



# Surat Gas Project

## Off-tenure Pipelines and Associated Infrastructure (EPBC 2018/8223)

### EPBC Preliminary Documentation

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Appendix A – EPBC 2018/8223 Preliminary Documentation Information Requirements

Appendix B – Surat Gas Project Off-tenement Terrestrial Ecology Survey Report

Appendix C – DotEE suggested methodology for determining a ‘Habitat Score’, “Species habitat and TEC quality – EPBC offsets and the DEHP (2017) guide”

Appendix D – Granted Environmental Authority and Petroleum Pipeline Licence

Appendix E – Draft Offset Strategy

Appendix F – Arrow Sustainable Development Policy and Framework

Appendix G – Arrow’s Health, Safety and Environment Policy

## 1. Background

Arrow Energy Pty Ltd (hereafter Arrow) has been operating a strong domestic gas supply business since 2004 and we are expanding our CSG operations in the Surat Basin through the Surat Gas Project (SGP). Arrow lodged a Referral to the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the SGP on 27 January 2010 (EPBC 2010/5344). An Environmental Impact Statement (EIS) and Supplementary Report to the EIS (SREIS) were completed in March 2012 and June 2013 respectively. The Minister for the Environment of the Australian Government approved the SGP on 19 December 2013.

On 1 December 2017, Arrow Energy and the Shell-operated QCLNG joint venture announced a Gas Sales Agreement (GSA) to commercialise the majority of Arrow's gas reserves in the Surat Basin. The collaboration between the parties will see the use of some existing QGC-operated infrastructure such as gas compression, processing and transmission infrastructure as well as water transport and treatment facilities. Utilising the existing upstream infrastructure reduces the land disturbance footprint of the SGP development in comparison to the plans presented by Arrow in 2013, thus minimising impacts to landholders and the environment.

The use of the existing QGC-operated infrastructure necessitates additional pipeline easements that were not envisaged in the SGP EIS/SREIS. The easements are required to transfer gas and water from the Arrow's development to the facilities which are located off Arrow's existing tenements. An EPBC Referral (EPBC 2018/8223) to address these pipelines and associated infrastructure was lodged with the Department on 29 May 2018 and a Controlled Action decision was received on 7 September 2018. The controlling provisions for the action are Listed Threatened Species and Communities (Sections 18 and 18A) and the action requires assessment by Preliminary Documentation.

On 19 October 2018 the Department provided Arrow with the specific requirements to be provided within the Preliminary Documentation (see Appendix A). Table 1.1 summarises the additional information required and the corresponding section of this report where the information is provided.

**Table 1.1 Information required for assessment by Preliminary Documentation**

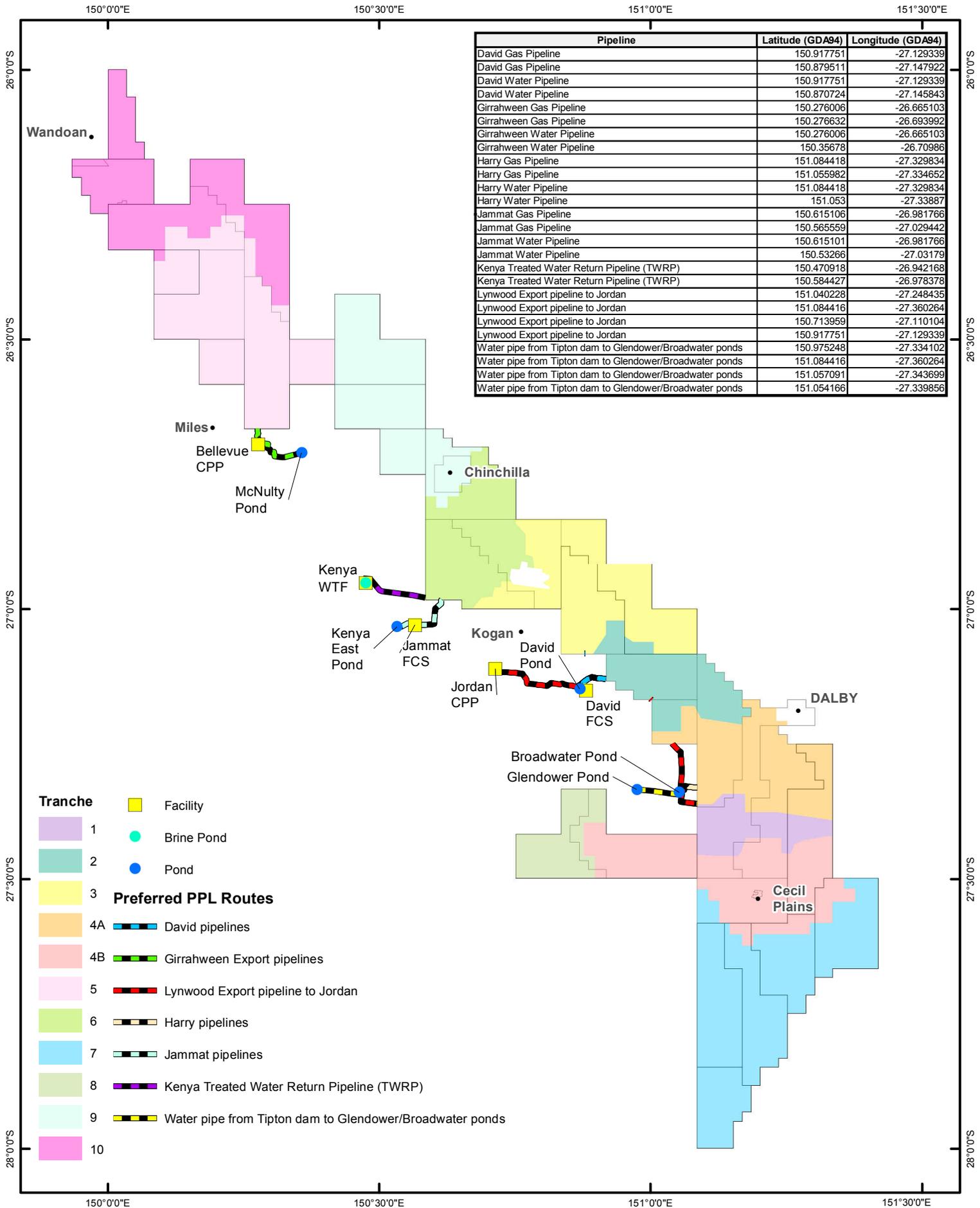
Content required	Summary description of information required	Section
Project Description	All construction, rehabilitation, operational/maintenance and (if relevant) decommissioning components of the project, and their timing.	Section 2
	Details on how the activities are to be undertaken (including stages of development and their timing) and design parameters for those aspects of the structures or elements of the action that may have impacts on relevant listed threatened species.	Section 2
	Details of any local, State and/or Commonwealth requirements, Australian standards, or industry best practice in relation to the construction of the action, including in relation to trenching activities.	Section 2 and Appendix D
Habitat Assessment	A habitat assessment of known and/or potential habitat for each of the listed threatened species within and (where relevant) downstream of the project site. Listed species identified by the Department based on the Referral are the Koala, Dunmall's Snake, Greater Glider, Squatter Pigeon, Murray Cod and Yakka Skink.	Section 3 and Appendix B
Impact Assessment	An analysis of the likely impacts on the above listed threatened species and/or their habitat associated with the vegetation clearance, construction and operational phases of the project.	Section 4 and Appendix C

