird species recorded one species, Little Lorikeet, is listed as vulnerable under the TSC Act, whilst two bird species Rufous Fantail and Rainbow Bee-Eater (**Merops ornatus**) are listed as migratory under the EPBC Act, as shown on Figure 4.3. These species are discussed further in Section 5.3.

Mammals

A total of 19 mammals species (six of which were introduced) were recorded in the study area during this survey, as listed in Appendix C. The introduced species, Domestic Cattle (**Bos taurus**), Domestic Sheep (**Ovis aries**), Rabbit (**Oryctolagus cuniculus**), Brown Hare (**Lepus capensis**), Pig (**Sus scrofa**) and numerous House Mouse (**Mus musculus**) were recorded in the woodland and plains grass grassland areas of the study area, as listed in Appendix C.

One threatened mammal, the Koala was recorded three times in the study area. The Koala was recorded through targeted searches around known Koala habitat trees (White Box, Bimble Box and White Cypress Pine) by means of spotlighting and scat searches, as shown on Figure 4.2. No other threatened mammals listed under the TSC Act and/or EPBC Act were recorded in the study area.

Microbats

**Anabat Analysis Results**

Numbers in columns (Table 4.3) represent number of calls attributed to each species or species group (Ford, 2011).
Table 4.3: Anabat Analysis Data

<table>
<thead>
<tr>
<th>Species</th>
<th>29 March</th>
<th>30 March</th>
<th>31 March</th>
<th>Total Calls</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calls/species positively identified</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalinolobus gouldii</td>
<td>55</td>
<td>23</td>
<td>30</td>
<td>108</td>
</tr>
<tr>
<td>Chalinolobus morio</td>
<td>23</td>
<td>3</td>
<td>1</td>
<td>27</td>
</tr>
<tr>
<td>Nyctophilus species</td>
<td>0</td>
<td>2</td>
<td>20</td>
<td>27</td>
</tr>
<tr>
<td>Scotorepens balstoni</td>
<td>28</td>
<td>2</td>
<td>2</td>
<td>32</td>
</tr>
<tr>
<td>Scotorepens greyii / S. species</td>
<td>8</td>
<td>5</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Austronomus australis</td>
<td>32</td>
<td>18</td>
<td>32</td>
<td>82</td>
</tr>
<tr>
<td>Mormopterus ridei (=M. sp 2)</td>
<td>41</td>
<td>4</td>
<td>18</td>
<td>63</td>
</tr>
<tr>
<td>Mormopterus species 3</td>
<td>19</td>
<td>60</td>
<td>15</td>
<td>94</td>
</tr>
<tr>
<td>Mormopterus species 4</td>
<td>22</td>
<td>267</td>
<td>20</td>
<td>309</td>
</tr>
<tr>
<td>Saccolaimus flaviventris 3</td>
<td>30</td>
<td>32</td>
<td>13</td>
<td>75</td>
</tr>
<tr>
<td><strong>Total positively identified calls</strong></td>
<td>258</td>
<td>421</td>
<td>153</td>
<td>832</td>
</tr>
<tr>
<td><strong>Calls/species NOT positively identified</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. gouldii or Mormopterus species</td>
<td>36</td>
<td>70</td>
<td>30</td>
<td>136</td>
</tr>
<tr>
<td>Vespadelus species 3</td>
<td>0</td>
<td>2</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>V. species or Miniopterus orianaee oceanensis</td>
<td>12</td>
<td>2</td>
<td>33</td>
<td>47</td>
</tr>
<tr>
<td>Mormopterus ridei or M. species 3</td>
<td>0</td>
<td>11</td>
<td>14</td>
<td>25</td>
</tr>
<tr>
<td>Mormopterus species 3 or M. species 4</td>
<td>17</td>
<td>19</td>
<td>17</td>
<td>53</td>
</tr>
<tr>
<td>Unidentified bat calls</td>
<td>36</td>
<td>7</td>
<td>25</td>
<td>68</td>
</tr>
<tr>
<td><strong>Total calls NOT positively identified</strong></td>
<td>104</td>
<td>111</td>
<td>139</td>
<td>354</td>
</tr>
<tr>
<td><strong>Total calls recorded</strong></td>
<td>362</td>
<td>532</td>
<td>292</td>
<td>1186</td>
</tr>
</tbody>
</table>

*Species listed in this section and not above should be considered as possibly present in the study area. See notes below regarding species identity for calls with poor resolution.

Notes – species / calls not reliably identified

Nyctophilus species - The long-eared bats produce distinctive linear calls that are usually distinguishable from other species; however, the species within the genus Nyctophilus cannot be differentiated using Anabat data. Based on the survey location and habitat (Box Gum Woodland), the calls recorded in this survey were most likely from N. geoffroyi and/or N. gouldii (Ford, 2011).

Scotorepens greyii / Scotorepens sp. (central-eastern broad-nosed bat) - Calls from these two species cannot be differentiated and both potentially occur in the study area.

Chalinolobus gouldii or Mormopterus species - C. gouldii frequency overlaps entirely with the three small Mormopterus spp, but its call pulses are generally steep, curved and alternate in frequency, whereas most Mormopterus spp pulses are flat or only slightly curved and do not alternate in frequency. Numerous better quality calls were positively identifiable based on these characteristics; however, a number of poor quality calls (brief and/or weak and/or noisy) could not be reliably attributed to any of these species (Ford, 2011).
**Vespadelus species and Miniopterus orianae oceanensis** - Several Vespadelus species (V. darlingtoni, V. regulus and V. vulturnus) produce calls around the same frequency as those from M. oceanensis. Differentiation can be difficult, but some Vespadelus calls have uniform pulses with distinctive cup-shaped base with upward sloping tail, whereas M. o. oceanensis calls are more erratic and generally have flatter base with no tail or down-ward-sloping tail. Of the 72 calls from this group, about 1/3 (25 calls) were almost certainly from Vespadelus species (most likely V. vulturnus), but the other 2/3 showed a mix of, or intermediate, pulse shapes and could have been from any of these species (Ford, 2011).

**Mormopterus species** - Mormopterus sp 4 call frequency (24-30 kHz) overlaps with that of M. sp 3 (28 – 31 kHz), which also overlaps with M. sp 2 (31-36 kHz); and all have very similar pulse shapes (flat to gently curved). Each species was positively identified from calls with pulses primarily outside of the frequency overlap zones (i.e. sp 4 @ <27 kHz; sp3 @ 30 – 31 kHz; sp 2 @ >32 kHz). A number of calls were recorded in the frequency overlap zones and were attributed to species pairs (i.e. sp 2/3 @ 31 – 32 kHz and sp 3/4 @ 28-30 kHz) (Ford, 2011).

**Unidentified bat calls** - These were calls that were too brief and/or weak and/or noisy to allow reliable attribution to any species or species group. All such calls were within the frequency ranges of species otherwise listed in the table and are unlikely to represent additional species (Ford, 2011).

**Reptiles**

Five reptile species were recorded in the study area including one snake, three skinks and one monitor, as listed in Appendix C. The diversity of reptiles recorded is moderate and may be indicative of the study area’s fragmentation from adjacent habitats and the availability of basking and sheltering resources in the study area.

No threatened reptile species such as the Border Thick-tailed Gecko (*Underwoodisaurus sphyrurus*) or Pale-headed Snake (*Hoplocephalus bitorquatus*) were recorded in the study area.

**Amphibians**

Two amphibians were recorded during opportunistically and during a spotlighting survey. The amphibians recorded during the field investigations are listed in Appendix C. Suitable habitat for the Booroolong Frog (*Litoria booroolongensis*), listed as endangered under both the TSC Act and EPBC Act, was not present in the study area, therefore targeted searches for this species were not undertaken. The Booroolong Frog is typically found in association with permanent rocky flowing streams in mountainous regions (Robinson, 2007).
Figure 4.3
Recorded Threatened or Migratory Species and Hollow Bearing Trees
4.5.6 Fauna of Conservation Significance

Threatened Species

A total of 38 Commonwealth and/or State listed fauna species were identified on the database searches as occurring or having the potential to occur (based on habitat assessment) within the study area. Two threatened species and two migratory fauna species listed under the TSC Act and/or EPBC Act were recorded in the present study.

Migratory Species

The Commonwealth Protected Matters Online Search Tool revealed 11 migratory species that have the potential to occur in the study area. Two migratory species Rufous Fantail and Rainbow Bee-eater were recorded in the study area and may regularly utilise the study area as vagrants, as such both species have been assessed under the EPBC Act assessment of significance criteria for migratory species.

Fauna Summary

A total of 63 fauna species were recorded in the study area. This included two amphibians, 47 birds, 19 mammals (including ten bats) and five reptiles. This list included seven introduced species (one bird and six mammals).

Four threatened species and two migratory species listed under the TSC Act and/or EPBC Act were recorded in the study area, another six threatened and/or migratory species were considered 'likely' to occur based on this assessment. Assessments of significance (AoS) under the TSC Act has been undertaken for each of these fauna species in Appendix D, and under the EPBC Act has been in Appendix E.
5.0 Environmental Impact Assessment

5.1 Identification of Threatened Species, Populations and Ecological Communities

Those threatened flora and fauna species (listed under the TSC Act and the EPBC Act) that have been gazetted / recorded from within the locality have been considered in this ecological assessment. EEC’s and Endangered Populations known from the broader area have also been addressed. Each species / community / population is considered for its potential to occur within the study area and the likely level of impact as a result of the proposed activities. This ecological assessment deals with each species / community / population separately and identifies the ecological parameters of significance associated with the proposed activities.

Those species / communities that have been identified as potentially being impacted have been assessed as set out in Appendix D and Appendix E.

‘Species’ or ‘EEC / Population’ – Lists each threatened species / EEC / population known from the vicinity of the site. The status of each threatened species under the TSC Act and EPBC Act is also provided.

‘Habitat’ – Provides a brief account of the species / community / population and the preferred habitat attributes required for the existence / survival of each species / community / population.

‘Likelihood of Occurrence’ – Assesses the likelihood of each species / community / population to occur within the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

‘Potential for Impact’ – Through consideration of the likely level / significance of impacts to each species / community / population that would result from the proposed activities, taking into account both short and long-term impacts, a decision has been made whether further assessment is required. This assessment is largely based on the chance of occurrence of each species / community with due recognition to other parameters such as home range, habitat use, connectivity etc. It also considers the scope of the proposed activities.
### Table 5.1: Likelihood of Occurrence of Threatened Flora and Fauna Species, Populations and Ecological Communities within the Study Area.

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>TSC Act Status</th>
<th>EPBC Act Status</th>
<th>Habitat</th>
<th>Likelihood of Occurrence</th>
<th>Potential for Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flora</strong></td>
<td></td>
<td>V</td>
<td>V</td>
<td>Forms a closed or open canopy mixing with Eucalypt and Cypress Pine species with a typical soil profile of sandy loam surface layer, grading from a light clay to medium clay with depth.</td>
<td>Surveys did not record this species on the site. Unlikely due to lack of suitable habitat.</td>
<td>Considered unlikely to be adversely affected by the proposed activities. Detailed flora surveys were conducted within the proposed disturbance areas, and no individuals were observed. The proposed activities will not result in the removal of this species. Furthermore, limited areas of suitable habitat will be removed as part of construction.</td>
</tr>
<tr>
<td><em>Cadellia pentastylis</em></td>
<td>Ooline</td>
<td>V</td>
<td>V</td>
<td>Found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture on heavy basaltic black soils and stony red-brown hard setting loam with clay subsoil.</td>
<td>Suitable habitat occurs in disturbed woodland and black soil plains.</td>
<td>While small areas of disturbed potential habitat will be cleared as part of construction, extensive areas of suitable habitat will be retained across the site. A 7-part test of significance (TSC Act) has been applied to this species in Appendix D, as well an AoS (EPBC Act) in Appendix E.</td>
</tr>
<tr>
<td><em>Dichanthium setosum</em></td>
<td>Bluegrass</td>
<td>V</td>
<td>V</td>
<td>Occurs in grasslands and in undulating woodlands and open forests with an underlying basaltic geology.</td>
<td>Suitable habitat occurs in disturbed woodland and black soil plains.</td>
<td>The proposed activities will result in the clearing of small areas of suitable black soil plains habitat, however large areas of suitable habitat are to be retained on site and potential impacts are unlikely, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Digitaria porrecta</em></td>
<td>Finger Panic Grass</td>
<td>E</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
<td>Potential for Impact</td>
</tr>
<tr>
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<td>---------</td>
<td>-------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Hakea pulvinifera</td>
<td>Lake Keepit Hakea</td>
<td>E</td>
<td>E</td>
<td>Associated with <em>Alstonia constricta</em> and <em>Acacia decora</em> with a sparse cover of grasses with 50% being bare earth or rock.</td>
<td>Unlikely, outside of known distribution</td>
<td>The site is outside on the species known distribution. The proposed activities are highly unlikely to impact on this species; therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Philotheca ericifolia</td>
<td>-</td>
<td>V</td>
<td>V</td>
<td>Grows mostly in dry sclerophyll forest and heath on damp sandy flats and gullies.</td>
<td>Suitable habitat occurs in woodland communities; however this species was not identified in the study area.</td>
<td>Detailed flora surveys conducted across the proposed disturbance areas did not identify this species. While the proposed activities will result in the clearing of small areas of disturbed woodland, extensive suitable habitat is to be retained across the site. Potential impacts are unlikely; therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Prasophyllum sp. Wybong</td>
<td>A Leek-orchid</td>
<td>-</td>
<td>CE</td>
<td>Generally found in shrubby and grassy habitats in dry to wet soil. It is known to occur in open Eucalypt woodland and grassland.</td>
<td>The site does not contain suitable habitat in the form of damp sandy flats and gullies.</td>
<td>No potential habitat is present in the study area, and thus this species is unlikely to be affected by the proposed activities, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Pterostylis cobarenensis</td>
<td>Cobar Greenhood Orchid</td>
<td>V</td>
<td>V</td>
<td>Found in Eucalypt woodlands, open mallee or <em>Callitris</em> shrublands on low or stony ridges and slopes in skeletal sandy-loam soils.</td>
<td>Suitable habitat occurs in woodland.</td>
<td>Unlikely to be adversely impacted by the proposed activities. Disturbance areas are limited to existing areas of disturbed vegetation, and are unlikely to support this species. Intact suitable habitat is to be retained across the site and potential impacts are unlikely, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
<td>Potential for Impact</td>
</tr>
<tr>
<td>-------------------------</td>
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<td>-----------------</td>
<td>--------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><em>Rulingia procumbens</em></td>
<td></td>
<td>V</td>
<td>V</td>
<td>Grows in sandy sites, often along roadsides and is associated with <em>Eucalyptus dealbata</em> and <em>Eucalyptus sideroxylon</em> communities.</td>
<td>Outside of known distribution</td>
<td>The study area is outside the species known distribution. The proposed activities are highly unlikely to impact this species; therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Swainsona murrayana</em></td>
<td>Slender Darling-pea</td>
<td>V</td>
<td>V</td>
<td>Known to occur on clay-based soils in a variety of vegetation types, including Bladder Saltbush, Black Box and grassland communities on level plains, floodplains and depressions. It is often found with <em>Maireana</em> species.</td>
<td>No suitable habitat occurs across the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat on site, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Thesium australe</em></td>
<td>Austral Toadflax</td>
<td>V</td>
<td>V</td>
<td>Occurs in grasslands or grassy woodlands and is often found in damp sites in association with Kangaroo Grass.</td>
<td>Potential habitat exists within the deeper soils of the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities. Limited areas of suitable grassland habitat will be disturbed as part of construction. Areas of potential habitat for this species will be conserved across the site and potential impacts are unlikely, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Tylophora linearis</em></td>
<td></td>
<td>V</td>
<td>E</td>
<td>Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry Eucalypt and/or Callitris woodlands.</td>
<td>Marginal habitat occurs in woodland.</td>
<td>Limited areas of disturbed marginal habitat will be cleared as part of construction, which is unlikely to adversely impact this species and potential impacts are unlikely, therefore AoS for this species is not required.</td>
</tr>
</tbody>
</table>
### TSC Act and/or EPBC Act - Threatened Ecological Communities

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>TSC Act Status</th>
<th>EPBC Act Status</th>
<th>Habitat</th>
<th>Likelihood of Occurrence</th>
<th>Potential for Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSC Act - Artesian Springs Ecological Community</td>
<td>Naturally restricted to the artesian springs of the Great Artesian Basin in north-western NSW. The springs occur where artesian water emerges at the surface through fault-lines in the overlying rock and produce mounds from the salts and sediments as the water evaporates. The vegetation within the community frequently consists of sedges or similar vegetation, however, trees and shrubs may be adjacent to the springs or nearby. Occurs at the edges of the Great Artesian Basin. Mostly found in Queensland and South Australia, however, a few occur in the Mulga Lands, Darling Riverine Plains and Cobar Peneplain Bioregions of New South Wales.</td>
<td>No artesian springs were observed in the study area. Goran Lake is a naturally occurring ephemeral lake and is part of a major saline aquifer recharge zone and as such has not been mapped as a Wetland GDE, as it is not reliant on groundwater discharge from the Great Artesian Basin (RPS, 2011b). Furthermore, according to Golder Associates (2011) there is no high priority GDEs within a 50 km radius of the test area (see Figure 11, Appendix of REF).</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as the predicted Groundwater Modelling of the depressurisation of the Hoskissons Coal seam, as undertaken by Golder Associates (2011), has determined that the predicted drawdown in the overlying aquifers is negligible and that there would be no drawdown in the Gunnedah Formation, and that the predicted drawdown in the upper aquifers will also be less than the expected seasonal fluctuations of the Gunnedah Formation. Therefore AoS for this EEC is not required.</td>
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<tr>
<td>Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South bioregion</td>
<td>The Ooline community is an unusual and distinctive forest community with the canopy dominated by the tree Ooline (<em>Cadellia pentastylis</em>). Other canopy species include White Box (<em>Eucalyptus albans</em>), Ironbarks (<em>E. bayeriana</em> and <em>E. melanophloia</em>), Dirty Gum (<em>E. chlorociada</em>), Narrow-leaved Grey Box (<em>E. pilligaensis</em>), Green Mallee (<em>E. viridis</em>) and White Cypress Pine (<em>Callitris glaucophylla</em>). The understorey is made up of a range of shrubs such as Wattles and grasses. Extensively cleared and now known from only seven main locations on the</td>
<td>This ecological community was not identified in the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area, therefore AoS for this species is not required.</td>
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<tr>
<td>Species</td>
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<tr>
<td>Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions</td>
<td>EEC</td>
<td>-</td>
<td></td>
<td>North West Slopes in NSW, between Narrabri and the Queensland border, and also in Queensland.</td>
<td>This was previously an open forest community of flora and fauna that may now exist as woodland or as remnant trees. Characteristic tree species are Carbeen (<em>Corymbia tessellaris</em>) and White Cypress-pine (<em>Callitris glaucophylla</em>). Associated trees include <em>Corymbia dolichocarpa</em>, <em>Eucalyptus populnea</em>, <em>E. camaldulensis</em>, <em>Casuarina cristata</em> and <em>Allocasuarina luehmannii</em>. Found on riverine plains of the Meehi, Gwydir, MacIntyre and Barwon Rivers and in small remnants farther south.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area, therefore AoS for this species is not required.</td>
</tr>
</tbody>
</table>

<p>| Fuzzy Box Woodland on alluvial Soils of the South Western Slopes; Darling Riverine Plains and Brigalow Belt South Bioregions | EEC | - | | Tall woodland or open forest dominated by Fuzzy Box <em>Eucalyptus conica</em>, often with Grey Box <em>Eucalyptus microcarpa</em>, Yellow Box <em>Eucalyptus melliodora</em>, or Kurrajong <em>Brachychiton populneus</em>. Buloke <em>Allocasuarina luehmannii</em> is common in places. Shrubs are generally sparse, and the groundcover moderately dense, although this will vary with season. Alluvial soils of the South West Slopes, Brigalow Belt South and Darling Riverine Plains Bioregions. Mainly in the Dubbo-Narromine-Parkes-Forbes area. | This ecological community was not identified in the study area. | Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area, therefore AoS for this species is not required. |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>TSC Act - Inland Grey Box Woodland in the Riverina; NSW South Western Slopes; Cobar Peneplain; Nandewar and Brigalow Belt South Bioregions</td>
<td>Eucalyptus microcarpa (Inland Grey Box) grassy woodlands and derived native grasslands of south-eastern Australia</td>
<td>E</td>
<td>E</td>
<td>Inland Grey Box Woodland includes those woodlands in which the most characteristic tree species, <em>Eucalyptus microcarpa</em> (Inland Grey Box), is often found in association with <em>E. populnea</em> subsp. bimbil (Bimble or Poplar Box), <em>Callitris glaucophylla</em> (White Cypress Pine), <em>Brachychiton populneus</em> (Kurrajong), <em>Allocasuarina luehmannii</em> (Bullooak) or <em>E. melliodora</em> (Yellow Box), and sometimes with <em>E. albens</em> (White Box). The community generally occurs as an open woodland 15–25 m tall but in some locations the overstorey may be absent as a result of past clearing or thinning, leaving only an understorey. Inland Grey Box Woodland occurs predominately within the Riverina and South West Slopes regions of NSW down to the Victorian border. This community also extends across the slopes and plains in Central and Northern NSW up to the Queensland Border.</td>
<td>The main indicator canopy species (Grey Box) was not recorded within the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>TSC Act - Myall Woodland in the Darling Riverine Plains; Brigalow Belt South; Cobar Peneplain; Murray-Darling Depression; Riverina and NSW South Western Slopes bioregions</td>
<td>Weeping Myall Woodlands</td>
<td>E</td>
<td>E</td>
<td>This ecological community is scattered across the eastern parts of the alluvial plains of the Murray-Darling river system. Typically, it occurs on red-brown earths and heavy textured grey and brown alluvial soils within a climatic belt receiving between 375 and 500 mm mean annual rainfall. The structure of the community varies from low woodland and low open woodland to low sparse woodland or open shrubland, depending on site quality.</td>
<td>The main indicator species (Weeping Myall) was not recorded within the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area, therefore AoS for this species is not required.</td>
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<tr>
<td>Native Vegetation on Cracking Clay Soils of the Liverpool Plains</td>
<td></td>
<td>EEC</td>
<td>CE</td>
<td>and disturbance history. The tree layer grows up to a height of about 10 metres and invariably includes Acacia pendula (Weeping Myall or Boree) as one of the dominant species or the only tree species present. This EEC is known from parts of the Local Government Areas of Berrigan, Bland, Bogan, Carrathool, Conargo, Coolamon, Coonamble, Corowa, Forbes, Gilgandra, Griffith, Gwydir, Inverell, Jerilderee, Lachian, Leeton, Lockhart, Moree Plains, Murray, Murrumbidgee, Narrabri, Narranderra, Narromine, Parkes, Urana, Wagga Wagga and Warren, and but may occur elsewhere in these bioregions.</td>
<td>The Plains Grass grassland in the northwestern corner of the study area does not constitute this TEC.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>EPBC Act – Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland</td>
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TSC Act - Native Vegetation on Cracking Clay Soils of the Liverpool Plains

EPBC Act – Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland
### Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions

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<td></td>
<td></td>
<td>EEC</td>
<td>CE</td>
<td>A low, dense form of dry rainforest generally less than 10 m high, made up of vines and rainforest trees as well as some shrubs. This community often stands out as a bright green against surrounding woodland due to many species having bright-coloured leaves. The main canopy is dominated by rainforest species such as Red Olive Plum (<em>Cassine australis var. angustifolia</em>), Wilga (<em>Geijera parvifolia</em>) Native Olive (<em>Notelaea microcarpa var. microcarpa</em>) and Peach Bush (<em>Ehretia membranifolia</em>), with taller eucalypts and cypress pines from surrounding woodland vegetation emerging above the main canopy. A scattered distribution near Gunnedah, Barraba, Bingara and north of Warialda on the NSW North West Slopes and Plains, and also in Queensland.</td>
<td>This ecological community was not identified in the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area, therefore AoS for this species is not required.</td>
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</tbody>
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### TSC Act - White Box Yellow Box Blakely's Red Gum Woodland  
EPBC Act - White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland

<table>
<thead>
<tr>
<th>Species</th>
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<td></td>
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<td>EEC</td>
<td>CE</td>
<td>White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation) , in which the most obvious species are one or more of the following: White Box Eucalyptus albans, Yellow Box E. melliodora and Blakely's Red Gum E. blakelyi. Intact sites contain a high diversity of plant species, including the TSC Act – Known. Identified in the study area. EPBC Act - Known. Identified in the study area.</td>
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<td><strong>Fish</strong></td>
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<tr>
<td><em>Macullochella peelii</em> peeli</td>
<td>Murray Cod</td>
<td>-</td>
<td>V</td>
<td>Found in clear rocky streams to slow flowing, turbid rivers and billabongs. Usually found near large rocks, snags, overhanging vegetation and other woody structures.</td>
<td>The site does not provide suitable habitat to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.</td>
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<td><strong>Amphibians</strong></td>
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<tr>
<td><em>Litoria booroolongensis</em></td>
<td>Booroolong Frog</td>
<td>E</td>
<td>E</td>
<td>Found along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses.</td>
<td>Habitat in the study area is not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.</td>
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<tr>
<td><strong>Reptiles</strong></td>
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<tr>
<td><em>Elseya belli</em></td>
<td>Bell’s Turtle</td>
<td>V</td>
<td>V</td>
<td>Found in shallow to deep pools in upper reaches or small tributaries of major rivers in granite country, with rocky or sandy bottoms and patches of vegetation.</td>
<td>Habitat in the study area is not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
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<tr>
<td><em>Hoplocephalus bitorquatus</em></td>
<td>Pale-headed Snake</td>
<td>V</td>
<td>-</td>
<td>Found mainly in dry Eucalypt forests and woodlands, Cypress woodland and occasionally in rainforest or moist Eucalypt forest. Favours streamside areas, particularly in drier habitats.</td>
<td>Suitable marginal habitat occurs in woodland, however no streamside habitats available in study area.</td>
<td>The proposed activities will have minimal impact on this species. No optimal habitat for this species occurs in the study area; therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Underwoodisaurus sphyrurus</em></td>
<td>Border Thick-tailed Gecko</td>
<td>V</td>
<td>V</td>
<td>Favours forest and woodland areas on steep rocky or scree slopes, with boulders, rock slabs, fallen timber and deep leaf litter.</td>
<td>Marginal habitat occurs in woodland, however unlikely to occur in the study area due to isolation and lack of favourable steep rocky or scree slopes, with boulders, rock slabs habitats.</td>
<td>The proposed activities are unlikely to adversely affect this species, as no core habitat will be disturbed; therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><strong>Birds</strong></td>
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<tr>
<td><em>Anthochaera phrygia</em></td>
<td>Regent Honeyeater</td>
<td>E</td>
<td>E</td>
<td>Inhabits dry open forest and woodland, particularly Box-Ironbark woodland and open riparian forests of River She-oak.</td>
<td>Suitable habitat occurs in woodland, may use the study area as a foraging and breeding resource.</td>
<td>The proposed activities will have only a minimal impact on this species’ habitat, as the well leases have been sited within existing highly disturbed areas. Suitable habitat for this species will be retained across the study area; therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Certhionyx variegatus</em></td>
<td>Pied Honeyeater</td>
<td>V</td>
<td>-</td>
<td>Inhabits wattle shrub, mallee, Spinifex and Eucalypt woodlands, usually when shrubs are flowering.</td>
<td>Suitable habitat occurs in woodland; however study area is at the limit of its known range.</td>
<td>While small areas of disturbed woodland will be cleared, large tracts of suitable habitat will be retained across the study area. The proposed activities will have a low impact on this species, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Species</td>
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<tr>
<td><em>Climacteris picumnus</em></td>
<td>Brown Treecreeper</td>
<td>V</td>
<td>-</td>
<td>Found in Eucalypt woodlands and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked Eucalypts, usually with a grassy understorey.</td>
<td>Suitable foraging and nesting resources in woodland habitat.</td>
<td>The proposed activities may impact on this species habitat. A 7-part test of significance (TSC Act) has been applied to this species in Appendix D</td>
</tr>
<tr>
<td><em>Ephippiorhynchus Asiaticus</em></td>
<td>Black-necked Stork</td>
<td>E</td>
<td>-</td>
<td>Mainly found on shallow, permanent, freshwater terrestrial wetlands and surrounding marginal vegetation.</td>
<td>Habitat in the study area is not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Glossopsitta pusilla</em></td>
<td>Little Lorikeet</td>
<td>V</td>
<td>-</td>
<td>Forages primarily in the canopy of open Eucalypt forest and woodland. Riparian habitats are particularly used, due to higher soil fertility. Also found in isolated flowering trees in open country, e.g. paddocks and roadside remnants.</td>
<td>Recorded as an overfly species above the study area.</td>
<td>The proposed activities are unlikely to adversely impact this species; as well leases have been sited in highly disturbed areas within woodland communities. Large tracts of suitable habitat are to be retained across the site. However as this species was recorded, a 7-part test of significance (TSC Act) has been applied to this species in Appendix D.</td>
</tr>
<tr>
<td><em>Grantiella picta</em></td>
<td>Painted Honeyeater</td>
<td>V</td>
<td>-</td>
<td>Inhabits Boree, Brigalow and Box-Gum woodlands and Box-Ironbark forests, feeding on the fruits of mistletoes growing on woodland Eucalypts and Acacias.</td>
<td>Suitable nesting resources in woodland habitats, but lack of favourable foraging resources.</td>
<td>While small areas of disturbed woodland will be cleared, minimal nesting resources will be removed as part of the proposed activities. Large tracts of suitable nesting habitat will be retained across the site. The proposed activities will have a low impact on this species habitat, therefore AoS</td>
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Appendix D
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<tr>
<th>Species</th>
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</thead>
<tbody>
<tr>
<td>Hamirostra melanosternon</td>
<td>Black-breasted Buzzard</td>
<td>V</td>
<td>-</td>
<td>Lives in a range of habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands.</td>
<td>Habitat in the study area is not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Lathamus discolor</td>
<td>Swift Parrot</td>
<td>E</td>
<td>E</td>
<td>Migrates to south-east Australia between March and October. Occurs in areas where Eucalypts are flowering profusely or where there are abundant lerp infestations.</td>
<td>Suitable foraging habitat occurs in woodland during autumn to spring. It is likely that this species utilises the study area temporarily as a vagrant.</td>
<td>The proposed activities will have a low impact on this species, as minimal foraging trees will be removed as part of this proposed activities, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Lophoictinia isura</td>
<td>Square-tailed Kite</td>
<td>V</td>
<td>-</td>
<td>Found in a variety of habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.</td>
<td>Suitable woodland habitat, but may only occur in study area as part of a larger home range.</td>
<td>It is unlikely that the proposed activities will have an adverse impact on this species. Large tracts of suitable habitat will be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Melanodryas cucullata</td>
<td>Hooded Robin</td>
<td>V</td>
<td>-</td>
<td>Prefers lightly wooded country and structurally diverse habitats, usually open Eucalypt woodland, Acacia scrub and mallee, often in or near clearings or open areas.</td>
<td>Suitable foraging and breeding resources occurs in woodland and grassland habitats.</td>
<td>The proposed activities will have only a minimal impact on this species' habitat, therefore AoS for this species is not required</td>
</tr>
<tr>
<td>Melithreptus gularis</td>
<td>Black-chinned Honeyeater</td>
<td>V</td>
<td>-</td>
<td>Occupies mostly upper levels of drier open forests or woodlands dominated by Box or ironbark Eucalypts. Also inhabits open forests of smooth-barked Gums, stringy barks, ironbarks and tea-trees.</td>
<td>Suitable habitat occurs in woodland; however this nomadic species may only use study area as a vagrant.</td>
<td>The proposed activities will have only a minimal impact on this species' habitat. Furthermore, suitable habitat is to be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Species</td>
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<tr>
<td><em>Neophema pulchella</em></td>
<td>Turquoise Parrot</td>
<td>V</td>
<td>-</td>
<td>Lives on edges of Eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.</td>
<td>Suitable foraging and breeding resources in woodland habitats; however this semi-nomadic species may only use the study area as a vagrant.</td>
<td>The proposed activities will have only a minimal impact on this species’ habitat. Furthermore, suitable habitat is to be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Ninox connivens</em></td>
<td>Barking Owl</td>
<td>V</td>
<td>-</td>
<td>Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Roosts in shaded portions of tree canopies, with tall midstorey species, such as Acacia and Casuarina species.</td>
<td>Suitable foraging and breeding resources occur in woodland habitats.</td>
<td>The proposed activities may impact on this species habitat. A 7-part test of significance (TSC Act) has been applied to this species in Appendix D</td>
</tr>
<tr>
<td><em>Polytelis swainsonii</em></td>
<td>Superb Parrot</td>
<td>V</td>
<td>V</td>
<td>Found in Box-Gum, Box-Cypress-pine and Boree woodlands and River Red Gum forest. Nests in small colonies in the hollows of large trees, mainly in tall riparian River Red Gum forest or woodland.</td>
<td>Suitable foraging resources in woodland habitats, but only known to breed south of 32° S.</td>
<td>While habitat occurs across the study area for this species, it is unlikely that this species utilises the study area for breeding purposes. Suitable foraging habitat will be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Pomatostomus temporalis temporalis</em></td>
<td>Grey-crowned Babbler</td>
<td>V</td>
<td>-</td>
<td>Inhabits open Box-Gum woodlands on the slopes, Box-Cypress pine and open Box woodlands on alluvial plains.</td>
<td>Suitable foraging and breeding resources in woodland and grassland habitats.</td>
<td>The proposed activities may impact on this species habitat. A 7-part test of significance (TSC Act) has been applied to this species in Appendix D</td>
</tr>
<tr>
<td><em>Pyrrholaemus saggitatus</em></td>
<td>Speckled Warbler</td>
<td>V</td>
<td>-</td>
<td>Lives in a wide range of Eucalypt dominated communities that have a grassy understorey and often on rocky ridges or in gullies.</td>
<td>Suitable habitat occurs in woodland, but it is not favourable habitat, and may only occur as a vagrant.</td>
<td>Habitat in the study area is marginal at best and large areas of similar habitat will be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
</tbody>
</table>
### Species Distribution and Likelihood of Occurrence

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>TSC Act Status</th>
<th>EPBC Act Status</th>
<th>Habitat</th>
<th>Likelihood of Occurrence</th>
<th>Potential for Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Rostratula australis</em></td>
<td>Australian Painted Snipe</td>
<td>E</td>
<td>V</td>
<td>Inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans.</td>
<td>Habitats in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Stagonopleura guttata</em></td>
<td>Diamond Firetail</td>
<td>V</td>
<td>-</td>
<td>Found in grassy eucalypt woodlands, including Box-Gum woodlands and Snow Gum woodlands. Often found in riparian areas and sometimes in lightly wooded farmland.</td>
<td>Suitable foraging and breeding resources in woodland and grassland habitats.</td>
<td>The proposed activities will have only a minimal impact on this species, as small areas of disturbed woodland will be removed and suitable habitat will be retained across the site, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Tyto novaehollandiae</em></td>
<td>Masked Owl</td>
<td>V</td>
<td>-</td>
<td>Roosts and breeds in moist Eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Lives in dry Eucalypt forests and woodlands.</td>
<td>Suitable foraging resources in woodland habitats; however large enough hollows for roosting and/or breeding were not observed. May use study area as part of a larger home range.</td>
<td>It is likely that this species utilises the study area as part of a larger home range only. As no roosting / breeding hollows large enough for the species will be disturbed as part of the proposed activities, it is unlikely that the proposed activities will have an adverse affect on this species; therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
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<tr>
<td><em>Chalinolobus dwyeri</em></td>
<td>Large-eared Pied Bat</td>
<td>V</td>
<td>V</td>
<td>Roosts in caves, crevices in cliffs, old mine workings and disused Fairy Martin (<em>Hirundo ariet</em>) nests, frequenting dry open forest and woodland close to these features.</td>
<td>Suitable foraging resources in woodland habitats.</td>
<td>The proposed activities will have only a minimal impact on this species’ habitat. Suitable habitat will be retained across the study area; therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
<td>Potential for Impact</td>
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</tr>
<tr>
<td>Chalinolobus picatus</td>
<td>Little Pied Bat</td>
<td>V</td>
<td>-</td>
<td>Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee and Bimbil box. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings.</td>
<td>Suitable foraging and roosting resources in woodland habitats.</td>
<td>The proposed activities may impact on this species habitat. A 7-part test of significance (TSC Act) has been applied to this species in Appendix D.</td>
</tr>
<tr>
<td>Dasyurus maculatus maculatus</td>
<td>Spotted-tail Quoll</td>
<td>V</td>
<td>E</td>
<td>Recorded in a wide range of habitat types including dry and moist sclerophyll forests and woodlands, rainforest, coastal heathland, and riparian forest. Found in shelters and dens in small caves, fallen logs with large hollows and tree hollows.</td>
<td>Unlikely to occur as the site is highly isolated, and occurs in a fragmented landscape.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring in the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Lagorchestes leporides</td>
<td>Eastern Hare-wallaby</td>
<td>PE</td>
<td>EX</td>
<td>Little is known about this species, but it appears to have inhabited open grassland plains.</td>
<td>Habitats in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the site. Additionally, this species is presumed extinct; therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Macropus dorsalis</td>
<td>Black-striped Wallaby</td>
<td>E</td>
<td>-</td>
<td>Preferred habitat is characterised by dense woody or shrubby vegetation that must occur near a more open, grassy area to provide suitable habitat.</td>
<td>The open woodland habitats of the study area and the highly fragmented landscape are not favourable to the species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Mormopterus norfolkensis</td>
<td>Eastern Freetail-bat</td>
<td>V</td>
<td>-</td>
<td>Occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roosts mainly in tree hollows but also under bark or in man-made structures.</td>
<td>Suitable foraging and roosting resources in woodland habitats.</td>
<td>The proposed activities may impact on this species habitat. A 7-part test of significance (TSC Act) has been applied to this species in Appendix D.</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
<td>Potential for Impact</td>
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</tr>
<tr>
<td><em>Nyctophilus timoriensis</em></td>
<td>Greater Long-eared Bat</td>
<td>V</td>
<td>V</td>
<td>Commonly roosts in crevices, hollows and under loose bark in Box / Ironbark / Cypress Pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.</td>
<td>Recorded in the study area based on Anabat data analysis.</td>
<td>The proposed activities may impact on this recorded species habitat. A 7-part test of significance (TSC Act) has been applied to this species in Appendix D, as well an AoS (EPBC Act) in Appendix E.</td>
</tr>
<tr>
<td><em>Onychogalea fraenata</em></td>
<td>Bridled Nailtail Wallaby</td>
<td>-</td>
<td>E</td>
<td>Preferred habitat is a narrow band of transitional vegetation that separates dense Acacia scrub from open grassy Eucalypt woodland.</td>
<td>Outside of known distribution.</td>
<td>The study area is not within the species known distribution. It is unlikely that the proposed activities will have an impact in this species; therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Perameles bougainvillea fasciata</em></td>
<td>Western Barred Bandicoot</td>
<td>-</td>
<td>EX</td>
<td>Inhabited a variety of landscapes and vegetation types, including Saltbush covered Nullarbor Plain, woodlands on sand ridges, Bluebush plains, Desert Acacia, shrublands and heath.</td>
<td>The species is presumed extinct.</td>
<td>As this species is presumed extinct, it is unlikely that this species will be impacted by the proposed activities; therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Petaurus norfolcensis</em></td>
<td>Squirrel Glider</td>
<td>V</td>
<td>-</td>
<td>Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.</td>
<td>Targeted surveys did not reveal its presence; however suitable habitat occurs in woodland.</td>
<td>The proposed activities may impact on this species habitat. A 7-part test of significance (TSC Act) has been applied to this species in Appendix D.</td>
</tr>
<tr>
<td><em>Petrogale penicillata</em></td>
<td>Brush-tailed Rock-wallaby</td>
<td>E</td>
<td>V</td>
<td>Occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges.</td>
<td>Habitats in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring in the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
<td>Potential for Impact</td>
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<tr>
<td>Phascolarctos cinereus</td>
<td>Koala</td>
<td>V</td>
<td>-</td>
<td>Inhabits Eucalypt woodlands and forests, spending most of their time in trees. Feeds on the foliage of more than 70 Eucalypt and 30 non-Eucalypt species.</td>
<td>This species is known to occur in the study area. Three observations, in White Box and Bimble Box trees, were recorded.</td>
<td>The proposed activities may impact on this species habitat. A 7-part test of significance (TSC Act) has been applied to this species in Appendix D.</td>
</tr>
<tr>
<td>Pseudomys australis</td>
<td>Plains Rat</td>
<td>-</td>
<td>V</td>
<td>Primarily found in stone-covered plains and mod slopes with boulders, small stones and gilgais. Associated vegetation is predominantly chenopod as well as ephemeral plants.</td>
<td>Habitats in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring in the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Pteropus poliocephalus</td>
<td>Grey-headed Flying-fox</td>
<td>V</td>
<td>V</td>
<td>A range of habitats including subtropical and temperate rainforests, dry and wet sclerophyll forests, Banksia woodland, heaths and Melaleuca swamps.</td>
<td>Suitable foraging resources in woodland habitats, but may only occur rarely as a vagrant.</td>
<td>The proposed activities will have only a minimal impact on this species’ habitat; as areas of previously disturbed woodland are to be removed only. Suitable habitat will be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Saccolaimus flaviventris</td>
<td>Yellow-bellied Sheathtail-bat</td>
<td>V</td>
<td>-</td>
<td>Roosts in tree hollows and buildings. If there are no trees, they are known to occupy mammal burrows.</td>
<td>Recorded in the study area based on Anabat data analysis.</td>
<td>The proposed activities may impact on this species habitat. A 7-part test of significance (TSC Act) has been applied to this species in Appendix D.</td>
</tr>
</tbody>
</table>

**Sources:** EPBC Act and TSC Act.

**Key:** CE: Critically Endangered, E: Endangered, V: Vulnerable, **Bold:** Recorded- known to occur.

**Note:** This table excludes migratory species.
Table 5.2: Likelihood of Occurrence of Migratory Fauna Species in the Study Area

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>TSC Act Status</th>
<th>EPBC Act Status</th>
<th>Habitat</th>
<th>Likelihood of Occurrence</th>
<th>Likely Level of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Anthochaera phrygia</em></td>
<td>Regent Honeyeater</td>
<td>CE</td>
<td>M</td>
<td>Inhabits dry open forest and woodland, particularly Box-Ironbark woodland and open riparian forests of River She-oak.</td>
<td>Suitable habitat occurs in woodland, may use site as a foraging and breeding resource.</td>
<td>The proposed activities will result in minimal impact on this species’ habitat within the study area and is unlikely to directly or indirectly impact upon this species habitats or other environments at Goran Lake. Construction activities will have a minimal impact on suitable habitat and suitable habitat will be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Apus pacificus</em></td>
<td>Fork-tailed Swift</td>
<td>-</td>
<td>M</td>
<td>Aerial over open country, from semi-desserts to coasts, islands and sometimes over forests and cities.</td>
<td>Suitable foraging resources in woodland habitats, but may only occur rarely as a vagrant.</td>
<td>The proposed activities will result in minimal impact on this species’ habitat within the study area and is unlikely to directly or indirectly impact upon this species habitats or other environments at Goran Lake. Construction activities will have a minimal impact on suitable habitat and suitable habitat will be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Ardea alba</em></td>
<td>Great Egret</td>
<td>-</td>
<td>M</td>
<td>Prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands.</td>
<td>Habitats in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring in the study area. The proposed activities are also unlikely to directly or indirectly impact upon this species habitats or other environments</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
<td>Likely Level of Impact</td>
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</tr>
<tr>
<td>Ardea ibis</td>
<td>Cattle Egret</td>
<td>-</td>
<td>M</td>
<td>Found in grasslands, woodlands, wetlands, pastures and croplands, especially where drainage is poor.</td>
<td>Habits in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring in the study area. The proposed activities are also unlikely to directly or indirectly impact upon this species habitats or other environments at Goran Lake. Therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Gallinago hardwickii</td>
<td>Latham’s Snipe</td>
<td>-</td>
<td>M</td>
<td>This species favours soft wet ground or shallow water with tussocks with other green or dead growth, wet parts of paddocks, seepage below dams, irrigated areas, scrub or open woodland from sea level to alpine bogs over 2000m, samphire on salt marshes, mangrove fringes</td>
<td>Habits in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring in the study area. The proposed activities are also unlikely to directly or indirectly impact upon this species habitats or other environments at Goran Lake. Therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Haliaeetus leucogaster</td>
<td>White-bellied Sea-Eagle</td>
<td>-</td>
<td>M</td>
<td>Habitat characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest (including rainforest) and even urban areas.</td>
<td>Habits in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring in the study area. The proposed activities are also unlikely to directly or indirectly impact upon this species habitats or other environments at Goran Lake. Therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
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<tr>
<td><em>Hirundapus caudacutus</em></td>
<td>White-throated Needletail</td>
<td>-</td>
<td>M</td>
<td>Almost exclusively aerial most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy.</td>
<td>Suitable foraging resources in woodland habitats, but may only occur rarely as a vagrant.</td>
<td>The proposed activities will result in minimal impact on this species’ habitat within the study area and is unlikely to directly or indirectly impact upon this species habitats or other environments at Goran Lake. Construction activities will have a minimal impact on suitable habitat and suitable habitat will be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Merops ornatus</em></td>
<td>Rainbow Bee-eater</td>
<td>-</td>
<td>M</td>
<td>Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation.</td>
<td>Recorded in southwest corner and central area of the study area.</td>
<td>The proposed activities may impact on this species foraging habitat, where the ephemeral waterhole is to be potentially impacted. However, it is unlikely to directly or indirectly impact upon this species habitats or other environments at Goran Lake. An AoS (EPBC Act) in Appendix E has been applied to this species.</td>
</tr>
<tr>
<td><em>Myiagra cyanoleuca</em></td>
<td>Satin Flycatcher</td>
<td>-</td>
<td>M</td>
<td>Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.</td>
<td>Habitats in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring in the study area. The proposed activities are also unlikely to directly or indirectly impact upon this species habitats or other environments at Goran Lake. Therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
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<tr>
<td><em>Rhipidura rufifrons</em></td>
<td>Rufous Fantail</td>
<td>-</td>
<td>M</td>
<td>The Rufous Fantail is found in rainforest, dense wet forests, swamp</td>
<td>Recorded in northeast corner of study area.</td>
<td>The proposed activities may impact on this species habitat in the study area. However it is</td>
</tr>
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<td>woodlands and mangroves, preferring deep shade, and is often seen close</td>
<td>unlikely to directly or indirectly impact upon these species habitats or other environments</td>
<td>unlikely to directly or indirectly impact upon these species habitats or other environments at Goran Lake. An AoS (EPBC Act) in Appendix E has been applied to this species.</td>
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<td>to the ground. During migration, it may be found in more open habitats</td>
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<td>or urban areas (Birds in Backyards, 2005).</td>
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<tr>
<td><em>Rostratula benghalensis s. lat.</em></td>
<td>Painted Snipe</td>
<td>-</td>
<td>M</td>
<td>Inhabits inland and coastal shallow freshwater wetlands, occurring in</td>
<td>Habitats in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low</td>
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<td>both ephemeral and permanent wetlands, particularly where there is grass.</td>
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<td>likelihood of the species occurring in the study area. The proposed activities are also</td>
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<td>Individuals have been spotted in artificial dams, sewage ponds and</td>
<td></td>
<td>unlikely to directly or indirectly impact upon this species habitats or other environments at Goran Lake. Therefore AoS for this species is not required.</td>
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<td>waterlogged grasslands.</td>
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</tbody>
</table>

Sources: EPBC Act and TSC Act.
Key: CE: Critically Endangered, M: Migratory
Bold: Recorded- known to occur.
5.2 Impact Assessment under the TSC Act

Section 5A of the EP&A Act lists seven factors that must be taken into account in the determination of the significance of potential impacts proposed activities on ‘threatened species, populations or ecological communities (or their habitats)’ listed under the TSC Act. The Assessment of Significance (7-part test) is used to determine whether there is likely to be a significant affect on threatened species, populations or ecological communities, or their habitats and thus whether a Species Impact Statement (SIS) is required.

On this basis an assessment of significance was completed for the threatened species populations and ecological communities shown in Table 5.3 and Table 5.4. This assessment concluded that one flora species, nine fauna species and one ecological community may potentially be impacted by the proposed activities, so as to require further assessment under a 7-part test of significance (refer to Appendix D). The application of the 7-part test concluded that there is not likely to be a significant effect on threatened species, populations or ecological communities, or their habitats arising from the proposed activities.

5.3 Impact Assessment under the EPBC Act

An EPBC Act Protected Matters Search was undertaken using the SEWPac on-line database to generate a list of those MNES on George’s Island. This data, combined with other local knowledge and records, was utilised to assess whether the proposed activities will have, or are likely to have a significant impact on MNES

World Heritage areas:

The proposed activities are not in a World Heritage area, and are not in close proximity to any such area.

Wetlands protected by international treaty (the RAMSAR convention):

The proposed activities will not occur in a RAMSAR Wetland area. Goran Lake is located approximately 15 to 20 km northwest of the study area and is listed as a nationally important wetland but it is not a listed RAMSAR Wetland and as such is not a MNES. Goran Lake provides viable breeding and foraging habitat for listed migratory species. The proposed activities are unlikely to impact upon any migratory species and/or their habitats that occur at Goran Lake, due to the distance between the activity site and Goran Lake, the unlikely occurrence of groundwater drawdown and the short timeframe of the pump test.

Nationally listed threatened species, migratory species and ecological communities:

Two threatened plant species, two migratory species and one CEEC listed under the EPBC Act were positively recorded or potentially occur in the locality (Refer to Table 5.1 and Table 5.2). These were:

Critically Endangered Ecological Community

- White Box Yellow Box Blakely’s Red Gum Grassy Woodlands and Derived Native Grasslands.
Vulnerable Species

- Bluegrass (*Dichanthium setosum*); and
- Greater Long-eared Bat (*Nyctophilus timoriensis*).

Migratory Species

- Rufous Fantail (*Haliaeetus leucogaster*); and
- Rainbow Bee-eater (*Merops ornatus*).

All nuclear actions:

No type of nuclear activity is proposed.

Commonwealth marine areas:

The proposed activities will not have a significant impact on any Commonwealth marine area.

Conclusion

Pursuant to the EPBC Act, an assessment of potential impacts arising from the proposal on MNES has been undertaken. The findings have been summarised in the following tables (see Appendix E and summarised in Tables 5.3 and Table 5.4). The assessment has concluded that no significant impact is likely to relevant MNES. This assessment has been undertaken in accordance with the EPBC Act and *EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance* (DEWHA, 2009).
Table 5.3: Summary of Assessments of Significance for Threatened Flora Species and EEC

<table>
<thead>
<tr>
<th>Species/ EEC</th>
<th>EPBC Act Status</th>
<th>TSC Act Status</th>
<th>Potential Impact</th>
<th>Assessment of Significance of Potential Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TSC Act 7-Part Test</td>
<td>EPBC Act MNES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluegrass</td>
<td>V</td>
<td>V</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>A Leek Orchid</td>
<td>CE</td>
<td>-</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td></td>
<td>CE</td>
<td>EEC</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>TSC Act - White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland</td>
<td>CE</td>
<td>EEC</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>Bluegrass</td>
<td>V</td>
<td>V</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>A Leek Orchid</td>
<td>CE</td>
<td>-</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
</tbody>
</table>

Table 5.4: Summary of Assessments of Significance for Threatened and Migratory Fauna Species

<table>
<thead>
<tr>
<th>Species</th>
<th>EPBC Act Status</th>
<th>TSC Act Status</th>
<th>Potential Impact</th>
<th>Assessment of Significance of Potential Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TSC Act 7-Part Test</td>
<td>EPBC Act MNES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recorded</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Little Lorikeet</td>
<td>-</td>
<td>V</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>Koala</td>
<td>-</td>
<td>V</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>Rainbow Bee-eater</td>
<td>M</td>
<td>-</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>Rufous Fantail</td>
<td>M</td>
<td>-</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>Greater Long-eared Bat</td>
<td>V</td>
<td>V</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>Yellow-bellied Sheathtail-bat</td>
<td>V</td>
<td>-</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>Considered Likely to Occur</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Treecreeper</td>
<td>-</td>
<td>V</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>Barking Owl</td>
<td>-</td>
<td>V</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>Grey-crowned Babbler</td>
<td>-</td>
<td>V</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>Little Pied Bat</td>
<td>-</td>
<td>V</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
<tr>
<td>Eastern Freetail-bat</td>
<td>-</td>
<td>V</td>
<td>Loss of habitat</td>
<td>Significant impact unlikely</td>
</tr>
</tbody>
</table>
## Assessment of Significance of Potential Impacts

<table>
<thead>
<tr>
<th>Species</th>
<th>EPBC Act Status</th>
<th>TSC Act Status</th>
<th>Potential Impact</th>
<th>TSC Act 7-Part Test</th>
<th>EPBC Act MNES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squirrel Glider</td>
<td>-</td>
<td>V</td>
<td>Loss of habitat</td>
<td></td>
<td>Significant impact unlikely</td>
</tr>
</tbody>
</table>

### 5.4 Key Threatening Processes Relevant to Proposed Activities

A threatening process is defined under the TSC Act as ‘a process that threatens, or that may threaten, the survival or evolutionary development of a species, population or ecological community’. Threatening processes that adversely affect threatened species, populations or ecological communities, or possibly cause others that are not currently threatened; to become threatened are listed as key threatening processes (KTPs) under the TSC, FM and EPBC Acts. KTPs relevant to the proposed activities are discussed in Table 5.5.

#### Table 5.5: Key Threatening Processes Relevant to the Proposed Activities

<table>
<thead>
<tr>
<th>Key Threatening Process</th>
<th>Relevance to Proposed Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invasion of native plant communities by exotic perennial grasses</td>
<td>There exists the potential for the invasion of native woodland and grassland communities by exotic perennial grass species.</td>
</tr>
<tr>
<td>Competition and grazing by the feral European rabbit</td>
<td>Rabbit warrens were observed across the study area, but Rabbits were observed to be in relatively low numbers.</td>
</tr>
<tr>
<td>Bushrock Removal</td>
<td>Bushrock was present across the site and may provide important sheltering and breeding resources for reptiles and small ground dwelling mammals. Bushrock habitats will be disturbed by the proposed activities, but these habitat resources will be relocated elsewhere in the study area and none will be removed from the study area.</td>
</tr>
<tr>
<td>Clearing of native vegetation</td>
<td>Land clearing is to occur as a result of the proposed activities, however the 2.12 ha to be cleared is minimal in contrast to how much vegetation is to be retained within the study area and wider study area.</td>
</tr>
<tr>
<td>Loss of hollow-bearing trees</td>
<td>Six hollow bearing trees will be lost from the study area. This impact is unavoidable. The hollow bearing trees to be removed will be placed into adjacent habitats as hollow logs and woody debris. Four other hollow bearing trees, located just beyond the development footprint, may be subject to structural root zone impacts and may die back and turn into stag trees; therefore the hollow bearing resources associated with these four trees will not be lost from the study area.</td>
</tr>
<tr>
<td>Removal of dead trees and dead wood</td>
<td>No dead ‘stag’ trees will be removed from the study area, however some dead wood in the form of hollow logs and fallen woody debris will be disturbed by the proposed activities, but these habitat resources will be relocated elsewhere in the study area or study area and none will be removed from the study area.</td>
</tr>
<tr>
<td>Infection of native plants by <em>Phytophthora cinnamomi</em></td>
<td>There exists the potential for the importation of this pathogen on unclean vehicles and plant machinery. It is recommended that all vehicles be cleaned of foreign soil from other sites to ensure that this pathogen is not introduced.</td>
</tr>
</tbody>
</table>

#### 5.5 SEPP 44 Assessment

The proposed activities may temporarily impact approximately 1.55 ha of modified woodland habitat over the short-term including important habitat features relevant to the Koala:

- Five Koala feed trees (Bimble Box) around the Glasserton 3 well lease;
One Koala feed tree (Bimble Box) along proposed access track; and

Minimal impacts associated with pruning/trimming of Koala feed trees (Bimble Box) to facilitate road widening along the proposed access track.

Three Koalas were recorded in the study area and scats and scratches were observed at several locations (Figure 4.3). However, scats were of generally low to moderate density. Koalas are listed as Vulnerable under the TSC Act and their habitat is protected under SEPP 44.

The study area is within the Gunnedah LGA, which is listed in the State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44), as a Schedule 1 LGA where this policy applies. Gunnedah LGA is generally regarded as a population stronghold of this species in NSW.

Schedule 2 of SEPP 44 lists 10 tree species that are indicators of ‘Potential Koala Habitat’. The presence of any of the species listed on a site proposed for development triggers the requirement for an assessment for Potential Koala Habitat. SEPP 44 defines Potential Koala Habitat as:

“potential koala habitat means areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.”

Two Schedule 2 feed tree species White Box (Eucalyptus albens) and Bimble Box (E. populnea) were recorded within the study area. Some areas have either or both of these two species present in numbers exceeding 15%, therefore parts of the study area do constitute Potential Koala Habitat.

Three koalas were observed within the study area during field surveys. Evidence of Koalas such as scats or scratches on tree trunks was observed. George’s Island is known to support a population of Koalas, both male and female. Accordingly an assessment of whether the study area constitutes ‘Core Koala Habitat’ was undertaken. SEPP 44 defines Core Koala Habitat as:

“core koala habitat means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.”

It has been determined that the study area does provide suitable core breeding habitat for the Koala, in the form of approximately 37.83 ha of White Box, Yellow Box, Blakely’s Red Gum Woodland and approximately 8.38 ha of Bimble Box Woodland, and therefore the study area does constitute Core Koala Habitat as defined in SEPP 44. This was based on the presence of a small Koala population, abundance of Koala feed trees and the isolation of George’s Island and its local importance for the Koala population present. A Koala Plan of Management for the study area and is presented in Appendix F.

5.6 Discussion of Impacts

The majority of potential impacts associated with the proposed activities are short-term and temporary (Q4 2012, as outlined in the project description). Longer-term impacts will be associated with the establishment of 5 m x 5 m (25 m²) fenced off area around each of the Glasserton wellheads, as well as leaving the water tank in its installed position at the water holding facility. The physical ground disturbance will be minimised to the actual rig platform including rod rack and transfer area. The
remaining rig infrastructure will be placed on grade or elevated on blocks, bricks or timber to reduce the amount of ground disturbance.

The extent (ha) of vegetation community/ habitat and identified EEC that is to be disturbed, as a result of the proposed activities, and the percentage of each to be disturbed within the study area, is provided in Table 5.6 and depicted on Figure 5.1 whilst Table 5.7 details the extent (ha) of each habitat type to be disturbed.

5.6.1 Overview of Identifying Potential Impacts

The assessment of potential ecological impacts revealed the following:

- Potential ecological impacts;
- Potential short-term and long-term impacts;
- Vegetation clearing;
- Disturbance to vegetation communities and habitats;
- Fauna displacement;
- Disruption of breeding cycle, roosting and sheltering behaviour;
- Hollow bearing tree removal;
- Removal of hollow logs, fallen woody debris and bushrock;
- Impacts on migration and dispersal ability;
- Disruption of pollination cycle and seed dispersion;
- Introduction of weeds and feral pest species; and
- Noise.

Each of the above listed potential impacts is discussed in greater detail within the following relevant sections.

Potential Ecological Impacts

Temporary short-term impacts will be associated with the proposed activities through the establishment and operation of the well head lease sites and the upgrading of access tracks. The only long-term impacts will be associated with the 5 m x 5 m fenced off areas around each of the Glasserton wellheads and leaving the water tank in its installed position at the water holding facility. The project timeframe from initial works to completion of rehabilitation is expected to be Q4 2012, as outlined in the project description.

The proposed location of the Glasserton well heads has been sited within areas of past disturbance (such as the former gravel quarry and historically cleared areas) to minimise the amount of clearing and disturbance to the TSC Act and EPBC Act Box Gum Woodland. In addition, the configuration and design of the proposed well sites has been prepared to minimise the footprint of each, including vegetation
clearing requirements. The well sites will require approximately 1.26 ha of vegetation clearing. The access tracks will require approximately 1.03 ha of vegetation clearing.

The Glasserton 1 site contains a small proportion of native groundcover including grasses, but is dominated by weed species. The proposed Glasserton 2 site will require no clearing of mature vegetation, with clearing being restricted to immature (approximately 2 – 3 m tall) regrowth and native grasses.

Adjacent to Glasserton 2, immediately south of the main access track, there is a previously quarried area that represents a similar level of disturbance and minimal natural regeneration to the well drill site. Its ecological character is such that it offers limited habitat availability for any faunal guilds, other than basking reptiles on the peripherals where it is close to refuge habitat to reduce risk of predation. As an ephemeral waterhole it would provide a faunal watering point and microchiropteran bat flyway.

The current proposal seeks to establish a level pad (approximately 2,600 m² area) to accommodate a water handling facility as outlined in the proposal description. It is likely that there will be a temporary reduction in the overall size of this water hole to establish the water handling facility, however this may only pose a very minor impact on threatened species, populations and ecological communities and non-threatened fauna such that a significant impact is unlikely. The majority of the water handling facility will be removed from site, apart from the water tank that will remain in place. Appropriate rehabilitation will be undertaken in this area, except for where the water tank will be remaining in place.

Clearing at Glasserton 3 will result in the removal of four mature hollow bearing trees within the lease footprint (see Figure 5.1) and may impact the structural root zone (SRZ) of four other mature hollow bearing trees that are located just beyond the northeastern boundary of the lease footprint. It is possible that impacts on the SRZ may result in four of the hollow bearing trees dying back and becoming stag trees. At Glasserton 4, a small number of mature White Cypress Pine trees will be required to be cleared, in addition to native grasses.

An existing access track is present in the study area and will be upgraded to provide adequate and safe access for the proposed activities and to avoid any additional clearing for access requirements. The track is currently approximately 4 m wide and will require widening by a further 4 m to a maximum carriageway of 8 m. Additional clearing along the track is likely to remove some mature trees and some post 1990 regrowth saplings along the western boundary where the existing track narrows, but no mature White Box or Yellow Box trees that are representative of this EEC or CEEC will be cleared to formalise this section of access track.

Primarily only juvenile Eucalypt saplings will be required for clearing along the access track upgrade. However, it is anticipated that a limited number of Silver-leaved Ironbark and Bimble Box trees (including two hollow bearing trees) are to be removed and a minimal amount of pruning of overhanging canopy vegetation may also be required to facilitate the access of drilling rigs along the proposed access tracks.

George’s Island 3 is located in Box Gum Woodland at an existing wellhead and can be effectively accessed along an existing access track. No surface regrading or vegetation clearing is required along the existing access track or at the George’s Island 3 wellhead. Therefore, no ecological impacts will occur along the existing access track or at the existing George’s Island 3 wellhead, to install a downhole pressure gauge for monitoring purposes.
Potential Short-term and Long-term Impacts

Temporary short-term impacts will be associated with the establishment and operation of the well head lease sites, water handling facility and the upgrading of access tracks. The only long-term impacts will be associated with the 5 m x 5 m fenced off areas around each of the Glasserton wellheads and leaving the water tank in its installed position at the water holding facility.

The proposed rehabilitation and revegetation of the well lease sites (except for the 5 m x 5 m fenced off areas around each of the Glasserton wellheads) and where access track widening may occur, Q4 2012, as outlined within the project description following initial site works, will reinstate vegetation of greater structural diversity and habitat value over the long-term in comparison to what currently occurs at each well lease site.

The clearing of 2.12 ha of native vegetation in the study area will result in the removal of some foraging and breeding resources for a suite of locally occurring species from the study area. However the removal of these resources is minimal in extent in comparison to the amount of available ‘like’ resources in adjacent lands and those that will be retained, and in some areas improved, within the remainder of the study area.

In consideration of site rehabilitation and revegetation activities that are to occur at each well site once decommissioning has occurred, it is unlikely that there will be any long-term impacts associated with the proposed activities apart from the 5 m x 5 m fenced off areas around each of the Glasserton wellheads and the water tank at the water holding facility.

Vegetation Clearing

The extent of each vegetation community to be potentially impacted by the proposed activities has been determined by the results of the flora surveys and on ground observations. GIS maps have been developed to present the results of these findings and they are shown in Figure 5.1.
Figure 5.1
Impact Areas and Hollow Bearing Tree Removal
Clearing of Vegetation Communities and Habitats

The proposed activities are likely to result in the reduction of local populations of some plant species that occur within the proposed activities footprint. The extent (ha) of vegetation community and identified EEC that is to be disturbed, as a result of the proposed activities, and the percentage of each to be disturbed within the study area, is provided in Table 5.6 and depicted on Figure 5.1, whilst Table 5.7 details the extent (ha) of each habitat type to be disturbed.

Table 5.6: Extent of Vegetation Communities within Study Area and Total Area of each to be disturbed

<table>
<thead>
<tr>
<th>Vegetation Community or EEC</th>
<th>Total within Study Area (ha)</th>
<th>Total Area of Disturbance (ha)</th>
<th>Percentage (%) of each to be Disturbed</th>
<th>Long-term Disturbance Areas (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bimble Box Woodland</td>
<td>8.38</td>
<td>0.71</td>
<td>8.47</td>
<td>25</td>
</tr>
<tr>
<td>TSC Act - White Box Yellow Box Blakely's Red Gum Woodland</td>
<td>37.83</td>
<td>0.65</td>
<td>1.72</td>
<td>25</td>
</tr>
<tr>
<td>EPBC Act - White Box-Yellow Box-Blakely’s Red Gum grassy woodland and derived native grassland</td>
<td>37.83</td>
<td>0.65</td>
<td>1.72</td>
<td>25</td>
</tr>
<tr>
<td>Silver-leaved Ironbark Woodland</td>
<td>2.9</td>
<td>0.19</td>
<td>6.55</td>
<td>0</td>
</tr>
<tr>
<td>Plains Grass Grassland</td>
<td>2.85</td>
<td>0.08</td>
<td>2.8</td>
<td>0</td>
</tr>
<tr>
<td>Disturbed Land</td>
<td>0.6</td>
<td>0.49</td>
<td>81.67</td>
<td>120</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>52.56 ha</strong></td>
<td><strong>2.12 ha</strong></td>
<td><strong>4.03 %</strong></td>
<td><strong>170m²</strong></td>
</tr>
</tbody>
</table>

The clearing of 1.55 ha of woodland habitat represents disturbance to 0.36 % of woodland habitat across the entire George’s Island based on the Curlewis vegetation data (DoP, 2001). Similarly, the clearing of 0.65 ha of the White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland impacts on 0.34 % of this community occurring on the Island. A relatively minor area (50m²) of woodland habitat will be subject to longer-term disturbance. This disturbance is associated with the retention of a 5 x 5 m well head at Glasserton 3 & 4.

Table 5.7: Extent of Habitat Type within Study Area and Total Area of each to be disturbed

<table>
<thead>
<tr>
<th>Vegetation Community or EEC / Habitat Type</th>
<th>Total within Study Area (ha)</th>
<th>Total Area of Disturbance (ha)</th>
<th>Percentage (%) of each to be Disturbed</th>
<th>Long-term Disturbance Areas (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodland</td>
<td>49.11</td>
<td>1.55</td>
<td>3.16</td>
<td>50</td>
</tr>
<tr>
<td>Grassland</td>
<td>2.85</td>
<td>0.08</td>
<td>2.8</td>
<td>0</td>
</tr>
<tr>
<td>Disturbed Land</td>
<td>0.6</td>
<td>0.49</td>
<td>81.67</td>
<td>120</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>52.56 ha</strong></td>
<td><strong>2.12 ha</strong></td>
<td><strong>4.03%</strong></td>
<td><strong>170m²</strong></td>
</tr>
</tbody>
</table>

The clearing of 1.55 ha of woodland habitat represents disturbance to 0.36 % of woodland habitat across the entire George’s Island based on the Curlewis vegetation data (DoP, 2001). Similarly, the clearing of 0.65 ha of the White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland impacts on 0.34 % of this community occurring on the Island. A relatively minor area (50m²) of woodland habitat will be subject to longer-term disturbance. This disturbance is associated with the retention of a 5 x 5 m well head at Glasserton 3 & 4.

Fauna Displacement

The proposed activities are likely to result in the clearing of 2.12 ha of viable habitat from the study area. This habitat provides foraging, breeding, roosting and sheltering resources that may currently be utilised by all the faunal groups identified in the study area. This will result in the displacement of native fauna...
across the study area. Displaced fauna will need to relocate into adjacent habitats, which will place short-term pressure on the available habitat resources within these habitats.

The degree of displacement within the study area and the intensity of pressure placed on adjacent habitats are minimal based on the percentage of habitats to be lost in comparison to what will be retained in the study area. Additionally, like habitats are also available throughout George’s Island and as such an even smaller percentage of habitat resources are to be lost over the short-term from the wider study area.

In consideration of the proposed post construction rehabilitation identified in the EMP, the potential impacts associated with fauna displacement are likely to be minimal in extent and are only likely to occur over the short-term. Furthermore, the already structurally modified vegetation of the site is likely to be improved where rehabilitation works are to occur and as a result improve habitat values for native fauna.

**Disruption of Breeding Cycle, Roosting and Sheltering Behaviour**

The breeding cycle, roosting, sheltering and foraging behaviour for some species is likely to be impacted by the proposed activities, particularly within the woodland habitats. This impact is most likely to occur where the proposed activities will result in the removal of hollow bearing trees and where hollow logs, fallen woody debris and bushrock habitats are to be removed from the impact areas and relocated into other parts of the study area.

**Hollow Bearing Trees**

It is expected that six hollow bearing trees are to be removed as a result of the proposed activities. These trees provide viable nesting, roosting and/or breeding resources for native birds, arboreal mammals and some reptile species. Four other hollow bearing trees, located just beyond the development footprint, may be subject to structural root zone impacts and may die back and turn into stag trees and as such the associated hollow bearing resources will not be lost.

Even though measures (development footprint refinement) were undertaken, the potential removal of six hollow bearing trees is unavoidable. However, in consideration of the remainder of the study area and wider study area providing an abundance of hollow bearing trees that also contain viable nesting, roosting and/or breeding resources, the potential removal of six hollow bearing trees is not significant.

In consideration of the availability of nesting, roosting and/or breeding resources in adjacent habitats in comparison to the relatively low number of hollow bearing resources to be lost as a result of the proposed activities, it is unlikely that hollow dependant fauna will be adversely impacted by the proposed activities and should be able to relocate successfully into hollow bearing resources that are present throughout the adjacent habitats. Mitigation measures to help ameliorate these impacts are prescribed in **Section 6**.

**Hollow Logs, Fallen Woody Debris and Bushrock**

It is expected that a relatively small volume of hollow log, fallen woody debris and bushrock habitats that are currently present in the study area will be disrupted and relocated as a result of the proposed activities. This is likely to temporarily disrupt the nesting, breeding and/or sheltering behaviour of some reptiles and ground dwelling mammals.
However, this disruption is likely to be minimal in extent and is unlikely to be significant, as these habitat resources will be relocated into adjacent habitats within the study area and/or wider study area and retained over the long-term, and as a result will not be permanently lost from the study area. Mitigation measures to help ameliorate these impacts are prescribed in Section 6.

**Impacts on Migration and Dispersal Ability**

The impact on the migration and dispersal ability of native flora and fauna, like most of the other impacts, is species specific. Species, which are less mobile (e.g. reptiles and amphibians), residents (e.g. some birds) or species whereby the habitat to be removed forms an important component of the overall habitat area, are those that would be most likely impacted. George’s Island is already an isolated area of woodland vegetation, which has been fragmented from larger areas of vegetation in the locality (i.e. neighbouring State Forests).

The proposed activities are unlikely to further fragment or isolate areas of vegetation within George’s Island or impose a significant barrier to the migration and dispersal ability of native biota. Mobile species such as microbats, medium to large mammals and woodland birds would not be impacted by the proposed activities.

The less mobile smaller species are also unlikely to be significantly impacted, as the area/extent of habitats to be cleared is 2.12 ha in comparison to the area of habitats to be retained across the study area 50.46 ha should allow such species to migrate and disperse across George’s Island successfully. Additionally, the size and shape of existing vegetation and habitats within the study area would be altered slightly based on the proposed areas (ha) of disturbance.

**Disruption of Pollination Cycle and Seed Dispersion**

Excessive dust from the proposed activities could potentially disrupt the pollination cycle and ability of native plants to regenerate (i.e. germination, revegetation and re-colonisation of existing plants). Mitigation measures to help ameliorate these impacts are prescribed in Section 6.

**Introduction of Weeds and Feral Pest Species**

The proposed activities have the potential to create favourable conditions for introduced weed species within the study area, which could potentially lead to an increase of existing weed populations. This is most likely to occur where soil disturbance is to occur.

All plant and machinery will be washed down and cleaned of any foreign soil and seed prior to being transported onsite to prevent the potential spread of introduced weeds and pathogens.

Disturbance of surface soils along access roads/ tracks and where re-shaping/ re-levelling earthworks are proposed to occur may encourage weed growth. Weed species, especially those listed as noxious, should be removed from site or controlled by means of herbicide applications to help prevent or minimise their re-occurrence within the proposed activities footprints. Weed control measures should primarily focus on preventing the spread of the noxious weed Prickly Pear. Where practical these weeds should be
removed from site or controlled by means of herbicide applications to help prevent or minimise their re-occurrence.

Revegetation of the areas adjacent to the areas of disturbance should occur where practicable as soon as possible during or after construction. Initially it would be important to re-establish groundcover in the form of grass species, so as to provide competition against the invasive noxious weed Prickly Pear. This would also re-establish foraging resources for native fauna. Mitigation measures to help ameliorate these impacts are prescribed in Section 6.

**Noise**

Noise pollution as a result of vehicles, machinery and drilling may deter native fauna from utilising the study area and immediate surrounding areas as habitat. The proposed activities could affect the migration and dispersal ability of native fauna particularly in relation to noise and vehicular movements. The proposed activities may result in increased noise pollution which has the potential to disrupt the breeding cycle and the foraging and roosting behaviour of some native fauna species.

5.7 **Significance of Potential Impacts**

**Little Lorikeet**

The Little Lorikeet was recorded flying over the study area by means of visual and call identification. The subject may provide foraging and nesting resources for this highly mobile nomadic species. The small amount 1.55 ha of woodland habitat to be impacted ‘removed’ as part of the proposed activities are unlikely to impact on the long-term persistence of the species in the study area.

**Koala**

The Koala was recorded three times in known Koala feed trees (White Box and Bimble Box) by means of spotlighting and opportunistic sightings, as shown on Figure 5.1. Koala scats were also recorded at the base of Koala feed trees. Koala feed trees are found across the majority of the study area. The small amount 1.55 ha of woodland habitat containing Koala feed trees to be impacted ‘removed’ as part of the proposed activities are unlikely to impact on the long-term persistence of the species in the study area.

**Brown Treecreeper**

It is likely that the species uses the woodland habitat of the study area for foraging and nesting, due to the presence of hollow bearing trees and fallen woody debris, and is therefore important habitat for the species. The small amount 1.55 ha of woodland habitat to be impacted ‘removed’ as part of the proposed activities are unlikely to impact on the long-term persistence of the species in the study area.
**Barking Owl**

It is possible that the species uses the woodland habitat of the study area for foraging, roosting and nesting, due to the presence of hollow bearing trees and viable foraging habitat, and is therefore considered important habitat for the species. The small amount 1.55 ha of woodland habitat to be impacted ‘removed’ as part of the proposed activities are unlikely to impact on the long-term persistence of the species in the study area.

**Grey-crowned Babbler**

The study area provides ideal foraging and breeding habitat for the Grey-crowned Babbler in the form of large mature trees and dense stands of saplings, and is therefore important habitat for the species. The small amount 1.55 ha of woodland habitat to be impacted ‘removed’ as part of the proposed activities are unlikely to impact the long-term persistence of the species in the study area.

**Little Pied Bat, Eastern Freetail-bat and Greater Long-eared Bat**

It is likely that these three micro-bat species utilise the woodland habitat of the study area for foraging and diurnal roosting, due to the presence of hollow bearing trees and viable foraging habitat, and is therefore important habitat for the species. The small amount 1.55 ha of woodland habitat to be impacted ‘removed’ as part of the proposed activities are unlikely to impact the long-term persistence of the species in the study area. Additionally, the temporary removal of the manmade waterhole in the already disturbed area is also unlikely to impact this species' persistence in the study area.

**Squirrel Glider**

It is likely that the species utilises the woodland habitat of the study area for foraging, roosting and nesting, due to the presence of hollow bearing trees and viable foraging habitat, and is therefore important habitat for the species. The small amount 1.55 ha of woodland habitat to be impacted ‘removed’ as part of the proposed activities are unlikely to impact the long-term persistence of the species in the study area.
6.0 Impact Mitigation and Management

6.1 Introduction

The management of potential adverse effects from the proposed activities has been presented according to the hierarchy of:

(1) Avoidance;
(2) Minimisation;
(3) Mitigation; and
(4) Offsetting of impacts.

Potential impacts of the proposed activities on native biota and their habitats will be greatest in the ground surface disturbance areas where vegetation clearing is to occur. These impacts would be greatest during the establishment of the well leases, due to direct habitat loss and landscape modification. Specific mitigation measures have been incorporated into the design of the proposed activities to minimise impacts on biota within the activity site and on the ecosystems of the study area.

6.2 Significant Ecological Values

The dominant vegetation community in the study area is Box Gum Woodland, commonly known as White Box Yellow Box Blakely’s Red Gum Woodland was found to occupy the central and western naturally-vegetated portions of the study area. This community is listed as an Endangered Ecological Community (EEC) under the NSW TSC Act (1995). In addition, Box Gum Woodland is also known as White Box-Yellow Box-Blakely’s Red Gum grassy woodland and derived native grassland, as listed as a Critically Endangered Ecological Community (CEEC) under the EPBC Act (1999).

In order to minimise potential impacts on these listed ecological communities, the location, configuration and design of the three proposed well leases and associated infrastructure has been undertaken in accordance with the ‘avoid – minimise - mitigate – offset’ hierarchy.

6.3 Avoidance of Impacts

As discussed in Section 1.2.1, the initial recommendations on well lease site selection were to locate the proposed well leases in the cultivated areas of the study area. However, this has not been possible due to landowner restrictions. Therefore, Santos was forced to investigate the vegetated environments of George’s Island within the study area for potential well lease sites. The proposed activities design aims to avoid environmental impacts, as far as is practicable, on sensitive receptors such as the Box Gum Woodland TSC Act - EEC / EPBC Act - CEEC, which provides significant habitat values for threatened and migratory species, as well as avoiding impacts on any other MNES.

6.4 Minimisation of Impacts

The three proposed new well lease sites have been selected to minimise ecological impacts as they have been identified as areas where historical disturbances have modified the natural condition. Existing roads
will be used to access the works areas at the Glasserton well leases; however an additional access road and widening of the primary access road to no greater than 8m will be required. Where ever possible the extent and nature of clearing will be minimised and/or undertaken in a sensitive manner.

Furthermore, a range of harm minimisation measures would be implemented to prevent further disturbance and to minimise adverse impacts on retained native vegetation, habitats and resident fauna. These measures are designed to address potential impacts associated with the construction phase of the proposed activities, any necessary post construction rehabilitation works and the long-term protection of biodiversity. These mitigation measures would be implemented under the broader Site Management Plan associated with the proposal being carried out over the study area.

6.5 Mitigation Strategy

A series of ecological measures should be implemented to mitigate potential impacts under the broader Site Management Plan that will be prepared to guide the proposal execution and completion within the activity site and as required, adjacent study area.

The key ecological heads of consideration generally fall under the following categories:

- Vegetation Pre-Clearance Survey;
- Fauna Management;
- Conserving and Re-using Topsoil;
- Salvaging and re-using material for the activity site;
- Managing Waste Vegetation;
- Rehabilitation;
- Weed Management; and
- Disease Control.

6.5.1 Vegetation Pre-Clearance Survey

Prior to any vegetation clearing, the Activity Area will be subject to a pre-clearance survey to identify and flag/record any threatened species and/or habitat trees with the potential to occur within the locality. To date no threatened flora species have been observed within the Activity Area, however the study area provides suitable habitat for a wide variety of threatened and non-threatened fauna species as assessed within this ecological assessment.

Habitat / Hollow-bearing Tree Survey and Marking

The pre-clearance survey will include a search within the Activity Area to be cleared for habitat/hollow bearing trees. When hollow bearing trees are found they will be marked all the way around the trunk at a height of approximately 1.5 m with a band and an ‘H’ on no fewer than three sides using fluorescent spray marking paint. This is to ensure that the hollow bearing tree markings are clearly visible from all directions. All hollow bearing trees will be plotted using a D-GPS accurate to less than two metres and
notes will be made regarding the number and size of the hollows within each tree and whether any fauna are using the hollows.

**Threatened Species Searches**

Comprehensive searches will be undertaken by a suitably qualified ecologist(s) within the Activity Area during the preclearance survey. These searches will target suitable habitat areas for threatened flora and fauna species that are known to occur within the locality. Lists of threatened flora and fauna species within the locality obtained for this ecological assessment from the NSW Wildlife Atlas database and Federal Protected Matters Search Tool will inform the ecologist(s) for target species during the survey.

**Pre-clearance Reporting**

A brief letter style report and map detailing the survey times, effort and results of the pre-clearance survey will be submitted to the client for distribution to any regulatory authorities as required.

### 6.5.2 Fauna Management

Fauna management is required within the Activity Area in order to protect any fauna that may be encountered during execution of the proposal, especially during vegetation clearing/ modification works. Suitable protocols are required for the clearing of vegetation in an environmentally sensitive manner in order to protect and allow fauna to evacuate the site voluntarily. The following measures are recommended to protect fauna during the vegetation clearing.

**Habitat/hollow-bearing Tree Felling Protocol**

Habitat trees are to be clearly prior to vegetation clearing commencing during the pre-clearance survey. Any hollow bearing trees or trees with fauna known to be in residence are to be noted and treated with the utmost circumspect to protect the fauna and allow them to vacate the tree.

Hollow bearing trees are to be cleared after all other vegetation has been removed. It is good practice to remove all other vegetation several days in advance of hollow tree removal in order to make the hollow bearing trees less suitable as nesting or roosting due to the lack of cover and foraging habitat nearby. Animals will frequently vacate dens and nests in this way.

Hollow bearing trees are to be felled using the following protocol in association with the presence of a qualified ecologist(s):

1. Plant equipment such as an excavator or front-end loader is to be used. The plant is to be of sufficient size, weight and power to achieve this with a large margin of safety;
2. Each individual hollow bearing tree is to be gently ‘tapped’ twice with the machine;
3. The operator is to wait for approximately one minute to see if any fauna appear;
4. A second series of slightly harder ‘taps’ is to be delivered to the hollow bearing tree;
5. Wait for another minute, watching for the appearance of fauna;
(6) If fauna appears from within the tree every effort should be made to encourage and assist the animal/s to vacate and relocate into the wider study area;

(7) If no fauna appears, the tree is to be pushed over as slowly or gently as possible (known as ‘soft felled’);

(8) After the felled tree has settled, the ecologist(s) is to inspect the hollows and any other part of the tree for the presence of fauna; and

(9) If any fauna are found within the tree they are to be allowed to relocate into nearby bushland, if they are uninjured. However if they are injured the ecologist is to either transport the animal to a vet for treatment or perform euthanasia (in a humane manner consistent with the guidelines produced by the Animal Research Authority licensing agreement held by the ecological company) on the animal if it is obvious that the animal has no chance of survival.

Displaced Fauna

Fauna that has been displaced by the clearing of vegetation or the felling of hollow bearing trees is to be allowed to find its way into the wider study area. If the animal requires assistance to do so then assistance to achieve removal of the animal is to be given. This assistance is to be as non-invasive as possible and is to be carried out in the gentlest or least traumatic possible way.

Injured Fauna

Injured fauna is to be assessed regarding survivability. If the animal is likely to survive it is to be captured and taken to a local vet or to an organisation such as WIRES for treatment. If it is considered that the animal has been mortally injured or is unable to move or feed then the ecologist is to euthanize the animal in a humane manner consistent with the guidelines produced by the Animal Research Authority licensing agreement held by the ecological company.

6.5.3 Conserving and Re-using Topsoil

Topsoil is the uppermost layer of soil that is present over most areas. This layer is very important from an ecological perspective as it contains a higher amount of nutrients, vegetative matter, microorganisms and also dormant seeds of plants. The conservation and handling of topsoil is important when undertaking developments because it is irreplaceable when undertaking landscaping or re-vegetation activities.

Seedbank

Topsoil contains various amounts of dormant seeds from the vegetation which occupies the site. This ‘seedbank’ contains propagules from most of the plants that naturally occur within that area. Therefore it is highly advantageous to conserve this seedbank in order to re-use it at a later time when landscaping or rehabilitating disturbed areas.

The seedbank within topsoil is usually kept viable by regular deposits of new seeds each year. If topsoil is to be removed and stored then the seedbank is not replenished and will eventually die if it is not allowed
to germinate. Different seeds have different dormancy rates and therefore some species seeds will die sooner than others.

Another factor in the viability of a seedbank is the way in which the topsoil is stored, if it is stored in one large or deep stockpile then the centre of the pile will become compacted and the permeability of the central portions of the pile will decrease. This permeability applies to oxygen and water.

Impermeable soil will decrease the amount of oxygen available for the seeds to use (anoxia) and even though the seed is dormant it still requires oxygen to survive, therefore the seeds in an anoxic environment will die much sooner.

Impermeable soil will also upset the availability of water or moisture which is present in all topsoil. Impermeability may result in too much water (waterlogging) or too little water (desiccation) of the seeds. This also severely limits the viability or longevity of a seedbank.

To provide a suitable environment for the seedbank within topsoil it is recommended to store topsoil in such a manner as to limit impermeability. Some general strategies are:

- Use the topsoil as soon as possible;
- Aerate the topsoil at regular intervals during storage (by moving it or otherwise with a machine); and
- Store topsoil in shallow or small piles or windrows (to allow oxygen and moisture to penetrate).

**Topsoil Removal**

Topsoil is to be removed from the newly cleared areas using appropriate machinery such as excavators or self filling scrapers. The topsoil will then be stockpiled for later use in the Activity Area rehabilitation phase.

**Topsoil Stockpiling, Location, Method**

The location of any topsoil stockpile is yet to be determined. However, it is suggested that top soil removed from each area within the Activity Area is stockpiled separately and where possible close to the initial area of removal.

Topsoil stockpiling is best done in small piles or windrows to facilitate the permeability required to provide adequate moisture and oxygen for the seedbank.

**Sediment Control**

Topsoil stockpiles will need to have erosion and sediment controls in place at least until the stockpile is used or it re-vegetates naturally. Sediment controls shall be installed in accordance with best practice.

Erosion and sediment control measures shall be implemented to minimise adverse effects as a result of increased likelihood of erosion and sediment transportation. Erosion and sediment control measures include:
Identification of potential erosion areas;

Installation and maintenance of flow, erosion, sediment and nutrient control structures;

Control of nutrients through construction of drains and nutrient basin/s;

Diversion of clean water around site and back into natural flow channels;

Coordinated work practices aimed at minimising land disturbance;

The minimisation of groundcover disturbance through the Activity Area; and

Routine site inspections of erosion and sediment controls.

The minimisation of soil erosion will be achieved through soil stabilisation measures. These measures may include strategies or methods such as sediment fencing and water control techniques.

Soil stabilisation measures which may be implemented include, mulching or the installation of biodegradable blankets on high erosion risk areas.

6.5.4 Salvaging and re-using material from the Activity Site

Salvaging and re-using material from the activity site is an ecologically sound strategy to minimise waste and to recycle materials that may otherwise end up in landfill.

Dead Timber or Trees

Dead timber or trees not containing hollows can be salvaged and re-distributed within the study area. Dead wood provides food and nesting habitat for a number of insects and reptiles which in turn provide food for other fauna.

Hollow Trees / Logs

Hollow trees when felled can be cut into manageable pieces and reused. Hollow logs can be relocated and placed on the ground within Buffer areas to retain or enhance the natural bushland habitat values.

Smaller hollow branches can be re-used by fastening them in retained trees for use as replacement nests or dens by birds or arboreal fauna.

Mulch

Most of the cleared vegetation can be mulched and re-used throughout the site to assist with vegetation regeneration works. When used in this way mulch helps to ameliorate the effects of drying and assists with the retention of moisture in the soil. Mulch also assists in the stabilisation of soil and helps minimise soil erosion and sedimentation.

Noxious or weed species are to be excluded from the mulching process. Mulch containing weed fragments or propagules will spread the incidence of weeds within any area where the mulch is spread.
6.5.5 Managing Waste Vegetation

It is anticipated that cleared vegetation will be mostly recycled or re-used within the study area. Hollow logs and branches are to be re-used as supplementary. The majority of the tree crowns can be mulched and re-used in the re-vegetation or rehabilitation works associated with the proposal.

As most of the vegetation is to be recycled and used within the study area, it is anticipated that the waste vegetation will consist of larger commercially or otherwise useful timber trunks, tree stumps which are not suitable for mulching and any vegetation waste derived from noxious or weed species.

Tree Trunks

Some dead tree trunks can be re-used within the Buffers or other areas within the study area not associated with the proposal. These trunks can be placed on the ground to provide food and nesting habitat for a variety of insects and reptiles which provide food for other fauna.

Some tree trunks may be suitable for commercial or other uses and can be recycled in this manner.

Stumps

Tree stumps are generally difficult to mulch and therefore require disposal. It is recommended that tree stumps be collected and transported to a green waste collection facility for disposal.

Noxious or Weedy Vegetation

Vegetative matter derived from or containing weed material in the form of propagules such as seeds, suckers, bulbs or cuttings and any other parts of weed material capable of striking roots or shoots should be collected and transported to a green waste collection facility where it will be destroyed. This will help prevent the spread of weeds in the study area and throughout George's Island.

6.5.6 Rehabilitation

Staged revegetation and rehabilitation of the well leases will be undertaken. The first stage is to stabilise the well lease outside of the well head area immediately following well development. This will involve seeding with native grasses to restabilise topsoil and reduce the potential for weed invasion. Following decommissioning of the well leases, full revegetation and rehabilitation of the well lease will be undertaken.

The aim of the Revegetation and Rehabilitation is to restore the natural ecosystems, utilising endemic native plant species that occur in the adjacent habitats for revegetation purposes. In consideration of the past disturbances and structural modification that has occurred at the study area in association with agricultural land use, rehabilitation will aim to restore the areas to be revegetated and rehabilitated to a condition that would be representative of the structural diversity of pre-clearance woodland vegetation. At a minimum:
successional restoration of native vegetation cover, to be initiated with the establishment of grass species to stabilise topsoil and limit weed invasion; and

Collection of benchmark data on surrounding vegetation in the study area and other examples of intact ‘like’ vegetation communities of the region, to determine target plant cover, height and structural composition for performance criteria associated with revegetation activities.

6.5.7 Weed Management

The location of the study area within the wider George’s Island, while isolated from proximate vegetation, remains subject to weed invasion via the surrounding agricultural land use and direct dispersal by fauna and humans.

Weeds of National Significance

Weeds of National Significance (WoNS) are the highest priority species targeted for sustained nationally coordinated action under the Australian Weeds Strategy. This provides for national management to eradicate WoNS species from parts of the country where Australia’s productive capacity & natural ecosystems are affected.

Each WoNS has a strategic plan that outlines strategies and an action required to control the weed, and identifies those responsible for each action. Individual landowners and managers are ultimately responsible for managing WoNS species. State and territory governments are responsible for overall legislation and administration.

WoNS species must be identified for the locality and considered under the weed management activities carried out within the activity site and broader study area.

Listed Noxious Weeds in Gunnedah LGA

The NSW Department of Industry & Investment under the Noxious Weeds Act, (1993) has issued a list of Noxious Weed declarations for all Local Government Areas. Similarly to WoNS, these must be identified for the locality and considered under the weed management activities carried out within the activity site and study area.

Other Known or Likely Weeds

In addition to the abovementioned WoNS and Noxious Weeds there will be further weeds of local significance that should be considered during weed management activities. The local Catchment Management Authority, Council are likely to have current lists for weed species. Other sources such as community Bushcare groups may also be useful points of contact.
Preventative Measures

Preventative measures for weeds are generally limited to control of weed occurrences within the activity site, prevention of the spread of weeds throughout the study area and prevention of the transportation of weeds into the study area from external sources.

On this basis control of weeds within the activity site is the most effective strategy. Weed control within the site is discussed in more detail below.

To control the spread of weeds to and from the study area it is recommended that all vehicles are inspected on a regular basis and any plant material removed from underneath vehicles. Furthermore all civil plant machinery transported to the study area must be clean of foreign soil and vegetative matter prior to arrival.

Weed Control Methods

Generally major causes of weed spread in the region are:

- Disturbance such as clearing, soil erosion or fire in natural areas;
- Vehicle transport of seeds along roads, tracks and railway corridors;
- Use of weed contaminated soil, mulch or other horticulture products;
- Use of weed contaminated hay or other stock feed, and spread from faeces or fur of stock; and
- Spread of weed seed or propagules on clothing and boots.

Poor vegetation management practices such as over-clearing, slashing and trampling stock. Minimising or active control of the above points as part of an integrated strategy will ameliorate the spread of weeds within the activity site and surrounds. Those weeds that bypass these strategies or naturally disperse into the site should be controlled by weed management procedures.

Weed removal shall include any species likely to significantly invade bushland, prevent natural regeneration, or impede native seedling growth. Priority shall be given to species listed as WoNS and Noxious Plants

Weeding techniques should be appropriate to the weed type, growth form, ecology and to the existing site conditions. Wherever possible, weed removal should be carried out prior to annual seed set.

The accepted strategy for weed removal is based on the Bradley (2002) Method and is summarised as follows:

- Work from good (low weed level) areas into the bad (high weed level) areas;
- Make minimal disturbance to the soil or adjacent native plants; and
- Do not over-clear, it results in potential soil erosion and provides space for more weeds to colonise.
Use of Herbicides

Herbicides should not be applied prior to rain occurring. This reduces the effectiveness of the herbicide and poses the risk of the herbicide being transported by runoff into local creeklines and waterways.

An advantage of herbicide use is the low time taken to spray weeds as compared to physically removing them, particularly for large infestations of weeds.

The use of herbicides should be considered when:

- There are small areas of dense weeds with few or no native plants to protect;
- There are large areas of weeds; and
- The weeds are growing too rapidly for physical removal.

Herbicide application via stem injection, frilling, scraping or foliar spray must not be applied to plants bearing ripe or semi-ripe fruit. It is important to plan herbicide control of target species according to a weeding calendar that recognises the weed’s life form and seasonality (i.e. flowering, fruiting and seed set).

The spraying of weeds must only be undertaken by experienced persons with Chemcert or equivalent qualifications. The success of each treatment must be evaluated by the operator after a set period of time and re-applied (if necessary) according to the labeled effectiveness for each herbicide. Care must be taken when applying herbicides near drainage lines to avoid excess use environmental contamination and loss of sensitive flora and fauna.

The herbicide of choice for bush regeneration work is glyphosate. A bioactive form of Glyphosate shall be used in wet areas (e.g. drainage lines, dams). Garlon (triclopyr) is recommended for control of Blackberry.

Unless otherwise agreed, herbicide application shall be limited to the following techniques:

- Cut-stump and poison (cut and dab);
- Stem injection;
- Stem-scrape or frilling and poison;
- Basal bark painting; and
- Selective spot-spraying.

6.5.8 Disease Control

Disease control is required due to the potential for spread of Phytophthora. Phytophthora can be spread via unregulated exposure and movement of soils between areas of construction. Measures must therefore be implemented to avoid such disease facilitation from occurring. Consultation with the Code of Practice for this disease should form the foundation of implemented control measures.
7.0 Conclusion and Recommendations

Santos is seeking approval to undertake the drilling, completion and testing of three pilot wells on "Georges Island" within PEL 1, located in the western extent of the Glasserton property, Lot 1 DP1099622, on the western side of Clift Road, (study area). Additionally, the proposal also includes the installation of a wellhead and downhole gauge in Glasserton 3 and 4 and George's Island 3 to monitor pressure data in the target Hoskisson's coal seam. George's Island 3 is located at a previously approved and constructed well lease site.

RPS was engaged to undertake an ecological assessment to identify ecological constraints, potential impacts and mitigation measures associated with the proposed activities. The study area is approximately 52.56 ha of land located approximately 40 km south of Gunnedah and 35 km north-west of Quirindi within the Gunnedah LGA. The majority of the study area supports woodland which occurs on a low hill. The northwestern corner occurs on level plains and has been historically cleared for agricultural purposes.

The native vegetation in the study area consists of a number of tree species such as White Cypress, Bimble Box, White Box, Yellow Box and Silver-leaved Ironbark occurring in various combinations and densities across the study area, the majority of which is a Box Gum Woodland vegetation community. The shrub layer is sparse while the ground layer is moderately dense and consists of mostly native grasses with native herbs and forbs. Weed or exotic species are present in the shrub and ground layers but are not dominant.

7.1 Ecological Values

The dominant vegetation community in the study area is Box Gum Woodland, commonly known as White Box Yellow Box Blakely's Red Gum Woodland was found to occupy the central and western naturally-vegetated portions of the study area. This community is listed as an Endangered Ecological Community (EEC) under the NSW TSC Act (1995). In addition, Box Gum Woodland is also known as White Box- Yellow Box-Blakely’s Red Gum grassy woodland and derived native grassland, as listed as a Critically Endangered Ecological Community (CEEC) under the EPBC Act (1999). This ecological community provides the most significant ecological conservation values in the study area.

The study area provides a diversity of habitat resources including abundant hollow-bearing trees, dense patches of White Cypress Pine, dense grass cover, abundant fallen woody debris and occasional bushrock habitats. These features provide important habitat elements for a variety of fauna guilds including numerous threatened species known from the area.

The Koala, listed as Vulnerable under the TSC Act, was recorded in the study area and scats and scratches were observed at several locations. The Little Lorikeet, listed as Vulnerable under the TSC Act, along with the Rufous Fantail and Rainbow Bee-eater, both listed as Migratory under the EPBC Act, were also recorded in the study area. No threatened flora species were recorded. Several flora and fauna species are likely to occur in the study area and may utilise the habitat resources of the study area.
7.2 Impacts on Native Biota

The proposed activities have a range of potential impacts. The study area contains an EEC and local populations of threatened biota and their habitats; however the potential impacts will be minimised and mitigated by the implementation of the mitigation measures set out in this ecological assessment.

The proposed activities will clear 2.12 ha of vegetation comprised of native and exotic plant species including 0.71 ha of Bimble Box Woodland, 0.65 ha of Box Gum Woodland (EEC / CEEC), 0.08 ha of Plains Grass Grassland and 0.19 ha Silver-leaved Ironbark Woodland, as well as disturbed land that comprises 0.49 ha of the study area.

The clearing of 1.55 ha of woodland habitat represents disturbance to 0.46 % of woodland habitat across the entire George’s Island based on the Curlewis vegetation data. Similarly, the clearing of 0.65 ha of the White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland impacts on 0.34 % of this community occurring on the Island. A relatively minor area (50m²) of woodland habitat will be subject to longer-term disturbance.

Given the implementation of the mitigation measures, and having regard to the fact that the activity site is already heavily modified agricultural land and gravel extraction pits, the proposed activities are not likely to have a significant impact on any native biota and their habitats or ecological communities.

Assessments of significance (7-part test) for eleven species and one ecological community listed as threatened under the TSC Act, determined that no significant impacts are likely as a result of the proposed activities and that a species impact statement is not required for any of these species.

The assessment concluded that the proposed activities will not have a significant impact on MNES. Santos will refer the proposed activities, in accordance with the EPBC Act, on the basis that they are not a controlled action.

7.3 Summary of Mitigation Measures

The three new well lease sites and George’s Island 3 have been historically cleared. In addition, the former gravel extraction pits at Glasserton 2 have not been sufficiently rehabilitated and remain in a disturbed state.

This ecological assessment sets out the mitigation measures that are to be implemented for the proposed activities. These mitigation measures are as follows:

- Well leases and access tracks are to be configured to avoid and/or minimise the clearing of native vegetation, especially mature canopy trees;
- An Environmental Management Plan (EMP) be prepared to incorporate the following:
  - The flora and fauna management measures aimed to control clearing to the nominated well leases to protect native flora and fauna from unnecessary impacts;
  - Weed Management Plan (WMP) that provides measures for weed control;
- Erosion and Sediment Control Plan (ESCP) to prevent soil erosion and dust generation; and
- Revegetation and rehabilitation management to restore the similar vegetation community in disturbed areas.

- Provide a Koala Plan of Management for the study area to ensure that Koalas and their habitats are protected from unnecessary potential impacts;
- All machinery to be clean of foreign soil and propagative matter to avoid the importation of non-endemic or exotic/invasive/weed species to the site and also soil born pathogens such as *Phytophthora cinnamomi*;
- Clean topsoil is imported for the former gravel pits at Glasserton 2 prior to revegetation to facilitate plant growth and recruitment; and
- Locate the SAMBA in Glasserton 1 (to avoid impacts on mature trees).

Although the proposed well sites consist of the Box Gum Woodland EEC / CEEC, opportunities exist to undertake well development within Glasserton 2, 3 and 4 without significantly compromising the values of these areas.
8.0 References

AH&A Ecology (2010a), *Santos Pty Ltd Gunnedah Coal Gas Seam Project George’s Island*, Alison Hunt & Associates Pty Ltd.


DoP (2001), *Joint Vegetation Mapping Project: NSW Western Regional Assessments*, NSW Department of Planning (DoP) in conjunction with NSW Department of Land and Water Conservation, NSW National Parks and Wildlife Service and State Forest of NSW.


Appendix A

EPBC Protected Matters Report
EPBC Act Protected Matters Report: Coordinates

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

Summary
Details
Matters of NES
Other matters protected by the EPBC Act
Extra Information
Caveat
Acknowledgements

Report created: 20/12/10 12:02:52

Coordinates
Buffer: 10Km

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010
Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

<table>
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<tr>
<td>National Heritage Places:</td>
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<td>Wetlands of International Significance (Ramsar Wetlands):</td>
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<td>Great Barrier Reef Marine Park:</td>
<td>None</td>
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<tr>
<td>Commonwealth Marine Areas:</td>
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</tr>
<tr>
<td>Threatened Ecological Communities:</td>
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<td>Threatened Species:</td>
<td>16</td>
</tr>
<tr>
<td>Migratory Species:</td>
<td>12</td>
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</tbody>
</table>

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

<table>
<thead>
<tr>
<th>Commonwealth Lands:</th>
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<tr>
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</tr>
<tr>
<td>Listed Marine Species:</td>
<td>10</td>
</tr>
</tbody>
</table>
Whales and Other Cetaceans: None
Critical Habitats: None
Commonwealth Reserves: None

Report Summary for Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE: None
State and Territory Reserves: None
Regional Forest Agreements: None
Invasive Species: 10
Nationally Important Wetlands: None

Details

Matters of National Environmental Significance

Threatened Ecological Communities

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Type of Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland</td>
<td>Critically Endangered</td>
<td>Community likely to occur within area</td>
</tr>
<tr>
<td>White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland</td>
<td>Critically Endangered</td>
<td>Community may occur within area</td>
</tr>
<tr>
<td>Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia</td>
<td>Endangered</td>
<td>Community may occur within area</td>
</tr>
<tr>
<td>Weeping Myall Woodlands</td>
<td>Endangered</td>
<td>Community may occur within area</td>
</tr>
</tbody>
</table>

Threatened Species

For threatened species where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened species distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Type of Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthochaera phrygia</td>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Regent Honeyeater [82338]</td>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Lathamus discolor</td>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Swift Parrot [744]</td>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Polytelis swainsonii</td>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Superb Parrot [738]</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Rostratula australis</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Australian Painted Snipe [77037]</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>FISH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Maccullochella peelii peelii</td>
<td>Murray Cod, Cod, Goodoo [68443]</td>
<td>Vulnerable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>FROGS</td>
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<td></td>
</tr>
<tr>
<td>Litoria boorooolongensis</td>
<td>Booroolong Frog [1844]</td>
<td>Endangered</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>MAMMALS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalinolobus dwyeri</td>
<td>Large-eared Pied Bat, Large Pied Bat [183]</td>
<td>Vulnerable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td></td>
<td>Nycotophilus timoriensis (South-eastern form)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Greater Long-eared Bat, South-eastern Long-eared Bat [66888]</td>
<td>Vulnerable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>PLANTS</td>
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<tr>
<td>Digitaria porrecta</td>
<td>Finger Panic Grass [12768]</td>
<td>Endangered</td>
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<tr>
<td></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
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<tr>
<td></td>
<td>Philotheca ericifolia [64942]</td>
<td>Vulnerable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td></td>
<td>Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]</td>
<td>Critically</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td></td>
<td>Pterostylis cobarensis Cobar Greenhood Orchid [12993]</td>
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</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td></td>
<td>Tylophora linearis [55231]</td>
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<td>Species or species habitat may occur within area</td>
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<td>REPTILES</td>
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<td>Underwoodisaurus sphyrurus</td>
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<td>Species or species habitat likely to occur within area</td>
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**Migratory Species**

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
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<tbody>
<tr>
<td>Migratory Marine Birds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apus pacificus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fork-tailed Swift [678]</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Ardea alba</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Great Egret, White Egret</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Ardea ibis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Migratory Terrestrial Species

- **Haliaeetus leucogaster**
  - White-bellied Sea-Eagle [943]
  - Species or species habitat likely to occur within area

- **Hirundapus caudacutus**
  - White-throated Needletail [682]
  - Species or species habitat may occur within area

- **Merops ornatus**
  - Rainbow Bee-eater [670]
  - Species or species habitat may occur within area

- **Myiagra cyanoleuca**
  - Satin Flycatcher [612]
  - Breeding likely to occur within area

- **Xanthomyza phrygia**
  - Regent Honeyeater [430]
  - Species or species habitat may occur within area

### Migratory Wetlands Species

- **Ardea alba**
  - Great Egret, White Egret [59541]
  - Species or species habitat may occur within area

- **Ardea ibis**
  - Cattle Egret [59542]
  - Species or species habitat may occur within area

- **Gallinago hardwickii**
  - Latham's Snipe, Japanese Snipe [863]
  - Species or species habitat may occur within area

- **Rostratula benghalensis s. lat.**
  - Painted Snipe [889]
  - Species or species habitat may occur within area

### Other Matters Protected by the EPBC Act

#### Listed Marine Species

<table>
<thead>
<tr>
<th>Name</th>
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</thead>
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<td><strong>Birds</strong></td>
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<td></td>
</tr>
<tr>
<td>Apus pacificus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fork-tailed Swift [678]</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Ardea alba</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Great Egret, White Egret [59541]</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Ardea ibis</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Cattle Egret [59542]</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Gallinago hardwickii</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Latham's Snipe, Japanese Snipe [863]</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Haliaeetus leucogaster</td>
<td></td>
<td>White-bellied Sea-Eagle [943]</td>
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<tr>
<td>White-bellied Sea-Eagle [943]</td>
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<tr>
<td>Hirundapus caudacutus</td>
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<td>White-throated Needletail [682]</td>
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<tr>
<td>Lathamus discolor</td>
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<td></td>
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<tr>
<td>Swift Parrot [744]</td>
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</tr>
<tr>
<td>Merops ornatus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rainbow Bee-eater [670]</td>
<td></td>
<td>Species or species habitat may occur within area</td>
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<tr>
<td>Myiagra cyanoleuca</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satin Flycatcher [612]</td>
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<td>Breeding likely to occur within area</td>
</tr>
<tr>
<td>Rostratula benghalensis s. lat.</td>
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<td></td>
</tr>
<tr>
<td>Painted Snipe [889]</td>
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<td>Species or species habitat may occur within area</td>
</tr>
</tbody>
</table>
## Extra Information

### Invasive Species

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Type of Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frogs</strong></td>
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<tr>
<td><em>Bufo marinus</em></td>
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</tr>
<tr>
<td>Cane Toad [1772]</td>
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<td></td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
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<td></td>
</tr>
<tr>
<td><em>Capra hircus</em></td>
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</tr>
<tr>
<td>Goat [2]</td>
<td></td>
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</tr>
<tr>
<td><em>Felis catus</em></td>
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</tr>
<tr>
<td>Cat, House Cat, Domestic Cat [19]</td>
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<tr>
<td><em>Oryctolagus cuniculus</em></td>
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<tr>
<td>Rabbit, European Rabbit [128]</td>
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<td></td>
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<tr>
<td><strong>Plants</strong></td>
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<tr>
<td><em>Lycium ferocissimum</em></td>
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</tr>
<tr>
<td>African Boxthorn, Boxthorn [19235]</td>
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<td></td>
</tr>
<tr>
<td><em>Nassella trichotoma</em></td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Pinus radiata</em></td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Rubus fruticosus aggregate</em></td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Blackberry, European Blackberry [68406]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of
International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:
- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:
- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:
- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

**Coordinates**

150.33639 -31.35667

**Acknowledgements**

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- Department of Environment, Climate Change and Water, New South Wales
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Parks, Water and Environment, Tasmania
- Department of Environment and Natural Resources, South Australia
- Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
- Environmental and Resource Management, Queensland
- Department of Environment and Conservation, Western Australia
- Department of the Environment, Climate Change, Energy and Water
- Birds Australia
- Australian Bird and Bat Banding Scheme
Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.
Appendix B

Flora Species List
<table>
<thead>
<tr>
<th>Family Name</th>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACANTHACEAE</td>
<td>Brunoniella australis</td>
<td>Blue Trumpet</td>
</tr>
<tr>
<td>AIZOACEAE</td>
<td>Trianthema triquetra</td>
<td></td>
</tr>
<tr>
<td>AMARANTHACEAE</td>
<td>Alternanthera denticulata</td>
<td>Lesser Joyweed</td>
</tr>
<tr>
<td>AMARANTHACEAE</td>
<td>Ammi majus*</td>
<td>Bishop's Weed</td>
</tr>
<tr>
<td>AMARANTHACEAE</td>
<td>Gomphrena celosioides</td>
<td>Gomphrena Weed</td>
</tr>
<tr>
<td>ANTHERICACEAE</td>
<td>Arthropodium milleflorum</td>
<td>Pale Vanilla Lily</td>
</tr>
<tr>
<td>ANTHERICACEAE</td>
<td>Dichopogon fimbriatus</td>
<td>Nodding Chocolate Lily</td>
</tr>
<tr>
<td>APIACEAE</td>
<td>Daucus glochidiatus</td>
<td>Native Carrot</td>
</tr>
<tr>
<td>ASTERACEAE</td>
<td>Bidens subalternans*</td>
<td>Greater Beggar's Tick</td>
</tr>
<tr>
<td>ASTERACEAE</td>
<td>Calotis cuneifolia</td>
<td>Purple Burr Daisy</td>
</tr>
<tr>
<td>ASTERACEAE</td>
<td>Calotis lappulacea</td>
<td>Yellow Burr Daisy</td>
</tr>
<tr>
<td>ASTERACEAE</td>
<td>Carthamus lanatus*</td>
<td>Saffron Thistle</td>
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<td>ASTERACEAE</td>
<td>Conyza bonariensis*</td>
<td>Flax-leaf Fleabane</td>
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<td>ASTERACEAE</td>
<td>Conyza sumatrensis*</td>
<td>Tall Fleabane</td>
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<td>ASTERACEAE</td>
<td>Euchiton sphaericus</td>
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<tr>
<td>ASTERACEAE</td>
<td>Hypochaeris glabra*</td>
<td>Smooth Catsear</td>
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Appendix C

Fauna Species List
### Table C.1: Fauna Species List

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**Mammals**

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**Reptiles**

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Appendix D

TSC Act Assessment of Significance (7-Part Test)
Approach

Section 5A of the EP&A Act lists seven factors that must be taken into account in the determination of the significance of potential impacts of proposed activities on ‘threatened species, populations or ecological communities or their habitats’ (threatened biota) listed under the TSC Act. The so-called ‘7-part test’ is used to determine whether there is likely to be a significant affect on threatened species, populations or ecological communities, or their habitats and thus whether a Species Impact Statement (SIS) is required to be produced.

The significance of the impacts on those threatened species and EECs, which have been recorded in the study area or are likely to occur, and are likely to utilise habitat to be potentially impacted by the proposed activities (see Table 5.1, Table 5.2 and Table 5.3) have been assessed. The following communities and species have been considered:

Flora
- Bluegrass (*Dichanthium setosum*).

Fauna
- Koala (*Phascolarctos cinereus*);
- Barking Owl (*Ninox connivens*); and
- Squirrel Glider (*Petaurus norfolcensis*).

Those threatened fauna species that possess similar habitat requirements or are from the same faunal group have been grouped together into a table format for ease of presentation and include the following:

**Birds that typically inhabit Box Woodland**
- Little Lorikeet (*Glossopsitta pusilla*);
- Brown Treecreeper (*Climacteris picumnus victoriae*); and
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*).

**Microbats that typically inhabit Woodlands**
- Little Pied Bat (*Chalinolobus picatus*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*);
- Greater Long-eared Bat (*Nyctophilus timoriensis*); and
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*).

**Endangered Ecological Communities**
- White Box Yellow Box Blakely’s Red Gum Woodland.
Threatened Flora

Bluegrass (*Dichanthium setosum*)

Bluegrass is an upright grass that mostly flowers during summer. Bluegrass occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, as well as in Queensland and Western Australia. It occurs widely on private property, including in the Inverell, Guyra, Armidale and Glen Innes areas.

It is associated with heavy basaltic black soils. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. It is often collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched.

Associated species include *Eucalyptus albens*, *Eucalyptus melanophloia*, *Eucalyptus melliodora*, *Eucalyptus viminalis*, *Myoporum debile*, *Aristida ramosa*, *Themeda triandra*, *Poa sieberiana*, *Bothriochloa ambigua*, *Medicago minima*, *Leptorrhynchos squamatus*, *Lomandra aff. longifolia*, *Aijuga australis*, *Calotis hispidula* and *Austrodanthonia*, *Dichopogon*, *Brachyscome*, *Vittadinia*, *Wahlenbergia* and *Psoralea* species.

7-Part Test Criteria

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The proposed activities may lead to the clearing of approximately 0.08 ha of grassland habitat and approximately 1.55 ha of woodland habitat in which this species may occur. If present within the study area, the area of similar grassland habitat to be left undisturbed is approximately 2.77 ha and likewise the area of similar woodland habitat to be left undisturbed is approximately 47.57, with additional similar habitat occurring within the wider study area. Additionally, the areas to be disturbed are unlikely to be habitat critical with this species more likely to occur on the basaltic black soils of the open plains within the locality.

Due to the small amount of potential marginal habitat to be removed, in comparison to the habitat available to this species within contiguous habitats, it is unlikely that the proposed activities would have an adverse effect on the life cycle of Bluegrass such that a viable local population of the species is likely to be placed at risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

There is no endangered population for these species currently listed on the TSC Act within the study area.
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

This factor does not apply to threatened species.

d) In relation to the habitat of a threatened species, population or ecological community:

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed activities may lead to the clearing of approximately 0.08 ha of grassland habitat and approximately 1.55 ha of woodland habitat in which this species may occur.

(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

This existing habitat is well connected to similar surrounding habitats and the proposed activities are unlikely to fragment or isolate the species from such areas.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposed activities may lead to the clearing of approximately 0.08 ha of grassland habitat and approximately 1.55 ha of woodland habitat in which this species may occur. If present within the study area, the area of similar grassland habitat to be left undisturbed is 2.77 ha and likewise the area of similar woodland habitat to be left undisturbed is approximately 47.57, with additional similar habitat occurring within the wider study area. Additionally, the proposed areas to be disturbed are unlikely to constitute habitat critical with this species more likely to occur on the basaltic black soils of the open plains within the locality. Therefore the habitat to be removed is of low importance for this species.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There is no critical habitat listed for these species on the register of critical habitat.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is no recovery plan for this species however there are 16 priority actions listed for Bluegrass within the priority action statement. A high priority action includes Habitat Management (ongoing EIA advice to consent and planning authorities and site protection e.g. fencing). The site is currently fenced off from livestock. Movement of machinery and personnel will be restricted to the designated footprint areas.
g) **Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process**

There are currently 35 key threatening processes (KTP's) listed under the TSC Act. The most relevant ones to this proposed activities and Bluegrass are the invasion of native plant communities by exotic perennial grasses and the clearing of native vegetation, which are listed as KTPs under TSC and EPBC Acts.

Invasion of native plant communities by exotic perennial grasses - The proposed activities may increase the invasion of exotic perennial grasses that currently occur in adjacent agricultural land. However the management actions identified in the EMP should limit the spread or invasion of exotic perennial grasses into the areas containing higher degrees of native vegetation.

Clearing of native vegetation - The proposed activities will clear approximately 1.63 ha of this species habitat. The loss of this relatively small amount of habitat is unavoidable in light of the proposed activities objectives and is unlikely to result in the decline of this species in the locality.

Provided the proposed EMP are followed, the development should not result in the operation of, or increase the impact of the invasion of exotic perennial weeds into those areas not impacted by the proposed activities.

**Conclusion**

Based on the consideration of the above factors, the proposed activities are not likely to significantly effect the listed threatened species Bluegrass or its habitats.
Threatened Fauna

Koala (*Phascolarctos cinereus*)

The Koala is the largest of Australia’s arboreal mammals. Its home range size varies with quality of habitat, ranging from less than two hectares to several hundred hectares in size. Koalas typically inhabit eucalypt woodlands and forests where they feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area would select preferred browse species.

They are generally inactive for most of the day, feeding and moving mostly at night. Koalas spend most of their time in trees, but would descend and traverse open ground to move between trees. This species is generally solitary, but has complex social hierarchies based on a dominant male with a territory overlapping several females and subordinate males on the periphery. Females breed at two years of age and produce one young per year (DECC, 2008).

7-Part Test Criteria

*a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*

The proposed activities involve the clearing of 1.55 ha of structurally modified woodland habitat; however only five mature Koala feed trees (Bimble Box) are to be removed. Therefore, it is unlikely to constitute habitat critical for the maintenance of a local population of the Koala due to an expanse of native vegetation in adjacent lands that has similar habitat values.

The study area is a smaller component of the overall habitat used by this species as they often have large home ranges and are known to traverse open landscapes. This species would primarily utilise the study area as a foraging resource, although the like habitats within the locality surrounding study area are more extensive and are of greater foraging and breeding importance to this species.

The proposed activities are likely to disturb a relatively small amount (1.55 ha) of existing foraging habitat for a local Koala population in the form of five mature Koala feed trees (Bimble Box); however the amount to be removed is insignificant in comparison to the amount to be retained in the study area. The proposed activities are unlikely to significantly affect breeding and foraging success, or dispersal of local Koalas.

It is therefore unlikely that the proposed activities would have an adverse effect on the life cycle of the Koala such that a viable local population of the species is likely to be placed at risk of extinction.

*b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*

There is no endangered population for these species currently listed on the TSC Act within the study area.
c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

This factor does not apply to threatened species.

d) In relation to the habitat of a threatened species, population or ecological community:

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The vegetation to be cleared comprises structurally modified woodland habitat due to past and ongoing agricultural land use. There are two species of SEPP 44 listed Koala feed trees located within the study area along with other less significant habitat trees, the Koala may utilise these trees opportunistically as a foraging resource. Five feed trees (Glasserton 3) are to be removed as part of the proposed activities. However, this impact is minimal in comparison to the relatively high number of Koala feed trees that are to be retained in the study area. Furthermore, the implementation of the EMP will provide additional habitat resources for the local Koala population over the long-term.

(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The effectiveness of the study area as a movement corridor and habitat resource for a local Koala population would not be negatively affected, as connectivity with like woodland habitat on the opposite side of Clift Road will be retained and no further fragmentation of the George’s Island habitat resource is likely to occur. Therefore, the proposed activities would not impose a barrier to movement for the Koala into adjacent lands.

Higher than normal vehicle activity along Clift Road and within the study area is expected but not for the long-term, hence the threat of car strikes in the local area would not be significantly increased as a result of the proposed activities. The proposed KPoM will provide measures to reduce the potential risk of car strike (i.e. Koala warning signage and controlled speed limits).

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Due to the large amount of alternative breeding and feeding habitat within George’s Island and the locality, the area to be affected by the proposed activities are not an important resource for the Koala and the proposed vegetation clearing would not have a significant impact on the long-term survival of the species or the local population of Koalas.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)
There is no critical habitat listed for these species on the register of critical habitat.

**f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**

There is a recovery plan for the Koala (NSW National Parks and Wildlife Service, 2003), which outlines specific objectives to help conserve the Koala and its habitat. Ten current threats to Koalas are identified. Habitat loss and fragmentation are the most important threats to this species in NSW. Although the proposed activities are not consistent with the objectives of the recovery plan it is assessed that there would be no negative impact on the long-term persistence and recovery of this species.

The similar woodland habitats associated with George’s Island, strengthens the vegetation connectivity of the study area and provides habitat linkages in the study area. Doona State Forest approximately 5 km to the east of George’s Island provides security for the long-term survival of the species within the locality.

The vegetation to be cleared is small in comparison to woodland vegetation associated with adjacent lands. Furthermore, the areas selected for the well leases possess lower habitat values than those to be retained in the study area and within adjacent lands, due to past and ongoing disturbances associated with agricultural land use resulting in structural modified vegetation within the selected well lease areas. George’s Island would not be further fragmented due to the proposed activities and the area to be revegetated as part of the EMP, would be planted with native tree species, including Koala food trees to avoid or reduce adverse impacts on the Koala.

**g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process**

There are currently 35 key threatening processes (KTP’s) listed under the TSC Act. The most relevant one to this proposed activities and the Koala is the clearing of native vegetation which is listed as a KTP under TSC and EPBC Acts.

*Clearing of native vegetation* - The proposed activities will disturb approximately 1.55 ha of this species habitat that contains five Bimble Box trees, which is listed as a Koala feed tree under Schedule 2 of SEPP 44. The loss of this relatively small amount of habitat is unavoidable in light of the objectives of the proposed activities and is unlikely to result in the decline of this species in the locality.

Provided the proposed flora and fauna mitigation measures, including the Koala Plan of Management, are implemented, the proposed activities will not result in a net loss of Koala habitat and may, over the long-term, provide additional foraging resources for the species.

**Conclusion**

Based on the consideration of the above factors, the proposed activities are not likely to significantly effect the listed threatened species Koala or its habitats.
Barking Owl (*Ninox connivens*)

Barking Owl is found throughout Australia except for the central arid regions and Tasmania (DECC 2008). The species inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses (DECC 2008). Denser vegetation is used occasionally for roosting (DECC 2008).

Territories range from 30 to 200 hectares and birds are present all year (DECC 2008). During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as *Acacia* and *Casuarina* species, or the dense clumps of canopy leaves in large Eucalypts (DECC 2008). Breeding occurs during late winter and early spring, with eggs laid in nests in hollows of large, old eucalypts including River Red Gum (*Eucalyptus camaldulensis*), White Box (*Eucalyptus albens*), Red Box (*Eucalyptus polyanthemus*) and Blakely’s Red Gum (*Eucalyptus blakelyi*) (DECC 2008).

7-Part Test Criteria

*a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*

The proposed activities may lead to the clearing of approximately 1.55 ha of woodland habitat that currently provides an important breeding and foraging resource for the species, due to the presence of large hollow bearing trees, in particular mature White Box trees. However the small amount of habitat to be removed is unlikely to constitute habitat critical for the maintenance of a local population of the Barking Owl, due to the study area’s connectivity with similar habitats.

The woodland habitat surrounding the study area also provides similar habitat values than the woodland to be potentially impacted within the study area. The Barking Owl is a highly mobile species and would be able to relocate into these surrounding habitats.

It is therefore unlikely that the proposed activities would have an adverse affect on the life cycle of the Barking Owl such that a viable local population of the species is likely to be placed at risk of extinction.

*b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*

There is no endangered population for these species currently listed on the TSC Act within the study area.

*c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(i) *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

This factor does not apply to threatened species.

d) In relation to the habitat of a threatened species, population or ecological community:

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Approximately 1.55 ha of woodland habitat is to be cleared at the study area, as a result of the proposed activities. The clearing of a small proportion of this species habitat is unlikely to fragment the remainder, as good connectivity already exists. Therefore it is unlikely to isolate or fragment the remaining habitat from similar adjacent habitats as a result of the proposed activities.

(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

This habitat has been identified as a breeding and foraging resource for the Barking Owl. Adjacent and relatively extensive woodland habitats surrounding the study area provide similar breeding and foraging resources as the study area, of which the species may currently inhabit.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Due to the presence of alternative breeding and foraging habitat adjacent to the study area, the minimal amount of habitat to be affected by the proposed activities are not isolating the species from similar viable habitats in the wider study area or locality and as such would not have a significant impact on the long-term survival of the species.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There is no critical habitat listed for these species on the register of critical habitat.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is a recovery plan for the Barking Owl (NSW National Parks and Wildlife Service, 2003), which outlines specific objectives to help conserve the Barking Owl and its habitat. Four current threats to Barking Owls are identified. Inappropriate forest harvesting practices that change forest structure and the removal of old growth hollow bearing trees, which is the primary threat posed by the proposed activities.

The retention of woodland remnants, especially those containing hollow bearing trees is one of the key strategies to recover the species. It is assessed that there would be no negative impact on the long-term persistence and recovery of this species.
g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

There are currently 35 key threatening processes (KTP’s) listed under the TSC Act. The most relevant one is the clearing of native vegetation which is listed as a KTP under TSC and EPBC Acts.

Clearing of native vegetation - The proposed activities will clear approximately 1.55 ha of this species habitat. The loss of this relatively small amount of habitat is unavoidable in light of the objectives of the proposed activities and is unlikely to result in the decline of this species in the locality.

Provided the proposed EMP is followed, the proposed activities will not result in a net loss of Barking Owl habitat and may, over the long-term, provide additional foraging resources for the species.

Conclusion

Based on the consideration of the above factors, the proposed activities are not likely to significantly effect the listed threatened species Barking Owl or its habitats.
Squirrel Glider (*Petaurus norfolcensis*)

The Squirrel Glider is distributed in eastern Australia from northern Queensland, through eastern NSW to Victoria (NPWS, 2000). The Squirrel Glider occurs in dry sclerophyll forest and woodland (Strahan, 1998). This species feeds on nectar, pollen, flowers, insects, and sap of particular eucalypts (Strahan, 1998; NPWS, 1999). The Squirrel Glider dens in hollow bearing trees, and often dens in family groups (Strahan, 1998; NPWS, 2000). Home ranges have been estimated as between 0.65 to 8.55 ha, with movements tending to be greater for males (NPWS, 1999).

**7-Part Test Criteria**

*a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*

The proposed activities may lead to the clearing of approximately 1.55 ha of woodland habitat that currently provides an important breeding and foraging resource for the species, due to the presence of large hollow bearing Eucalypts. However the small amount of habitat to be removed is unlikely to constitute habitat critical for the maintenance of a local population of the Squirrel Glider, due to the study area’s connectivity with similar habitats.

The woodland habitat surrounding the study area also provides similar habitat values than the woodland to be potentially impacted within the study area. The Squirrel Glider is a mobile species and would be able to relocate into these surrounding habitats. It is therefore unlikely that the proposed activities would have an adverse effect on the life cycle of the Squirrel Glider such that a viable local population of the species is likely to be placed at risk of extinction.

*b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*

There is no endangered population for these species currently listed on the TSC Act within the study area.

*c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

   *(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

   *(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

This factor does not apply to threatened species.
d) In relation to the habitat of a threatened species, population or ecological community:

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Approximately 1.55 ha of woodland habitat is to be cleared from the study area, as a result of the proposed activities. The clearing of a small proportion of this species habitat is unlikely to fragment the remainder, as good connectivity already exists. Therefore it is unlikely to isolate or fragment the remaining habitat from similar adjacent habitats as a result of the proposed activities.

(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

This habitat has been identified as a breeding and foraging resource for the Squirrel Glider. Adjacent and relatively extensive woodland habitats surrounding the study area provide similar breeding and foraging resources as the study area, of which the species may currently inhabit.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Due to the presence of alternative breeding and foraging habitat adjacent to the study area, the minimal amount of habitat to be affected by the proposed activities are not isolating the species from similar viable habitats in the wider study area or locality and as such would not have a significant impact on the long-term survival of the species.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There is no critical habitat listed for these species on the register of critical habitat.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is no recovery plan for this species however there are 9 priority actions listed for this species within the priority action statement. Medium priority actions include ensuring the largest hollow bearing trees (including dead trees) are given highest priority for retention and other environmental planning instruments, or other land assessment tools. Although the proposed activities are not consistent with some of the objectives of the 9 priority actions it is assessed that there would be no negative impact on the long-term persistence and recovery of this species.

The revegetation and rehabilitation within the EMP aims to re-establish vegetation within the study area. The intention is that this vegetation would be designed to mimic the White Box Yellow Box Blakely’s Red Gum Woodland EEC and Bimble Box Woodland habitats that are to be potentially impacted by the proposed activities. In this regard over the short to long-term a viable woodland habitat of greater habitat value than the woodland currently in the study area may be created and as such may become an important foraging resource for the Squirrel Glider.
g) **Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process**

There are currently 35 key threatening processes (KTP’s) listed under the TSC Act. The most relevant one is the clearing of native vegetation which is listed as a KTP under TSC and EPBC Acts.

*Clearing of native vegetation* - The proposed activities will clear approximately 1.55 ha of this species habitat. The loss of this relatively small amount of habitat is unavoidable in light of the objective of the proposed activities objectives and is unlikely to result in the decline of this species in the locality.

Provided the rehabilitation measures within the EMP are followed, the proposed activities will not result in a net loss of Squirrel Glider habitat and may, over the long-term, provide additional foraging resources for the species.

**Conclusion**

Based on the consideration of the above factors, the proposed activities are not likely to significantly effect the listed threatened species Squirrel Glider or its habitats.
Table D-1: Assessment of Significance for Threatened Birds that typically inhabit Box Gum Woodland

<table>
<thead>
<tr>
<th>Little Lorikeet (<em>Glossopsitta pusilla</em>)</th>
<th>Brown Treecreeper (<em>Climacteris picumnus victoriae</em>)</th>
<th>Grey-crowned Babbler (<em>Pomatostomus temporalis temporalis</em>)</th>
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<tbody>
<tr>
<td><strong>Background Information</strong></td>
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<td>Forages primarily in the canopy of open Eucalypt forest and woodland. Riparian habitats are particularly used, due to higher soil fertility. Also found in isolated flowering trees in open country, e.g. paddocks and roadside remnants.</td>
<td>The Brown Treecreeper is endemic to eastern Australia. It is found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range. It is typically not found in woodlands with a dense shrub layer. Fallen timber is an important habitat component for foraging. Hollows in standing dead or live trees and tree stumps are essential for nesting (DECCW, 2005).</td>
<td>In NSW, the Grey-crowned Babbler occurs on the western slopes of the Great Dividing Range, the woodlands in the Hunter Valley and in several locations on the north coast of NSW. This species prefers open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Grey-crowned Babblers feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses. They build and maintain several conspicuous, dome-shaped stick nests about the size of a football. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts.</td>
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</tbody>
</table>

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

<p>| The proposed activities may lead to the clearing of approximately 1.55 ha of woodland habitat that currently provides an important breeding and foraging resource for the species, due to the presence of Box-Gum Woodland tree species, some of which are hollow bearing. However the small amount of habitat to be removed is unlikely to constitute habitat critical for the maintenance of a local population of the Brown Treecreeper, due to the study area’s connectivity with similar habitats. The woodland habitat surrounding the study area also provides similar habitat values than the woodland to be potentially impacted within the study area. The Little Lorikeet is a highly mobile species and would be able to relocate into these surrounding habitats. It is therefore unlikely that the proposed activities would lead to a decline in the local population of the species. | The proposed activities may lead to the clearing of approximately 1.55 ha of woodland habitat that currently provides an important breeding and foraging resource for the species, due to the presence of Box-Gum Woodland tree species, some of which are hollow bearing. However the small amount of habitat to be removed is unlikely to constitute habitat critical for the maintenance of a local population of the Brown Treecreeper, due to the study area’s connectivity with similar habitats. The woodland habitat surrounding the study area also provides similar habitat values than the woodland to be potentially impacted within the study area. The Brown Treecreeper is a highly mobile species and would be able to relocate into these surrounding habitats. It is therefore unlikely that the proposed activities would lead to a decline in the local population of the species. | The proposed activities may lead to the clearing of approximately 1.55 ha of woodland habitat that currently provides an important breeding and foraging resource for the species, due to the presence of Box-Gum Woodland tree species, some of which are hollow bearing. However the small amount of habitat to be removed is unlikely to constitute habitat critical for the maintenance of a local population of the Grey-crowned Babbler, due to the study area’s connectivity with similar habitats. The woodland habitat surrounding the study area also provides similar habitat values than the woodland to be potentially impacted within the study area. The Brown Treecreeper is a highly mobile species and would be able to relocate into these surrounding habitats. It is therefore unlikely that the proposed activities would lead to a decline in the local population of the species. |</p>
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<td>have an adverse affect on the life cycle of the Little Lorikeet such that a viable local population of the species is likely to be placed at risk of extinction.</td>
<td>have an adverse affect on the life cycle of the Brown Treecreeper such that a viable local population of the species is likely to be placed at risk of extinction.</td>
<td>habitats. It is therefore unlikely that the proposed activities would have an adverse affect on the life cycle of the Grey-crowned Babbler such that a viable local population of the species is likely to be placed at risk of extinction.</td>
</tr>
</tbody>
</table>

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

There is no endangered population of these species currently listed on the TSC Act within the study area.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
- is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

This factor does not apply to threatened species.

d) In relation to the habitat of a threatened species, population or ecological community:

- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

Approximately 1.55 ha of woodland habitat is to be cleared from the study area, as a result of the proposed activities. The clearing of a small proportion of this species habitat is unlikely to fragment the remainder, as good connectivity already exists. Therefore it is unlikely to isolate or fragment the remaining habitat from similar adjacent habitats as a result of the proposed activities.

This habitat has been identified as a breeding and foraging resource for the Little Lorikeet. Adjacent and relatively extensive woodland and grassland habitats surrounding the study area provide similar breeding and foraging resources as the study area, of which the species currently inhabits.

Due to the presence of alternative breeding and foraging resources as the study area, of which the species may currently inhabit.

Approximately 1.55 ha of woodland habitat is to be cleared from the study area, as a result of the proposed activities. The clearing of a small proportion of this species habitat is unlikely to fragment the remainder, as good connectivity already exists. Therefore it is unlikely to isolate or fragment the remaining habitat from similar adjacent habitats as a result of the proposed activities.

This habitat has been identified as a breeding and foraging resource for the Brown Treecreeper. Adjacent and relatively extensive woodland and grassland habitats surrounding the study area provide similar breeding and foraging resources as the study area, of which the species currently inhabit.

Due to the presence of alternative breeding and foraging resources as the study area, of which the species may currently inhabit.

Approximately 1.55 ha of woodland habitat is to be cleared from the study area, as a result of the proposed activities. The clearing of a small proportion of this species habitat is unlikely to fragment the remainder, as good connectivity already exists. Therefore it is unlikely to isolate or fragment the remaining habitat from similar adjacent habitats as a result of the proposed activities.

This habitat has been identified as a breeding and foraging resource for the Grey-crowned Babbler. Adjacent and relatively extensive woodland and grassland habitats surrounding the study area provide similar breeding and foraging resources as the study area, of which the species currently inhabit.

Due to the presence of alternative breeding and foraging resources as the study area, of which the species may currently inhabit.
<table>
<thead>
<tr>
<th>Little Lorikeet (<em>Glossopsitta pusilla</em>)</th>
<th>Brown Treecreeper (<em>Climacteris picumnus victoriae</em>)</th>
<th>Grey-crowned Babbler (<em>Pomatostomus temporalis temporalis</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>habitat adjacent to the study area, the minimal amount of habitat to be affected by the proposed activities are not isolating the species from similar viable habitats in the wider study area or locality and as such would not have a significant impact on the long-term survival of the species.</td>
<td>habitat adjacent to the study area, the minimal amount of habitat to be affected by the proposed activities are not isolating the species from similar viable habitats in the wider study area or locality and as such would not have a significant impact on the long-term survival of the species.</td>
<td>Due to the presence of alternative breeding and foraging habitat adjacent to the study area, the minimal amount of habitat to be affected by the proposed activities are not isolating the species from similar viable habitats in the wider study area or locality and as such would not have a significant impact on the long-term survival of the species.</td>
</tr>
</tbody>
</table>

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

There is no critical habitat listed for these species on the register of critical habitat.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;

There is no recovery plan or priority action statement for this species. However, there are some objectives relevant to the proposed activities to recover the species, these include:

- Retain large old trees, especially those that are hollow-bearing;
- Ensure recruitment of trees into the mature age class so that there is not a lag period of decades between the death of old trees and hollow formation in younger trees;
- Protect large flowering Eucalyptus trees throughout the habitats frequented by this species. Manage remnant woodlands and forest for recovery of old-growth characteristics; and
- Where natural tree recruitment is inadequate, replant local species to maintain foraging habitat and breeding sites.

The EMP aims to re-establish vegetation within the study area. The intention is that this vegetation would be designed to mimic the White Box Yellow Box Blakely’s Red Gum Woodland EEC that is to be potentially impacted by the proposed activities. In doing so the rehabilitated vegetation is likely to have a higher level of floristic diversity than that of the woodland currently in the study area, because of past disturbances associated with livestock grazing. In this regard over the short to long-term a viable woodland habitat of greater habitat value than the woodland currently in the study area may be created and as such may become an important resource for the Brown Treecreeper.

There is no recovery plan for this species however there are 7 priority actions listed for this species within the priority action statement. One high priority action is Habitat Rehabilitation/Restoration and/or Regeneration (Identify key habitats or areas on a regional basis for protection and enhanced management through incentives). The EMP aims to re-establish vegetation within the study area. The intention is that this vegetation would be designed to mimic the White Box Yellow Box Blakely’s Red Gum Woodland EEC that is to be potentially impacted by the proposed activities. In doing so the rehabilitated vegetation is likely to have a higher level of floristic diversity than that of the woodland currently in the study area, because of past disturbances associated with livestock grazing. In this regard over the short to long-term a viable woodland habitat of greater habitat value than the woodland currently in the study area may be created and as such may become an important resource for the Grey-crowned Babbler.
disturbances associated with livestock grazing. In this regard over the short to long-term a viable woodland habitat of greater habitat value than the woodland currently in the study area may be created and as such may become an important foraging and breeding resource for the Little Lorikeet.

There are currently 35 key threatening processes (KTP’s) listed under the TSC Act. The most relevant one is the clearing of native vegetation which is listed as a KTP under TSC and EPBC Acts.

Clearing of native vegetation - The proposed activities will clear approximately 1.55 ha of this species habitat. The loss of this relatively small amount of habitat is unavoidable in light of the objectives of the proposed activities and is unlikely to result in the decline of this species in the locality.

Provided the proposed EMP is followed, the proposed activities will not result in a net loss of Little Lorikeet habitat and may, over the long-term, provide additional foraging resources for the species.

Based on the consideration of the above factors, the proposed activities are not likely to significantly effect the listed threatened species Little Lorikeet or its habitats.

There are currently 35 key threatening processes (KTP’s) listed under the TSC Act. The most relevant one is the clearing of native vegetation which is listed as a KTP under TSC and EPBC Acts.

Clearing of native vegetation - The proposed activities will clear approximately 1.55 ha of this species habitat. The loss of this relatively small amount of habitat is unavoidable in light of the objectives of the proposed activities and is unlikely to result in the decline of this species in the locality.

Provided the proposed EMP is followed, the proposed activities will not result in a net loss of Brown Treecreeper habitat and may, over the long-term, provide additional foraging resources for the species.

Based on the consideration of the above factors, the proposed activities are not likely to significantly effect the listed threatened species Brown Treecreeper or its habitats.

There are currently 35 key threatening processes (KTP’s) listed under the TSC Act. The most relevant one is the clearing of native vegetation which is listed as a KTP under TSC and EPBC Acts.

Clearing of native vegetation - The proposed activities will clear approximately 1.55 ha of this species habitat. The loss of this relatively small amount of habitat is unavoidable in light of the objectives of the proposed activities and is unlikely to result in the decline of this species in the locality.

Provided the proposed EMP is followed, the proposed activities will not result in a net loss of Grey-crowned Babbler habitat and may, over the long-term, provide additional foraging resources for the species.

Based on the consideration of the above factors, the proposed activities are not likely to significantly effect the listed threatened species Grey-crowned Babbler or its habitats.
### Table D-2: Assessment of Significance for Microbats that typically inhabit Woodlands

<table>
<thead>
<tr>
<th>Little Pied Bat (<em>Chalinolobus picatus</em>)</th>
<th>Eastern Freetail-bat (<em>Mormopterus norfolkensis</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background Information</strong></td>
<td></td>
</tr>
<tr>
<td>Occurs in dry open forest, open woodland, Mulga and riverine open forests, dry open forest, open woodland, chenopod shrublands, Callitris forest, Casuarina pauper woodlands and maile and forage predominantly on Moths. The Little Pied Bat roosts in hollow bearing trees, caves, abandoned mines and buildings. They often roost alone and favour large mature trees with dead limbs and dead trees that have fallen over leaving a hollowed stump. They will move roost location most days, although remaining in the same general area (all roosts within 200 m) (Churchill, 2008).</td>
<td>Occurs from Cape York along the east coast of Queensland through eastern Queensland and NSW and southern Victoria. Penetrates arid areas along the Murray River- present in Red Gum forest. Forages around swamps, rivers, creeks but frequently uses drier habitats and remnant vegetation. Feeds predominately on bugs, flies and beetles. The Eastern Freetail-bat roosts mainly in tree hollows but will also roost under bark, in buildings and cracks in wooden posts. Colonies of several hundred have been recorded (Churchill, 2008).</td>
</tr>
</tbody>
</table>

**a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;**

The proposed activities may lead to the clearing of 1.55 ha of woodland habitat that provides important foraging, roosting and breeding resources for the species. Additionally the entire study area provides suitable foraging habitat above open water and grassland habitats. However the small amount of primarily breeding habitat to be potentially removed is unlikely to constitute habitat critical for the maintenance of a local population of the species, due to the study area’s connectivity with similar habitats. The woodland habitat surrounding the study area also provides similar habitat values than the woodland to be potentially impacted within the study area. Even though the Little Pied Bat generally has a small home range based around regular roosts sites, it is known to travel up to 17 km to forage and is a highly mobile species that would be able to relocate into these surrounding habitats. It is therefore unlikely that the proposed activities would have an adverse affect on the life cycle of the Little Pied Bat such that a viable local population of the species is likely to be placed at risk of extinction.

The proposed activities may lead to the clearing of 1.55 ha of woodland habitat that provides important foraging, roosting and breeding resources for the species. Additionally the entire study area provides suitable foraging habitat above open water and grassland habitats. However the small amount of primarily breeding habitat to be potentially removed is unlikely to constitute habitat critical for the maintenance of a local population of the species, due to the study area’s connectivity with similar habitats. The woodland habitat surrounding the study area also provides similar habitat values than the woodland to be potentially impacted within the study area. The Eastern Freetail Bat is a mobile species with large home ranges and would be able to relocate into these surrounding habitats. It is therefore unlikely that the proposed activities would have an adverse affect on the life cycle of the Eastern Free-tail Bat such that a viable local population of the species is likely to be placed at risk of extinction.

**b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;**

There is no endangered population currently listed on the TSC Act within the study area.
<table>
<thead>
<tr>
<th>Little Pied Bat (<em>Chalinolobus picatus</em>)</th>
<th>Eastern Freetail-bat (<em>Mormopterus norfolkensis</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</td>
<td></td>
</tr>
<tr>
<td>d) In relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the action proposed, and whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</td>
<td></td>
</tr>
<tr>
<td>This factor does not apply to threatened species.</td>
<td></td>
</tr>
</tbody>
</table>

Approximately 1.55 ha of woodland habitat is to be cleared from the study area, as a result of the proposed activities. The clearing of a small proportion of this species habitat is unlikely to fragment the remainder, as good connectivity already exists. Therefore it is unlikely to isolate or fragment the remaining habitat from similar adjacent habitats as a result of the proposed activities.

This habitat has been identified as a breeding and foraging resource for the Little Pied Bat. Adjacent and relatively extensive woodland and grassland habitats surrounding the study area provide similar breeding and foraging resources as the study area, of which the species may currently inhabit.

Due to the presence of alternative breeding and foraging habitat adjacent to the study area, the minimal amount of habitat to be affected by the proposed activities are not isolating the species from similar viable habitats in the wider study area or locality and as such would not have a significant impact on the long-term survival of the species.

Approximately 1.55 ha of woodland habitat is to be cleared from the study area, as a result of the proposed activities. The clearing of a small proportion of this species habitat is unlikely to fragment the remainder, as good connectivity already exists. Therefore it is unlikely to isolate or fragment the remaining habitat from similar adjacent habitats as a result of the proposed activities.

This habitat has been identified as a breeding and foraging resource for the Eastern Freetail-bat. Adjacent and relatively extensive woodland and grassland habitats surrounding the study area provide similar breeding and foraging resources as the study area, of which the species may currently inhabit.

Due to the presence of alternative breeding and foraging habitat adjacent to the study area, the minimal amount of habitat to be affected by the proposed activities are not isolating the species from similar viable habitats in the wider study area or locality and as such would not have a significant impact on the long-term survival of the species.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

There is no critical habitat listed for this species on the register of critical habitat.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;

There is no recovery plan for this species however there are 24 priority actions listed for this species within the priority action statement. Two high priority actions include ensuring the largest hollow bearing trees and standing dead trees are given highest priority for retention and identify areas of private land that contain high densities of trees with hollows and dead standing trees as areas of high conservation value for planning and land management instruments.

Although the proposed activities are not consistent with some of the objectives of the 24 priority actions it is assessed that there would be no negative impact on the long-term persistence and recovery of this species.

The EMP aims to re-establish vegetation within the study area. The intention is that this vegetation would be designed to mimic the White Box Yellow Box Blakely’s Red Gum

There is no recovery plan for this species however there are 18 priority actions listed for this species within the priority action statement. Two high priority actions include ensuring the largest hollow bearing trees and standing dead trees are given highest priority for retention and identify areas of private land that contain high densities of trees with hollows and dead standing trees as areas of high conservation value for planning and land management instruments.

Although the proposed activities are not consistent with some of the objectives of the 18 priority actions it is assessed that there would be no negative impact on the long-term persistence and recovery of this species.

The EMP aims to re-establish vegetation within the study area. The intention is that this vegetation would be designed to mimic the White Box Yellow Box Blakely’s Red Gum.
Little Pied Bat (*Chalinolobus picatus*)
Woodland EEC and Bimble Box Woodland habitats that are to be potentially impacted by the proposed activities. In this regard over the short to long-term a viable woodland habitat of greater habitat value than the woodland currently in the study area may be created and as such may become an important foraging resource for the Little Pied Bat.

Eastern Freetail-bat (*Mormopterus norfolkensis*)
Gum Woodland EEC and Bimble Box Woodland habitats that are to be potentially impacted by the proposed activities. In this regard over the short to long-term a viable woodland habitat of greater habitat value than the woodland currently in the study area may be created and as such may become an important foraging resource for the Eastern Freetail-bat.

<table>
<thead>
<tr>
<th>g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are currently 35 key threatening processes (KTP’s) listed under the TSC Act. The most relevant one is the clearing of native vegetation which is listed as a KTP under TSC and EPBC Acts.</td>
</tr>
<tr>
<td>Clearing of native vegetation - The proposed activities will clear approximately 1.55 ha of this species habitat. The loss of this relatively small amount of habitat is unavoidable in light of the objectives of the proposed activities and is unlikely to result in the decline of this species in the locality.</td>
</tr>
<tr>
<td>Provided the proposed EMP is followed, the proposed activities will not result in a net loss of Little Pied Bat habitat and may, over the long-term, provide additional foraging resources for the species.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on the consideration of the above factors, the proposed activities are not likely to significantly effect the listed threatened species Little Pied Bat or its habitats.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on the consideration of the above factors, the proposed activities are not likely to significantly effect the listed threatened species Eastern Freetail-bat or its habitats.</td>
</tr>
</tbody>
</table>
Table D-3: Assessment of Significance for Microbats that typically inhabit Woodlands

<table>
<thead>
<tr>
<th>Greater Long-eared Bat (<em>Nyctophilus timorensis</em>)</th>
<th>Yellow-bellied Sheathtail Bat (<em>Saccolaimus flaviventris</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background Information</strong></td>
<td></td>
</tr>
<tr>
<td>River Red Gum forest, semi-arid woodlands and savannahs. It also occurs in box/ironbark/Callitris open forests and Buloke woodland in northern New South Wales and inland south-east Queensland. In South Australia it is confined to tall mallee shrublands north of the Murray River and is known to roost in hollows in Eucalyptus gracilis. Victorian records are from <em>E. gracilis mallee</em>, Buloke and Black Box woodlands. They forage on flying insects and fly very close to vegetation, often weaving through the gaps. They forage at least 3 km from the roost. Tree hollows are used as maternity sites (Churchill, 2008).</td>
<td><em>Saccolaimus flaviventris</em> (Yellow-bellied Sheathtail-bat) is widespread across Australia and its apparent rarity is probably due to its flying so high and fast that it is seldom collected. It has been reported from a wide variety of habitats. Hunting height appears to vary depending on the height of the dominant vegetation in Eucalypt forests it feeds above the canopy, but in mallee or open country it comes lower to the ground. Prey species include beetles, long-horned grasshoppers, shield bugs and flying ants. Usually solitary, but occasionally occurring in colonies of less than ten individuals, the <em>S. flaviventris</em> roosts in tree hollows, animal burrows, dry clay cracks, under rock slabs, abandoned <em>Petaurus breviceps</em> (Sugar Glider) nests, and has been found resting on the walls of buildings in broad daylight, and one such individual, caught at Queanbeyan, NSW, appeared to be so exhausted that it made no effort to escape. Similar reports suggest that it is migratory in southern Australia and that individuals found resting in the open are in the course of a winter migration from the cooler to warmer areas. They have been reported from southern Australia only between January and June.</td>
</tr>
<tr>
<td><strong>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;</strong></td>
<td></td>
</tr>
<tr>
<td>The proposed activities may lead to the clearing of 1.55 ha of woodland habitat that provides important foraging, roosting and breeding resources for the species. Additionally the entire study area provides suitable foraging habitat above open water and grassland habitats. However the small amount of primarily breeding habitat to be potentially removed is unlikely to constitute habitat critical for the maintenance of a local population of the species, due to the study area’s connectivity with similar habitats. The woodland habitat surrounding the study area also provides similar habitat values than the woodland to be potentially impacted within the study area. The Greater Long-eared Bat is a highly mobile species with large home ranges of up to 3 km and would be able to relocate into these surrounding habitats. It is therefore unlikely that the proposed activities would have an adverse affect on the life cycle of the Greater Long-eared Bat such that a viable local population of the species is likely to be placed at risk of extinction.</td>
<td>The proposed activities may lead to the clearing of 1.55 ha of woodland habitat that provides important foraging, roosting and breeding resources for the species. Additionally the entire study area provides suitable foraging habitat above open water and grassland habitats. However the small amount of primarily breeding habitat to be potentially removed is unlikely to constitute habitat critical for the maintenance of a local population of the species, due to the study area’s connectivity with similar habitats. The woodland habitat surrounding the study area also provides similar habitat values than the woodland to be potentially impacted within the study area. The Yellow-bellied Sheathtail Bat is a highly mobile species with large home ranges and would be able to relocate into these surrounding habitats. It is therefore unlikely that the proposed activities would have an adverse affect on the life cycle of the Yellow-bellied Sheathtail Bat such that a viable local population of the species is likely to be placed at risk of extinction.</td>
</tr>
<tr>
<td>Greater Long-eared Bat (<em>Nyctophilus timorensis</em>)</td>
<td>Yellow-bellied Sheathtail Bat (<em>Saccolaimus flaviventris</em>)</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td><strong>b)</strong> In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;</td>
<td></td>
</tr>
<tr>
<td>There is no endangered population currently listed on the TSC Act within the study area.</td>
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<tr>
<td><strong>c)</strong> In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</td>
<td></td>
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<tr>
<td>is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</td>
<td></td>
</tr>
<tr>
<td>This factor does not apply to threatened species.</td>
<td></td>
</tr>
<tr>
<td><strong>d)</strong> In relation to the habitat of a threatened species, population or ecological community:</td>
<td></td>
</tr>
<tr>
<td>• the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</td>
<td></td>
</tr>
<tr>
<td>• whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</td>
<td></td>
</tr>
<tr>
<td>Approximately 1.55 ha of woodland habitat is to be cleared from the study area, as a result of the proposed activities. The clearing of a small proportion of this species habitat is unlikely to fragment the remainder, as good connectivity already exists. Therefore it is unlikely to isolate or fragment the remaining habitat from similar adjacent habitats as a result of the proposed activities.</td>
<td></td>
</tr>
<tr>
<td>This habitat has been identified as a breeding and foraging resource for the Greater Long-eared Bat. Adjacent and relatively extensive woodland and grassland habitats surrounding the study area provide similar breeding and foraging resources as the study area, of which the species currently inhabits.</td>
<td></td>
</tr>
<tr>
<td>Due to the presence of alternative breeding and foraging habitat adjacent to the study area, the minimal amount of habitat to be affected by the proposed activities are not isolating the species from similar viable habitats in the wider study area or locality and as such would not have a significant impact on the long-term survival of the species.</td>
<td></td>
</tr>
<tr>
<td>This habitat has been identified as a breeding and foraging resource for the Yellow-bellied Sheathtail Bat. Adjacent and relatively extensive woodland and grassland habitats surrounding the study area provide similar breeding and foraging resources as the study area, of which the species currently inhabits.</td>
<td></td>
</tr>
<tr>
<td>Due to the presence of alternative breeding and foraging habitat adjacent to the study area, the minimal amount of habitat to be affected by the proposed activities are not isolating the species from similar viable habitats in the wider study area or locality and as such would not have a significant impact on the long-term survival of the species.</td>
<td></td>
</tr>
<tr>
<td><strong>e)</strong> Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);</td>
<td></td>
</tr>
<tr>
<td>There is no critical habitat listed for this species on the register of critical habitat.</td>
<td></td>
</tr>
<tr>
<td><strong>f)</strong> Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan;</td>
<td></td>
</tr>
<tr>
<td>There is no recovery plan for this species however there are 23 priority actions listed for this species within the priority action statement. High priority actions include encouraging the retention of the largest hollow bearing trees.</td>
<td></td>
</tr>
<tr>
<td>Although the proposed activities are not consistent with some of the objectives of the 23 priority actions it is assessed that there would be no negative impact on the long-term persistence and recovery of this species.</td>
<td></td>
</tr>
<tr>
<td>The EMP aims to re-establish vegetation within the study area. The intention is that this vegetation would be designed to mimic the White Box Yellow Box Blakely’s Red Gum</td>
<td></td>
</tr>
<tr>
<td>There is no recovery plan for this species however there are 23 priority actions listed for this species within the priority action statement. High priority actions include encouraging the retention of the largest hollow bearing trees.</td>
<td></td>
</tr>
<tr>
<td>Although the proposed activities are not consistent with some of the objectives of the 23 priority actions it is assessed that there would be no negative impact on the long-term persistence and recovery of this species.</td>
<td></td>
</tr>
<tr>
<td>The EMP aims to re-establish vegetation within the study area. The intention is that this vegetation would be designed to mimic the White Box Yellow Box Blakely’s Red Gum</td>
<td></td>
</tr>
</tbody>
</table>
Greater Long-eared Bat (*Nyctophilus timorensis*)

Woodland EEC and Bimble Box Woodland habitats that are to be potentially impacted by the proposed activities. In this regard over the short to long-term a viable woodland habitat of greater habitat value than the woodland currently in the study area may be created and as such may become an important foraging resource for the Greater Long-eared Bat.

Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)

Gum Woodland EEC and Bimble Box Woodland habitats that are to be potentially impacted by the proposed activities. In this regard over the short to long-term a viable woodland habitat of greater habitat value than the woodland currently in the Yellow-bellied Sheathtail Bat.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are currently 35 key threatening processes (KTP’s) listed under the TSC Act. The most relevant one to this proposed activities and the Greater Long-eared Bat is the clearing of native vegetation which is listed as a KTP under TSC and EPBC Acts.

*Clearing of native vegetation* - The proposed activities will clear approximately 1.55 ha of this species habitat. The loss of this relatively small amount of habitat is unavoidable in light of the proposed activities objectives and is unlikely to result in the decline of this species in the locality.

Provided the proposed EMP is followed, the proposed activities should not result in a net loss of Greater Long-eared Bat habitat and may, over the long-term, provide additional foraging resources for the species.

**Conclusion**

Based on the consideration of the above factors, the proposed activities are not likely to significantly effect the listed threatened species Long-eared Bat or its habitats.
Endangered Ecological Community (EEC)

White Box Yellow Box Blakely's Red Gum Woodland

White Box Yellow Box Blakely's Red Gum Woodland is found on relatively fertile soils on the tablelands and western slopes of NSW and generally occurs between the 400 and 800 mm isohyets extending from the western slopes, at an altitude of c. 170m to c. 1200 m, on the northern tablelands. The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions.

7-Part Test Criteria

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Approximately 0.65 ha of this EEC is likely to be cleared as a result of the proposed activities. The development will not significantly reduce the extent of this EEC in the wider study area as there are more extensive areas of this EEC within the local area, including larger areas to the east of the site. The local occurrence is not likely to be placed at risk of extinction.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The proposed activities will cause the clearing of a relatively small proportion of this EEC in the study area, which may lead to the mortality of some woodland EEC species. The proposed activities are also likely to modify the composition of the EEC vegetation that is adjacent to the vegetation to be impacted due to edge effects such as: extra light, wind and resultant temperature changes, which can favour the growth of weeds and/or hardier native species. This change in composition is already occurring where this EEC is to be potentially impacted. Overall this would comprise a minor modification and a minor reduction in the overall number of plant species and individuals that contribute to the composition of the EEC in the locality. Therefore the proposed activities are not likely to significantly modify the composition.
of this EEC, anymore than what has already occurred due to past and ongoing agricultural land use, such that the local occurrence is likely to be placed at risk of extinction.

**d) In relation to the habitat of a threatened species, population or ecological community:**

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The development will clear 0.65 ha of Box Gum Woodland EEC. Adjacent areas would be modified as a result of edge effects (see above).

(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

Even though Clift Road dissects this patch of EEC from a larger more extensive patch of similar EEC within George’s Island, it is part of this adjacent patch and seed dispersion between both patches is likely. George’s Island is already isolated and fragmented from similar woodland vegetation within the locality, as a result of past land clearing and agricultural land use. The proposed activities are unlikely to further fragment these patches of EEC.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The area of this EEC to be removed is limited in extent and subject to ongoing disturbances associated with weed invasion and periodic livestock grazing. This area is relatively small in contrast to similar habitats in the locality that also contain this EEC, where the species composition maybe greater and less structurally modified, and as such maybe a better representation of this EEC. However, in consideration of the EMP, this patch of EEC is likely to be improved in contrast to its current condition, species composition and structural diversity. The habitat to be removed or modified is not likely to be important for the long-term survival of the community.

**e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

No critical habitat is registered for this EEC.

**f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**

The DECCW (2010) has prepared a (draft) national recovery plan for this EEC. The primary objective of the recovery plan is to minimise the risk of extinction of this EEC through:

- Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- Increasing protection of sites in good condition;
- Increasing landscape functionality of the ecological community through management and restoration of degraded sites;
Increasing transitional areas around remnants and linkages between remnants; and

Bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

Only a very small proportion of this EEC in the locality would be temporarily lost, which is already structurally modified and in a degraded state. The un-impacted EEC adjacent to well lease 4 will be protected and some weed control will occur, as part of the proposed WMP, in and around the proposed well lease where vegetation clearing is likely to take place.

Agricultural land use prevents any opportunities to provide linkages between isolated patches of this EEC.

**g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process**

There are currently 35 key threatening processes (KTP’s) listed under the TSC Act. The most relevant ones to this proposed activities and White Box Yellow Box Blakely’s Red Gum Woodland are the invasion of native plant communities by exotic perennial grasses and the clearing of native vegetation, which are listed as KTPs under TSC and EPBC Acts.

**Invasion of native plant communities by exotic perennial grasses** - Based on the above considerations, the development would not result in a significant increase in the operation of any KTPs of relevance to White Box Yellow Box Blakely’s Red Gum Woodland.

**Clearing of native vegetation** - The proposed activities will clear approximately 0.65 ha of this EEC. The loss of this relatively small amount of structurally modified EEC is unavoidable in light of the proposed activities objectives and is unlikely to result the decline of this EEC in the locality. Provided the proposed WMP and EMP is followed, the development should not result in the operation of, or increase the impact of the invasion of exotic perennial weeds into those areas not impacted by the proposed activities (i.e. where vegetation clearing activities are likely to take place at well lease 4).

**Conclusion**

Based on the consideration of the above factors, the proposed activities are not likely to significantly effect the listed threatened ecological community White Box Yellow Box Blakely’s Red Gum Woodland or its habitats.
Appendix E

EPBC Act: Assessments of Significance
EPBC Act Assessment of Significance

Approach

An assessment of whether the proposed activities will have, or are likely to have a significant impact on listed threatened species or listed migratory species under the EPBC Act has been carried out in accordance with the EPBC Act and EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance (DEWHA, 2009). The DEWHA (2009) guidelines require proponents to self-assess as to whether or the action is likely to have a significant impact on MNES. Where impacts on MNES are likely, then an assessment of the significance of those impacts must be performed.

There are two threatened plant species, two migratory species and one EEC listed under the EPBC Act that were positively recorded or are considered as potentially occurring in the locality in terms of potentially suitable habitat, of which one plant is listed as critically endangered, one plant as vulnerable, two birds as migratory and one ecological community as critically endangered. These included:

Critically Endangered Ecological Community

- White Box Yellow Box Blakely’s Red Gum Grassy Woodlands and Derived Native Grasslands.

Vulnerable Species

- Bluegrass (*Dichanthium setosum*); and
- Greater Long-eared Bat (*Nyctophilus timoriensis*).

Migratory Species

- Rufous Fantail (*Haliaeetus leucogaster*); and
- Rainbow Bee-eater (*Merops ornatus*).
Critically Endangered Ecological Community

White Box Yellow Box Blakely’s Red Gum Grassy Woodlands and Derived Native Grasslands

White Box Yellow Box Blakely’s Red Gum Woodland Grassy Woodland and derived Native Grasslands (Box Gum Woodland) is found on relatively fertile soils on the tablelands and western slopes of NSW and generally occurs between the 400 and 800 mm isohyets extending from the western slopes, at an altitude of c. 170m to c. 1200 m, on the northern tablelands. The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions. Less than 5% of this community remains in good condition, and much of this occurs in small, isolated patches.

Significant Impact Criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

a) Reduce the extent of an ecological community;

The area of this community (0.65 ha) to be impacted by the proposed activities are minimal in contrast to the area occupied by this community in the broader study area (see Figure 4.2). Additionally, no White Box, Yellow Box or Blakely’s Red Gum individuals with a DBH of greater than 10 cm will be removed. The proposed use of the site and associated impacts to the woodland is temporary, whereby the impacted areas will be completely remediated thereafter. The extent of the ecological community will therefore not be reduced over the medium to long-term.

b) Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;

Some widening of the existing track that leads to the site will be required to enable access of a rig. This would require a maximum widening width of 8 m over a distance of approximately 380 m through the Box Woodland. This widening of the existing track will not greatly segregate any part of the Box Woodland and therefore is not fragmenting or increasing fragmentation of the ecological community.

c) Adversely affect habitat critical to the survival of an ecological community;

Past disturbances associated with land clearing for agriculture have already significantly impacted the extent of this community in the study area. The proposed activities are unlikely to further affect habitats critical to this community in the study area.

d) Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community’s survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;

The proposed activities will not impact abiotic factors necessary for the survival of the Box Woodland.
e) **Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;**

The impacts to the community will be limited to the proposed operation areas and access tracks. These areas do not contain species that are unique to the community within the same patch and temporarily removing or suppressing these species will not affect the diversity or overall functionality of the community. Following use of the site, remediation will be undertaken to restore the Box Woodland to equal or better condition than what currently exists.

f) **Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**

-- **assisting invasive species, that are harmful to the listed ecological community, to become established, or**

Guidelines will be put in place prevent the spread and invasion of weeds into this community and may reduce the presence of such weeds already present in the study area.

-- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or**

The proposed activities will not cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community.

g) **Interfere with the recovery of an ecological community.**

The DECCW (2010) has prepared a (draft) national recovery plan for this CEEC. The primary objective of the recovery plan is to minimise the risk of extinction of this CEEC through:

- Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- Increasing protection of sites in good condition;
- Increasing landscape functionality of the ecological community through management and restoration of degraded sites;
- Increasing transitional areas around remnants and linkages between remnants; and
- Bringing about enduring changes in participating land manager attitudes and behaviors towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

Only a very small proportion of this CEEC in the locality would be lost temporarily. Restoration of the ecological community following the use of the site will ensure that the recovery of the CEEC is not interfered with.
**Conclusion**

Based on consideration of the above factors it is concluded that the proposed activities are unlikely to have a significant impact on the White Box Yellow Box Blakely’s Red Gum Woodland.
Vulnerable Species

Bluegrass (*Dichanthium setosum*)

Bluegrass occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, as well as in Queensland and Western Australia. It occurs widely on private property, including in the Inverell, Guyra, Armidale and Glen Innes areas. It is associated with heavy basaltic black soils and is often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. It has often been collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched. Flowering occurs mostly during summer.

**Significant Impact Criteria**

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

*a) Lead to a long-term decrease in the size of an important population of a species;*

This species was not recorded in the study area; this may be due to the degree of past and ongoing disturbances associated with agricultural land use. If a population of this species were to be recorded in the study area, it could be considered an important population. It has therefore been assessed that it is likely to occur in the study area, but may only do so as individual occurrences that may be able to persist under agricultural land use. In this regard a population of Bluegrass is unlikely to exist and a long-term decrease of an important population of is therefore unlikely.

*b) Reduce the area of occupancy of an important population;*

The proposed activities involve the clearing of 0.08 ha of grassland habitat and 1.55 ha of woodland habitat that has the potential to provide habitat for a population of Bluegrass. Although the proposed activities would remove potentially viable habitat for this species there would be no negative impact on the long-term persistence of these species if it were to actually occur in the study area, due to the presence of similar grassland habitats in adjacent lands.

*c) Fragment an existing important population into two or more populations;*

Existing habitat is well connected to similar surrounding habitats (grazing land) adjacent to the study area. The proposed activities are unlikely to fragment populations of this species since connectivity of the surrounding land will be retained. Additionally no individuals of Bluegrass were actually recorded, which suggests that a population may not currently exist in the study area. As it was not identified during its flowering season, it is still easily identifiable outside of its flowering season. Additionally the survey occurred in March which is at the end of its actively growing or flowering period. However, further surveys during specific flowering seasons may determine whether it occurs or not.
d) Adversely affect habitat critical to the survival of a species;

The habitat in the study area could be considered critical habitat for the survival of this species, however habitats in adjacent lands within the locality have undergone similar levels of disturbance and may also provide viable habitats for Bluegrass.

e) Disrupt the breeding cycle of an important population;

It is only a possibility that Bluegrass may occur in the study area, in that an important population may not exist. In this regard the proposed activities are unlikely to disrupt the breeding cycle of an important population of this species.

f) Modify destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

The existing habitats in the study area are currently in a modified state due to current and previous agricultural practices. Similar modified habitats exist in adjacent lands. The removal of this modified habitat is unlikely to result in the decline of the species.

g) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat;

Invasive weeds already exist and additional weed infestation is unlikely to occur as a result of the proposed activities and recommended mitigation measures. Therefore the proposed activities will not result in an invasive species, which may be harmful to this vulnerable species, in becoming established in this area of potentially important habitat.

h) Introduce disease that may cause the species to decline; or

The proposed activities are unlikely to result in the introduction of a disease that may cause this species to decline.

i) Interfere with the recovery of the species.

Key priority actions for this species that are relevant to the proposed activities are centred around habitat management, weed control, fire management, feral pest management (i.e. Rabbits) and site protection. In light of the mitigation measures such as weed and feral pest control and providing fencing to protect the retained vegetation from the operation of the proposed activities, as a means to facilitate most of these priority actions, the proposed activities are unlikely to interfere with the recovery of Bluegrass.

Conclusion

Based on consideration of the above factors it is concluded that the proposed activities are unlikely to have a significant impact on Bluegrass.
Greater Long-eared Bat (*Nyctophilus timoriensis*)

This species is known to utilise River Red Gum forest, semi-arid woodlands and savannas. It also occurs in box/ironbark/Callitris open forests and Buloke woodland in northern New South Wales and inland south-east Queensland. In South Australia it is confined to tall mallee shrublands north of the Murray River and is known to roost in hollows in Eucalyptus gracilis. Victorian records are from E. gracilis mallee, Buloke and Black Box woodlands. They forage on flying insects and fly very close to vegetation, often weaving through the gaps. They forage at least 3 km from the roost. Tree hollows are used as maternity sites (Churchill, 2008).

**Significant Impact Criteria**

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

*a) Lead to a long-term decrease in the size of an important population of a species;*

This species was recorded within the study area, identified utilising Anabat analysis. It is likely that this species utilises the woodland habitats of the study area for foraging and diurnal roosting, due to the presence of hollow bearing trees and viable foraging habitat. Approximately 1.55 ha of woodland habitat is to be removed as part of the proposed activities. These areas are generally highly disturbed and are of low habitat value. The removal of this habitat is unlikely to lead to a long-term decrease in the size of the site species population.

Given that the habitat to be removed is within previously disturbed areas, is unlikely to impact the long-term persistence of the species in the study area.

*b) Reduce the area of occupancy of an important population;*

The proposed activities involve the clearing of 1.55 ha of Woodland communities that are considered to provide habitat for the Greater Long-eared Bat. The areas to be removed are highly disturbed and provide marginal habitat only. The clearing of the woodland habitat is unlikely to result in a negative impact on the long-term persistence of the Greater Long-eared Bat, due to the retention of high value habitat across the site.

*c) Fragment an existing important population into two or more populations;*

The study area is contiguous with a moderately large remnant patch of woodland that occurs over the greater George’s Island; however, George’s Island is isolated from neighbouring woodlands.

The proposed activities are unlikely to fragment populations of this species, as it will result in the clearing of minimal vegetation within the proposed well leases only. Given the limited areas of disturbance, and the high mobility of these species, the proposed activities are unlikely to result in fragmenting the site Greater Long-eared Bat population into two or more populations.
d) **Adversely affect habitat critical to the survival of a species;**

While habitat occurring across the study area could be considered critical habitat for the survival of this species, particularly given the isolated nature of the greater George’s Island, the proposed activities will not result in the removal of core habitat for the Greater Long-eared Bat. Approximately 1.55 ha of woodland vegetation, the majority of which is highly disturbed, is to be removed, while the remaining areas of the site are to be retained. The proposed activities are not considered to adversely affect habitat critical to the survival of the species.

e) **Disrupt the breeding cycle of an important population;**

It is unlikely that the breeding cycle of the Greater Long-eared Bat will be disrupted due to the proposed activities. This species utilised tree hollows as maternity sites. Given that the proposed activities will result in the removal of six hollow-bearing trees, the impact of the proposed activities on the breeding cycle is considered minimal.

f) **Modify destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The areas of habitat to be removed as part of the proposed activities are currently in a modified state due to current and previous land use, including agricultural land practices, gravel extraction, and exploratory drilling. Vegetation to be retained across the site is of higher habitat value for this species. The proposed activities are not considered to decrease the availability or quality of habitat to the extent that the species is likely to decline.

g) **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species’ habitat;**

It is unlikely that the proposed activities will result in invasive species that are harmful to the Greater Long-eared Bat becoming established in the vulnerable species habitat.

h) **Introduce disease that may cause the species to decline; or**

The proposed activities are unlikely to result in the introduction of a disease that may cause this species to decline.

i) **Interfere with the recovery of the species.**

Key priority actions for this species that are relevant to the proposed activities include the retention of hollow-bearing trees, and protecting roosts from damage and disturbance. Given that the proposed activities has minimised the impacts on hollow-bearing trees and potential roosts, as well as ensuring well leases are sited in areas of existing disturbances, it is unlikely that the proposed activities will interfere in the recovery of this species.

**Conclusion**

Based on consideration of the above factors it is concluded that the proposed activities are unlikely to have a significant impact on the Greater Long-eared Bat.
Migratory Species

The development will remove habitat for EPBC Act listed biota, which comprises an impact on a matter of NES. Two migratory species listed under the EPBC Act, the Rufous Fantail and Rainbow Bee-eater, were recorded at the site. A detailed assessment of the significance of impacts on these two migratory species is provided below.

Rufous Fantail (*Rhipidura rufifrons*)

The Rufous Fantail is found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. During migration, it may be found in more open habitats or urban areas (Birds in Backyards, 2005).

**Significant Impact Criteria**

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

1. **Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species,**

The site is not considered likely to constitute an important area of habitat on the basis of the following:

- The study area does provide foraging habitat and is likely to provide breeding habitat for the Rufous Fantail. However, the study area constitutes only a very small portion of more extensive areas of similar habitats within the locality. In this regard and the fact the Rufous Fantail migrates large distances, the study area is not likely to support an ecologically significant population of the species;
- While this species occurs within the study area and may be actively breeding in the study area, similar habitat is known to occur within the locality. In this regard the breeding resources of the study area are not of critical importance;
- The Rufous Fantail recorded in the study area is not at the limit of the species range. It is known to occur in a variety of habitats throughout eastern Australia, coastal islands and as far as Papua New Guinea;
- Due to the nature of the study area providing ideal foraging and breeding resources, it can be assumed that the species is not located within habitat where it is in decline.

2. **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species,** or

The proposed activities will not result in an invasive species that is harmful to this migratory species becoming established in this area of important habitat.

3. **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.**
The proposed activities are unlikely to significantly disrupt the lifecycle of the species. Potential breeding habitat will not be significantly impacted by the proposed activities and foraging habitat may be increased in the long-term as a result of the recommended site rehabilitation.

**Conclusion**

Based on consideration of the above factors it is concluded that the proposed activities are unlikely to have a significant impact on the Rufous Fantail.
**Rainbow Bee-eater (Merops ornatus)**

This species is widespread in Australia, except in desert areas, and breeds throughout most of its range. The Rainbow Bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels (Morcombe, 2004).

**Significant Impact Criteria**

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

1. **Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species,**

The site is not considered likely to constitute an important area of habitat on the basis of the following:

- The study area does provide foraging habitat and may provide breeding habitat for the Rainbow Bee-eater. However, the study area constitutes only a very small portion of more extensive areas of similar habitats within the locality. In this regard and the fact the Rainbow Bee-eater migrates large distances, the study area is not likely to support an ecologically significant population of the species;
- While this species occurs within the study area and may actively breed in the study area, more favourable breeding habitat is likely to occur within the locality where creeks and rivers are in association with alluvial floodplain deposits. In this regard the potential breeding resources of the study area are not of critical importance;
- The Rainbow Bee-eater recorded in the study area is not at the limit of the species known range. It is known to occur in a variety of habitats throughout Australia, coastal islands and as far as Papua New Guinea and Indonesia;
- Due to the nature of the study area providing ideal foraging resources and the locality potentially provide breeding resources, it can be assumed that the species is not located within habitat where it is in decline.

2. **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or**

   The proposed activities will not result in an invasive species that is harmful to this migratory species becoming established in this area of important habitat.

3. ** Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.**

   The proposed activities are unlikely to significantly disrupt the lifecycle (breeding) of the species because the site only occupies a small proportion of the overall breeding resources available in the study area and wider locality.
Conclusion

Based on consideration of the above factors it is concluded that the proposed activities are unlikely to have a significant impact on the Rainbow Bee-eater.
Appendix F

Koala Plan of Management
Glasserton Pilot Wells, PEL 1, Gunnedah Basin

Koala Plan of Management

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## Terms and Abbreviations

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# Koala Plan of Management

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Appendices

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1.0 Introduction

1.1 Background

Santos QNT Pty Ltd (Santos), as operator for and on behalf of the holders of petroleum exploration licence 1 (PEL 1), is seeking approval to undertake coal seam gas appraisal activities on George's Island. As part of this, three pilot wells are required to be drilled, completed and appraised within PEL 1, located in the western extent of the Glasserton property, Lot 1 DP1099622, on the western side of Clift Road, (study area). Additionally, the proposal also includes the installation of a wellhead and downhole gauge in Glasserton 3 and 4 and George's Island 3 to monitor pressure data in the target Hoskissons coal seam.

George's Island 3 is located within Lot 27 in DP755494 at a previously approved and constructed well lease site. Access to Georges Island 3 will be required across Lot 1 DP 571743, Lot 2 DP 1099622, and land marked as a road between Lot 2 DP 1099622 and Lot 27 in DP755494, on the eastern side of Clift Road. RPS was engaged to undertake an ecological assessment to identify ecological constraints, potential impacts and mitigation measures associated with the proposed activities.

A review of environmental factors (REF) has been prepared which assesses the environmental impacts of the proposed activities, in accordance with the Environmental Planning and Assessment Act 1979 (NSW) (EP&A Act). RPS has undertaken an ecological assessment (EA) for the purposes of preparing the REF. The Koala (Phascolarctos cinereus) was recorded in the study area throughout several ecological surveys conducted as part of the EA. Given the presence of koala on site, a KPoM has been prepared for inclusion with the REF.

1.2 Site Particulars

The study area occurs on a topographical feature referred to as George’s Island that is located approximately 40 km south of Gunnedah and approximately 35 km northwest of Quirindi within the Brigalow Belt South Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion and Liverpool Plains IBRA Subregion. Locally the study area is situated within the Gunnedah Local Government Area. George’s Island is isolated from neighbouring woodlands within the locality, with the closest being Doona State Forest located approximately 5 km to the east, Spring Ridge State Forest approximately 7 km to the southwest and Breeza State Forest approximately 7.5 km to the north (Figure 1.1). Due to George’s Island being fragmented and isolated from neighbouring woodlands, it fits with the broad principles of ‘island biogeography’ and therefore the extant biota therein will be representative such environs.

The study area is approximately 52.56 ha, which is a relatively small portion of George’s Island. The study area is comprised of a mosaic of grassy woodland vegetation communities and is bounded by similar vegetation to the east, northeast and south and agricultural land to the west and northwest (Figure 1.1). The study area contains two abandoned quarries previously used for gravel extraction. These quarries have since formed two small ephemeral waterholes. The study area is currently accessible via Clift Road, which connects to Quirindi Premer Road.

The topography of the study area is flat to undulating with slopes in the order of 0-10 %. An east to west low lying ridge dominates the study area with a relatively flat and level area in the north-western corner. Elevation across the study area ranges between approximately 310 m Australian Height Datum (AHD) in
the north-western corner up to approximately 330 m AHD along the south-eastern corner adjacent to Clift Road.
1.3 **Scope of the KPoM**

This KPoM has been developed using the *Approved Recovery Plan: Recovery Plan for the Koala* (DECC 2009) as a guide. This KPoM provides an overview of Koala species information and distribution within the locality, as well as a description of the study area Koala population, potential habitat, movement opportunities and current threats.

The KPoM includes a management framework that outlines the goals, responsibilities and reporting requirements associated with the implementation of the management plan. This KPoM outlines the key issues associated with koalas and koala habitat throughout the construction period, and relevant management actions to ensure the protection and conservation of the koala.

1.4 **Description of the Action**

Santos proposes to undertake drilling, completion and testing activities to assess the coal seam gas potential of the Gunnedah Basin in PEL 1.

A REF was submitted in October 2010 and approval granted by Department of Industry and Investment (DII) on 3 December 2010, for 3 pilot wells to be located in the flat, open agricultural land of the “Glasserton” property to the east of the subject site. Due to landholder concerns with that location, an alternative pilot well program is now being proposed, which is the subject of the revised REF.

The proposal includes drilling at three sites within George's Island (Glasserton 2, 3 and 4) to obtain information on coal depths, seam thickness, continuity and permeability. Coal seams of a particular interest will be cored in selected pilot wells for geo-mechanical analysis of coal seam permeability. Drill stem testing (DST) or equivalent downhole evaluation is also undertaken on coal seams to establish reservoir pressure and give an indication of permeability.

In addition, Santos proposes to install a wellhead and downhole gauge in the Glasserton 3 and 4 wells and in an existing well (George's Island 3) located on the other side of George's Island.

In summary, the process involves:

- Preparation of a level drill pad at the three drilling locations (also referred to as “well lease areas”);
- Placement of a drilling rig and ancillary equipment at the well lease;
- Drilling of the pilot wells including (on a per well basis):
  - Drilling of surface hole;
  - Casing and cementing of surface casing;
  - Drilling of main hole;
  - Collection and analysis of drill cores (as required);
  - Conducting of wireline evaluation (as required);
  - Conducting of well tests (as required);
• Casing and cementing of main hole; and
• Creation of access to target formation (e.g. via undereaming of main casing).

Completion of the wells via installation of required downhole equipment;
• Partial rehabilitation of the well leases;
• Construction of required water storage and surface facilities;
• Operation of Glasserton 2 for not less than 60 days (in total), with a maximum water output of 10 ML;
• Removal of equipment and imported materials;
• Shut-in of the wells, with rehabilitation to minimal area around each well site;
• Shallow Aquifer Monitoring Bore to remain;
• Cessation of operations of temporary water storage and load out facilities;
• Decommissioning of water storage facilities; and
• Suspension and rehabilitation as required.

Glasserton 2 will be the central well, in which a wellhead and downhole pumping assembly will be installed for the purposes of lifting water. Glasserton 3 and 4 and George’s Island 3 will have a wellhead and downhole pressure gauges installed for the purposes of monitoring the effect of the removal of water from the target formation in Glasserton 2. This will involve:

• Mobilising a wireline truck (dimensions approximately equal to a Isuzu 1400 tandem axle body truck) to conduct the wellhead installation and downhole gauge installation; and
• Construction of a data logger/telemetry skid at the wellhead.

A Shallow Aquifer Monitoring Bore (SAMB) will also be drilled within the disturbed drill lease area of Glasserton 3. The drilling of the SAMB will include:

• Constructing lined drilling sumps as required and otherwise preparing an area within the Glasserton 3 lease to accommodate the drilling rig and associated vehicles;
• Drill and completing the bore using a Truck Mounted Water Bore Drilling Rig;
• Drill 8” conductor hole to 5-10m and case with PVC casing to hold back unconsolidated soils;
• Drill hole (diameter 6”) to 30m into Trinkey Formation using mud rotary and/or rotary air hammer methods as required;
• Conduct open hole logging as required;
• Conduct permeability testing as required;
• Install steel tubing in the hole (expected tubing grade is 2-3/8” 4.7# J55 EUE) with attached downhole equipment:
  • Quartz Pressure Gauges across key formations of interest; and
  • Gauge control and data lines with associated tubing clamps.
- Cement the downhole equipment in place utilising a bentonite/cement mixture;
- Install solar powered data logger and telemetry at surface; and
- Fencing off the surface monitoring systems once in place.

Water will be lifted to the surface through Glasserton 2 to complete a 60 day pump test and will be temporarily stored in a storage facility to be constructed to the south of Glasserton 2 in a disused gravel pit. Water will be transported from the Glasserton 2 wellhead via a buried pipeline to a 30m diameter bunded tank. Water will be offloaded from the tank to water tankers as required via means of a load-out facility adjacent to the tank. Water will then be transported from George's Island to an agreed licensed facility.

A scouting survey has been undertaken prior to drilling taking place to locate the three sites with an emphasis on minimisation of impacts on the environment and property operations. Santos has entered into a land access agreement for Lot 1 in DP 1099622 and a separate land access agreement with a separate landholder for Lot 27 in DP755494.

### 1.5 SEPP 44

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) aims "to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline".

Schedule 1 of SEPP 44, which lists the LGAs to which SEPP 44 applies, includes the Gunnedah LGA. SEPP 44 applies to local councils determining development applications under Part 4 of the EP&A Act. Although SEPP 44 does not apply in relation to the assessment of development under Part 5 of the EP&A Act, it has been considered in the preparation of this REF.

SEPP 44 requires that before granting development consent under Part 4 of the EP&A Act for development on land over 1 hectare in area, a consent authority must form a view as to whether the land is "potential" or "core" koala habitat. Potential koala habitat is defined as:

> areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

Core koala habitat is defined as:

> an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

Where core koala habitat is found to occur, SEPP 44 requires that a site-specific koala plan of management be prepared.

George's Island is known to support a population of Koalas. Three Koalas were observed within the subject site during field surveys undertaken as part of the ecological assessment. Evidence of Koalas, including scats and scratches on tree trunks, was observed.
Based on the EA, it has been determined that George’s Island provides suitable core breeding habitat for the Koala, and therefore constitutes Core Koala Habitat. Accordingly, RPS has prepared this KPoM for inclusion with the REF.
Figure 1.1
Aerial of Study Area and Regional Location

Legend
- Study Area
- George's Island 3
- Contours (10m)
Legend

- Red: Study Area (52.56 ha)
- Green: Well Leases (1.34 ha)
- White: Water Handling Facility (0.26 ha)
- Purple: Track Widening
- Pink: Road Re-alignment
- Blue: Existing Track

Figure 1.2 Selected Well Lease and Water Handling Facility Footprints

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DIGITAL CADASTRAL DATA BASE - BOUNDARY INFORMATION.
2.0 Koala Species Profile

2.1 Species Distribution and Behavior Overview

The koala is an arboreal marsupial that occurs from north-eastern Queensland to south-eastern South Australia. While koalas were historically abundant, the species distribution has contracted, and abundance has declined. Within NSW this species is now listed as vulnerable under the Threatened Species Conservation Act 1995 (NSW) (TSC Act).

The koala home range size varies with quality of habitat, ranging from less than 2 ha to several hundred hectares in size. Koalas typically inhabit eucalypt woodlands and forests where they feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area would select preferred species (DECC 2008).

They are generally inactive for most of the day, feeding and moving mostly at night. Koalas spend most of their time in trees, but descend and traverse open ground to move between trees. This species is generally solitary, but has complex social hierarchies based on a dominant male with a territory overlapping several females and subordinate males on the periphery. Females breed at two years of age and produce one young per year (DECC, 2008).

Koalas’ primary diet consists of eucalypt leaves, which are high in indigestible components such as lignin and cellulose, as well as toxic compounds including oils and tannins. Eucalypt leaves are low in nutrients and energy, however to offset these factors koalas have a low metabolic rate and low nutrient requirements. In New South Wales, preferred eucalypt feed trees, as listed within Schedule 2 of SEPP 44, are:

- *Eucalyptus tereticornis* (Forest Red Gum);
- *Eucalyptus microcorys* (Tallowwood);
- *Eucalyptus punctata* (Grey Gum);
- *Eucalyptus viminalis* (Ribbon or Manna Gum);
- *Eucalyptus camaldulensis* (River Red Gum);
- *Eucalyptus haemastoma* (Broad-leaved Scribbly Gum);
- *Eucalyptus signata* (Scribbly Gum);
- *Eucalyptus albens* (White Box);
- *Eucalyptus populnea* (Bimble Box or Poplar Box); and
- *Eucalyptus robusta* (Swamp Mahogany).

Refer to Appendix 2 for detailed species profiles.
2.2 Local Population

In New South Wales, koala populations generally occur along the central and northern coasts, with some populations occurring in the western region, including to the west of Gunnedah.

The Gunnedah koala population was the subject of a study conducted by the National Parks and Wildlife Service (Smith, 1992). The study identified that healthy, Chlamydia free populations of koalas occurs in the region, with strong fecundity. The study identified that while koala numbers had increased over the previous 30 years diminishing availability of habitat, increased vehicle strikes, and increasing distances between feed trees was resulting in stress and illness to the local population. A recent study also identified a significant increase in the Gunnedah Koala population in 2006, compared with Koala populations in 1986 (Lunney 2009).

Additional key points outlined in the Smith study were:

- White Box (E. albans) is a preferred feed tree in the region, while Blakely's Red Gum (Eucalyptus blakelyi), Tumbledown Red Gum (E. dealbata), White Cypress Pine (Callitris glaucophylla), Bimble Box, and Narrow-leaved Grey Box (E. microcarpa-pilligaensis) are also important and favoured food trees;
- A significant number of koalas utilise roadside vegetation as movement passages, and are vulnerable to car-induced injuries and/or mortality;
- Koalas favour hills and mountains in the region, due to the generally heavily-wooded condition; and
- Koalas show a strong propensity to locate on better quality soils.

Koalas were recorded three times in the study area. Additionally, Koalas were incidentally observed within the broader George's Island area. Observations were recorded through targeted searches around known koala habitat trees (White Box, Blakely's Red Gum, Bimble Box and White Cypress Pine) by means of diurnal searches, spotlighting and scat searches.
3.0 Site Koala Habitat Values

A preliminary ecological survey was undertaken over the Study Area in December 2010 followed by the detailed EA which was carried out between 28 March 2011 and 1 April 2011, and included detailed flora and fauna surveys.

3.1 Koala Habitat across George’s Island

The EA included an appraisal of previous studies and observations of vegetation and habitat composition over George’s Island. This found that vegetation and subsequently habitat was generally consistent with the EA outcomes for the Study Area across the George’s Island, and also included areas of grassy woodland vegetation associated with grazing (Refer to Figure 3.1). The grassy open woodland habitat occurs to the north, west and south of the study area, and occupies approximately 170ha of George’s Island, as shown on Figure 3.1. This habitat is associated with agricultural land that is actively grazed by sheep and/or cattle, and as a result has little to no understorey present.

This habitat is comprised of scattered eucalypt trees in varying density across the community. This habitat comprises a valuable extension to the higher valuable woodland habitat associated with George’s Island.

Notwithstanding the overall quality of koala habitat within George’s Island, based on the floristic characteristics and structures, the key koala feed trees that are confirmed or highly probable (based on detailed survey within the Study Area) to exist are:

- SEPP 44
  - White Box; and
  - Bimble Box.
- NPWS (Smith 1992)
  - Blakeley’s Red Gum;
  - White Box;
  - Bimble Box; and
  - White Cypress Pine.

3.2 Koala Habitat within the Study Area

The study area generally comprises areas of woodland vegetation that includes three distinct vegetation communities.

As outlined on Figure 3.1, Box-Gum Grassy Woodland is the dominant vegetation community on site. The canopy and juvenile canopy layer of this community is dominated by White Box, Yellow Box (*Eucalyptus melliodora*), and Blakely’s Red Gum, with White Cypress also occurring. Of these species,
White Box is considered a koala feed tree under SEPP 44. Additionally, Blakeley’s Red Gum and White Cypress Pine are considered Koala feed trees by Smith (1992).

Bimble Box Woodland occurs across the northern portion of the site (Figure 3.1). This vegetation community is dominated by Bimble Box, with White Box also occurring in low densities. White Cypress commonly occurs within the sub-canopy. Within this community, Bimble Box and White Box are listed as koala feed trees under SEPP 44. White Cypress Pine is listed as a koala feed tree by Smith (1992).

A small portion of the site is comprised of Silver-leaved Ironbark (*Eucalyptus melanophloia*) Woodland (Figure 3.1). Dominant canopy species in this vegetation community include Silver-leaved Ironbark, with low densities of White Box. White Cypress commonly occurs within the canopy and sub-canopy. As outlined above, White Box and White Cypress are considered koala feed trees. While Silver-leaved Ironbark is not considered a koala feed tree, it is likely that this species is used as a habitat tree by koalas.

These woodland habitats have undergone past disturbances associated with periodic livestock grazing resulting in a structurally modified understorey. Grazing has reduced plant diversity within the understorey and encouraged some weed invasion and may, in some portions of these communities, be limiting the natural regeneration of eucalypt canopy species, resulting in the dominance of White Cypress Pine within these areas. Accordingly the condition rating of this habitat is moderate to good. Even though these habitats have undergone past disturbances, the fauna habitat values of this habitat type have not been significantly reduced.

### 3.3 Movement Corridors

In the context of koala habitat connectivity, George’s Island is isolated from proximate or interconnecting habitat within the locality. Specifically, Doona State Forest is situated approximately 5 km to the east; Spring Ridge State Forest approximately 7 km to the southwest and Breeza State Forest approximately 7.5 km to the north.

Within George’s Island only moderate levels of corridor fragmentation occur and are associated with Clift Road, access tracks and fence lines. Clift Road is the most notable habitat interruption largely between the eastern and western environs of George’s Island being approximately 10m wide and without significant bounding vegetation. The key risk associated with the road is vulnerability of Koalas crossing the road and the potential for vehicle related injury or mortality.

Limited canopy vegetation occurs along Clift Road, to the north of George’s Island, forming a depauperate movement corridor within roadside vegetation between George’s Island and proximate vegetation.

### 3.4 Current Potential Threats

Current threats to the koala population residing within the study area and George’s Island include:

- Physical Isolation;
- Genetic Isolation;
- Predation;
- Pressure on available habitat;
- Vehicle strike; and
- Bushfire.

The current George's Island koala population is largely isolated from other populations, resulting in a greater threat from factors such as loss of long term genetic diversity and integrity (in-breeding), disease and potential local extinction resulting from predation. Vehicle strike, while a threat, in the overall context of the rural location and likely lesser vehicle movements than in more built up areas, is considered to pose a lesser risk to the population. Given the abovementioned isolation within the locality and lack of suitable movement corridors outside/off George's Island, bushfire is a significant threat to the population, if in a worst case scenario the entire George's Island is subjected to wildfire.

Interactions with the wider Gunnedah population are considered mainly unlikely due to the lack of interconnecting vegetation that could form movement corridors as discussed previously.
Figure 3.1
Habitats within the Study Area and Adjacent Lands

Legend
- Study Area
- George's Island 3

Study Area Habitats
COMUNITIY
- Bimble Box Woodland
- Box – Gum Grassy Woodlands and Derived Grasslands (CEEC)
- Cleared / Disturbed land
- Dam
- Plains Grass Grassland
- Silver-leaved Ironbark Woodland

George's Island Habitats
VEGETATION
- Open Woodland
- Open forest
- Woodland

The image has been contoured as a best fit to the boundaries and position is approximate only.

Project Manager: BD
Prepared by: HR
Map Projection: MGAz56
Map Datum: GDA94
File Reference: 107106-1
Client: Santos

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DIGITAL CADASTRAL DATA BASE - BOUNDARY INFORMATION.
Vegetation data by DEC 2010 and RPS 2011
4.0 Management Framework

Based on the Study Area and situation within George’s Island and wider landscape coupled with the proposal, a management framework has been developed herewith to cater for the specific nature and extent of the activity to be carried out as follows:

1. **Performance Objectives / Indicators**

Describes the criteria against which the level of achievement of the stated objectives / targets will be measured, and identifies desired outcomes.

2. **Responsibility**

Outlines who is responsible for the implementation of the management measures.

3. **Key Issues**

Identifies key issues and threats to the koala population that may arise from the undertaking of the proposed activities.

4. **Management Actions**

Describes the management measures that will be implemented.

5. **Reporting**

Describes required reporting and review arrangements to be completed throughout the undertaking of the proposed activities.
5.0 Koala Management Plan

5.1 Objectives

The objectives of this KPoM are to:

- Conserve koalas in their existing habitat at the activity site; and
- Contribute to the rehabilitation and restoration of koala habitat at the activity site.

5.2 Responsibilities

Santos will appoint a Site Manager who will be responsible for the implementation of this KPoM. The Site Manager is responsible for ensuring all personnel; including subcontractors, are aware of the contents of this KPoM and act accordingly. All site personnel shall be educated during the site induction, of their responsibilities under this KPoM and ensure koalas are protected at the activity site. All staff working at the activity site will be provided with this KPoM.

A supervising ecologist(s) will be appointed, and will be present throughout all vegetation clearing and pruning activities at the activity site. The Site Manager will ensure that all directions issued by the supervising ecologist are implemented.

5.3 Key Issues

The following sections outline the key issues potentially resulting from the proposed activities at the activity site.

5.3.1 Habitat Loss

The proposed activities will temporarily impact a maximum area of approximately 2.03 ha of modified woodland habitat including the following important habitat features relevant to the koala:

- Five koala feed trees (Bimble Box) around the Glasserton 3 well lease;
- One koala feed tree (Bimble Box) along the proposed access track between Glasserton 2 and Glasserton 3;
- Minimal clearing of juvenile koala feed trees along the main access track; and
- Minimal impacts associated with pruning/trimming of koala feed trees (Bimble Box) to facilitate road widening along the proposed access tracks.

Other vegetation clearing will occur, and will consist of the removal of non-food trees including Silver-leaved Ironbark and Yellow Box. Although not recognized as feed trees, they may provide shelter for koalas.
5.3.2 Fragmentation

Well construction is unlikely to cause disruption to koala movements throughout the activity site and wider study area, as minimal disturbances to canopy vegetation are proposed. The main access track will be subject to widening works from the existing 4 m up to a maximum of 8 m. Generally the maximum width will only be required to achieve the required vehicle turning radius on corners and bends, whereas on straight sections of the access alignment, a lesser extent of widening to approximately 6 m is envisaged. Access tracks will primarily be located along existing tracks as discussed within Section 1.4. The access roads will not cause a significant disruption to koala movements.

5.3.3 Habitat Degradation

The proposed activities may result in habitat degradation resulting from edge effect such as weed invasion and changes to woodland floristic composition.

5.3.4 Bushfire

Actions associated with the proposed activity, including the storage of fuels, use of machinery, and smoking on site are potential fire hazards. Appropriate operational measures must be implemented to reduce the potential for fire. Additionally, mitigation measures must be implemented in case of fire.

5.3.5 Vehicle Strike

An increased risk of vehicle collision exists within and directly adjacent to the Activity Site during the period upon which the proposal is carried out. A significant increase of vehicular (including plant/ civil machinery) movements throughout the Study Area may occur during this period. Management Actions

The following sections outline management actions to be implemented within the activity site throughout the study area.

5.3.6 Habitat Protection

Well lease design and layout has taken koala habitat values into consideration to minimise the impacts on local koala populations. Minimal koala habitat and feed trees will be cleared as part of the proposed activities.

The extent of works will be clearly fenced to ensure adjacent vegetation is protected from construction activities. Where trees occur in close proximity to access tracks, tree barriers will be installed. Refer to EMP for detailed information.

Pre-clearing surveys are to be undertaken prior to the proposed activities commencing. Pre-clearing surveys will include identification of koala food trees within and adjacent to well leases and access roads.

Following completion of the action, rehabilitation of the Activity Site will occur. A focus will be to restore the woodland structure to its pre-development condition at a minimum. This will include the planting of
locally sourced, endemic tubestock within areas subject to clearing. In time as the planted trees mature, the available feed resource and habitat extent will be increased.

### 5.3.7 Koala Protection

The following measures will be implemented to ensure the resident koala population are protected throughout the undertaking of the proposed activities.

**Site Manager and Supervising Ecologist(s)**

Santos will appoint a Site Manager who will be responsible for the implementation of this KPoM. The Site Manager is responsible for ensuring all personnel; including subcontractors, are aware of the contents of this KPoM and act accordingly.

A supervising ecologist(s) will be present during all vegetation clearing and pruning along access tracks. The supervising ecologist will conduct daily searches for koalas occurring near well leases and access tracks prior to vegetation clearing and pruning commencing. The supervising ecologist will ensure that no koalas are located in trees to be felled or pruned, or in trees with overlapping crowns. Where a koala is present, koalas will be allowed to move out of trees that are to be cleared or pruned on their own accord, generally over night.

**Fencing**

Well leases will be bordered with temporary fencing to clearly delineate areas of vegetation to be retained and to be removed, as outlined within the EMP. Additionally, fencing will ensure koalas cannot access construction areas.

Temporary fencing will be unclimbable. Fencing will consist of mesh wire that is at least 1.5 m high. The fence will be clad with 13 line marsupial hinge joint and capped with a 600 mm wide strip of galvanised sheeting across the top of the fence to impede access. The following specifications will also be followed:

- Fence bracing/supports will be located within the construction area;
- Fencing will have a gap of less than 100 mm between the ground and the bottom of the fence;
- The fence will be kept clear of fallen branches and vines; and
- No barbed wire or electric fencing will be used.

**Warning Signs**

Designated koala warning signs will be installed along the access tracks. Additionally, the Site Manager will educate employees, during the site induction, of their responsibilities under this KPoM and to ensure koalas are protected at the activity site.
Controlled Speed Limits

All access tracks within the activity site will be speed limited to a maximum of 20 km/h to reduce the risk of collision with koalas. Speed limit signs will be installed on access tracks and at the entry points to the well lease area.

Dogs

No dogs will be permitted on the activity site at any time.

Injured Koalas

If injured or sick koalas are encountered by site personnel within the activity site, the Site Manager or supervising ecologist will contact the local Wildlife Information, Rescue and Education Service.

5.3.8 Rehabilitation of Koala Habitat

A staged revegetation and rehabilitation of the well leases will be undertaken as part of the proposed activities, as outlined within the detailed EA and EMP. The primary aim of revegetation and rehabilitation is to restore the natural ecosystems, utilising endemic native plant species that occur in the adjacent habitats for revegetation purposes. It will restore the areas to be revegetated and rehabilitated to a condition that would be representative of the structural diversity of pre-clearance woodland vegetation.

As part of the rehabilitation, koala food trees, namely Bimble Box and White Box will be planted to enhance the koala habitat values of the activity site.

5.4 Reporting

Following abandonment of the well leases, a report will be prepared by the Site Manager, with input from the fauna supervising ecologist outlining:

- The number and location of koalas recorded across the activity site;
- The number and location of koala injuries or mortalities within the activity site, and on access roads use for the action;
- Confirmation that the measures undertaken to protect koalas in the area have been adequately implemented and maintained; and
- A summary of the rehabilitation carried out within each of the well leases.
6.0 References

Department of Environment and Climate Change (2008). *Recovery Plan for the Koala (Phascolarctos cinereus)*. The Stage of NSW and DECC.


Appendix 1

SEPP 44
State Environmental Planning Policy No 44—Koala Habitat Protection

[1995-5]

Status Information

Currency of version
Current version for 20 April 2000 to date (accessed 17 May 2011 at 14:04). Legislation on this site is usually updated within 3 working days after a change to the legislation.

Provisions in force
The provisions displayed in this version of the legislation have all commenced. See Historical notes.

Authorisation
This version of the legislation is compiled and maintained in a database of legislation by the Parliamentary Counsel's Office and published on the NSW legislation website, and is certified as the form of that legislation that is correct under section 45C of the Interpretation Act 1987.

File last modified 26 April 2000.

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1 Name of Policy

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3 Aims, objectives etc

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Historical notes

Part 1 Preliminary

1 Name of Policy

This Policy may be cited as State Environmental Planning Policy No 44—Koala Habitat Protection.

2 Commencement

This Policy commences on 13 February 1995.

3 Aims, objectives etc

This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:
(a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and

(b) by encouraging the identification of areas of core koala habitat, and

(c) by encouraging the inclusion of areas of core koala habitat in environment protection zones.

4 Definitions

In this Policy:

*core koala habitat* means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

*guidelines* means the guidelines, as in force from time to time, made for the purposes of this Policy by the Director.

*potential koala habitat* means areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

5 Land to which this Policy applies

(1) This Policy applies to each local government area listed in Schedule 1.

(2) However, it does not apply to land dedicated or reserved under the *National Parks and Wildlife Act 1974* or to land dedicated under the *Forestry Act 1916* as a State forest or flora reserve.

Part 2 Development control of koala habitats

6 Land to which this Part applies

This Part applies to land:

(a) that is land to which this Policy applies, and

(b) that is land in relation to which a development application has been made, and

(c) that:

(i) has an area of more than 1 hectare, or

(ii) has, together with any adjoining land in the same ownership, an area of more than 1 hectare,

whether or not the development application applies to the whole, or only part, of the land.

7 Step 1—Is the land potential koala habitat?

(1) Before a council may grant consent to an application for consent to carry out development on land to which this Part applies, it must satisfy itself whether or not the land is a potential koala habitat.
(2) A council may satisfy itself as to whether or not land is a potential koala habitat only on information obtained by it, or by the applicant, from a person who is qualified and experienced in tree identification.

(3) If the council is satisfied:

(a) that the land is not a potential koala habitat, it is not prevented, because of this Policy, from granting consent to the development application, or

(b) that the land is a potential koala habitat, it must comply with clause 8.

8 Step 2—Is the land core koala habitat?

(1) Before a council may grant consent to an application for consent to carry out development on land to which this Part applies that it is satisfied is a potential koala habitat, it must satisfy itself whether or not the land is a core koala habitat.

(2) A council may satisfy itself as to whether or not land is a core koala habitat only on information obtained by it, or by the applicant, from a person with appropriate qualifications and experience in biological science and fauna survey and management.

(3) If the council is satisfied:

(a) that the land is not a core koala habitat, it is not prevented, because of this Policy, from granting consent to the development application, or

(b) that the land is a core koala habitat, it must comply with clause 9.

9 Step 3—Can development consent be granted in relation to core koala habitat?

(1) Before a council may grant consent to a development application for consent to carry out development on land to which this Part applies that it is satisfied is a core koala habitat, there must be a plan of management prepared in accordance with Part 3 that applies to the land.

(2) The council’s determination of the development application must not be inconsistent with the plan of management.

10 Guidelines—matters for consideration

Without limiting clause 17, a council must take the guidelines into consideration in determining an application for consent to carry out development on land to which this Part applies.

Part 3 Plans of management

11 Preparation of plan of management

(1) A plan of management may be prepared for:

(a) the whole of a local government area listed in Schedule 1, or
(b) a part of such a local government area (including an area of land that is the subject of a development application).

(2) Anyone (including a council) may prepare a plan of management.

(3) A plan of management is to be prepared in accordance with the guidelines.

12 Consultation with Director-General of National Parks and Wildlife

A person who prepares a plan of management for the whole of a local government area listed in Schedule 1 must consult the Director-General of National Parks and Wildlife.

13 Approval of plan of management

(1) A plan of management prepared by the council has no effect unless it is approved by the Director.

(2) A plan of management prepared by a person other than the council has no effect unless it is approved by the council and by the Director.

(3) A plan of management takes effect on the day it is approved by the Director or on a later day specified in it for the purpose.

14 Amendment or repeal of plan of management

A plan of management may be amended or repealed by another plan of management prepared and approved in accordance with this Part.

Part 4 Other environmental planning measures

15 Surveys, environmental protection zones and development control plans

In order to give effect to the aims of this Policy, a council of a local government area listed in Schedule 1 should:

(a) survey the land within its area so as to identify areas of potential koala habitat and core koala habitat, and

(b) make or amend a local environmental plan:

(i) to include land identified as a core koala habitat within an environmental protection zone, or

(ii) to identify land that is a core koala habitat and apply special provisions to control the development of that land, and

(c) give consideration to preparing an appropriate development control plan for land that is or adjoins a core koala habitat.

16 Preparation of local environmental studies

Without affecting the power of the Director to give a direction under section 74 (2) (b) of the Environmental Planning and Assessment Act 1979 to a council, the Director will consider giving a direction that sections 57 and 61 of that Act are to apply to a draft local environmental plan (with the consequence that the council must
prepare an environmental study of the land to which the draft local environmental plan applies) if, under the draft plan, it is proposed to zone (or rezone) land that is a potential koala habitat or a core koala habitat otherwise than as environment protection.

17 Guidelines—generally

(1) In exercising any function under this Policy, a council must take into consideration the guidelines that are relevant to the exercise of the function.

(2) Anyone may inspect the guidelines free of charge at any office of the Department of Planning during the hours when the office is open to the public.

Schedule 1 Local government areas

(Clauses 5 (1), 11 (1), 12, 15)

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Hawkesbury Werrington
Hornsby Weddin
Hume Wentworth
Inverell Windouran
Kempsey Wingecarribee
Ku-ring-gai Wollondilly
Kyogle Wollongong
Lake Macquarie Wyong
Leeton Yallaroi
Lismore Yarrowlumla
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Schedule 2 Feed tree species

Scientific Name
Eucalyptus tereticornis Forest red gum
Eucalyptus microcorys Tallowwood
Eucalyptus punctata Grey Gum
Eucalyptus viminalis Ribbon or manna gum
Eucalyptus camaldulensis River red gum
Eucalyptus haemastoma Broad leaved scribbly gum
Eucalyptus signata Scribbly gum
Eucalyptus albens White box
Eucalyptus populnea Bimble box or poplar box
Eucalyptus robusta Swamp mahogany

Historical notes

The following abbreviations are used in the Historical notes:

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Table of amending instruments

State Environmental Planning Policy No 44—Koala Habitat Protection published in Gazette No 49 of 6.1.1995, p 3394, and amended in Gazette No 14 of 10.2.1995, p 788, and as follows:
Coffs Harbour City Local Environmental Plan 2000 (GG No 49 of 20.4.2000, p 3394)

Table of amendments

Appendix 2

Koala Species Profiles
Koala

Phascolarctos cinereus (Goldfuss, 1817)

Other common names
None

Conservation status

The Koala is listed as a Vulnerable Species on Schedule 2 of the New South Wales Threatened Species Conservation Act, 1995 (TSC Act). The conservation status of this species varies across Australia, from secure in some areas to vulnerable or extinct in others (ANZECC 1998).

Description (summarised from Martin & Handasyde 1995)

Head and body length (range of averages)
705-782mm (males)
687-716mm (females)

Weight (max range)
6.5-12kg (males)
5.1-8.5kg (females)

The Koala is an arboreal marsupial with fur ranging in colour from pale grey in the northern parts of its range to grey-brown in the south. Koalas have large furry ears and no tail. In the south of their range they are significantly larger than in the north (Lee & Martin 1988).

Distribution

The Koala has a fragmented distribution throughout eastern Australia, from north-east Queensland to the Eyre Peninsula in South Australia (Martin & Handasyde 1995). The distribution of the species also extends west of the Great Dividing Range, where it mostly occurs along inland rivers (Martin & Handasyde 1995).

In NSW, the Koala mainly occurs on the central and north coasts (Reed & Lunney 1990), although some populations occur in the western region (such as in the Pilliga region, to the west of Gunnedah), and an individual was recorded north of Wilcannia in 1994 (Ellis et al. 1997).

The species was historically abundant on the south coast of NSW (Lunney & Leary 1988), but now occurs in sparse and possibly disjunct populations (Reed et al. 1990) primarily in the Eden-Narooma area. Koalas are also known from a number of sites on the Southern Tablelands.

Recorded occurrences in conservation reserves

In NSW, Koalas have been recorded in numerous conservation reserves along the east coast and the slopes and tablelands of the Great Dividing Range (NPWS 1999).
Habitat

The Koala inhabits eucalypt forest and woodland. The suitability of forest and woodland communities as habitat for Koalas is influenced by the size and species of trees present, soil nutrients, climate, rainfall and the size and disturbance history of the habitat patches (Reed et al. 1990).

Ecology

Koalas spend the majority of their time resting in the forks of trees and are generally most active in the first few hours following sunset (Mitchell 1990).

Throughout NSW, Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species (Phillips 1990). However, in any one area, Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis (Hindell & Lee 1990).

Some preferred species in NSW include Forest Red Gum *Eucalyptus tereticornis*, Grey Gum *E. punctata*, Monkey Gum *E. cypellocarpa* and Ribbon Gum *E. viminalis*. In coastal areas, Tallowwood *E. microcorys* and Swamp Mahogany *E. robusta* are important food species, while in inland areas White Box *E. albens*, Bimble Box *E. populnea* and River Red Gum *E. camaldulensis* are favoured (Smith 1992).

The Koala’s diet of eucalypt leaves is low in nutrients and difficult to digest. Koalas are able to deal with this diet because they have a
lower metabolic rate than most other mammals, low nutrient requirements and a complicated digestive tract that selectively keeps the nutritional parts of the diet and excretes the indigestible parts (Cork & Sanson 1990). Koalas also save energy by remaining relatively inactive.

Although Koalas are often regarded as solitary, they actually live in complex groups and individual animals have overlapping home range areas (Martin & Handasyde 1995). Young males reach sexual maturity at approximately two years, although they are generally excluded from mating by the dominant male (Martin & Handasyde 1990; Martin & Handasyde 1995).

Females reach sexual maturity at approximately two years and can produce one offspring each year, generally in summer (Martin & Handasyde 1990). Following birth, the young lives in the pouch for 6 months and on leaving the pouch it remains dependent on its mother, riding on her back. Young reach independence at about 12 months, although they can remain in the mother’s home range for a further 2-3 years. After this period, young animals disperse to establish their own home range. Dispersal distances generally range from 1-11 km (Gall 1980; Mitchell & Martin 1990), although movements in excess of 50 km have been recorded (Steve Phillips unpublished data).

**Threats**

- Destruction of habitat by clearing for urban development, agriculture and mining, particularly on high nutrient content soils
- Fragmentation of habitat by roads, urban development and agriculture, which creates barriers to movement, isolates individuals and populations, alters population dynamics and prevents gene flow and the ability to maintain recruitment levels
- Mortality from attacks by dogs, road fatalities, fires, drought or other natural disasters, particularly in fragmented landscapes without suitable refuge areas
- Degradation of habitat by fire, weed invasion, removal of important habitat trees and climate change
- In stressed populations, infection by *Chlamydia*, causing cystitis, keratoconjunctivitis, infertility and other symptoms

**Management**

- Survey and research to assess and map Koala populations and habitat
- Identification, protection and management of habitat, incorporating buffer or protection zones around prime habitat and the use of habitat links
- Habitat restoration and re-establishment of Koala feed trees in protection zones and in areas where clearing threatens the long-term persistence of local populations
- Research to determine the impact of fire, weed invasion and logging regimes
- Control of predators, in particular wild and domestic dogs
- Design of roads to incorporate movement structures and exclusion fencing and the setting of appropriate speed zones to allow for Koala movements and to reduce Koala deaths on roads
- Implementation of appropriate burning, logging, water-flow (particularly in arid areas) and grazing regimes to ensure the maintenance of known or potential habitat
- Education of residents, landholders, community groups and relevant authorities about threats to and management of Koalas
- Continuing involvement of the community in the survey, care and management of Koalas

**Recovery plans**

A recovery plan for the Koala is in preparation.
References


For further information contact

Threatened Species Unit, Policy and Science Directorate Phone 02 9585 6540.

General enquiries: 43 Bridge St Hurstville NSW 2220 Phone 1300 36 1967 or 02 9585 6333.
Web site www.npws.nsw.gov.au

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