Content required	Summary description of information required	Section
Avoidance, Safeguards and Mitigation Measures	Detailed descriptions of measures proposed to be undertaken by the proponent to avoid, minimise and manage relevant impacts of the project on the above listed threatened species.	Section 5
	Provide details on relevant measures to avoid, mitigate and/or manage mortality impacts on listed threatened species becoming trapped in open trenches or in uncapped pipes.	Section 5
Rehabilitation Requirements	A discussion on the rehabilitation activities that will be undertaken for the project. Please include rehabilitation goals for all disturbed areas, including both terrestrial and for watercourse crossings, and project site and species-specific rehabilitation activities that will be implemented to achieve these rehabilitation goals.	Section 6 and Appendix D
	If relevant, the preliminary documentation must provide details of any rehabilitation activities proposed to be undertaken as required by Commonwealth, State and/or local government legislation.	Section 6 and Appendix D
Environmental Offsets	An assessment of the likelihood of residual significant impacts occurring on relevant listed threatened species, after avoidance, mitigation and management measures relating to the project have been applied.	Section and & 7 and Appendix E
	If it is determined that a residual significant impact is likely, include a draft Offset Management Strategy.	Section 7 and Appendix E
	If available, include a draft Offsets Management Plan.	Section 7 and Appendix E
Ecologically Sustainable Development (ESD)	A discussion of how the project will conform to the principles of ESD.	Section 8 and Appendix F and G
Environmental Record of Person(s) Proposing to take the Action	<p>Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against:</p> <ul style="list-style-type: none"> <li>the person proposing to take the action; and</li> <li>for an action for which a person has applied for a permit, the person making the application.</li> </ul>	Section 9
Social and Economic Matters	A discussion and analysis of the social and economic impacts of the project, both positive and negative. Economic and social impacts should be considered at the local, regional and national levels.	Section 10

## 2. Project Description

### 2.1 Location

The proposed action is located in the Surat Basin, Queensland, approximately 230 km north-west of Brisbane. The northern most pipeline right-of-way (RoW) is approximately 10 km east of Miles; the central pipelines are approximately 25 km west of Kogan; and the southern pipelines are approximately 50 km west of Dalby (Figure 2.1). It is noted that the easement locations shown in Figure 2.1 are subject to change as the project progresses through the detailed design phase and Arrow shareholder and joint venture partner approval processes.



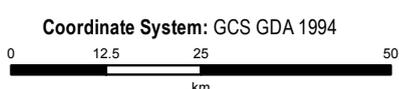
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**Source:** Arrow Energy Limited, Geosciences Australia Dept. Envir. and Resource Mgmt.



**Figure 2.1: Location of proposed infrastructure**



Date: 15/06/2018

Figure 2.1 shows the locations (including coordinates) of the proposed infrastructure, which from North to South includes:

- Girrahween Export pipelines – ~4 km medium pressure steel gas pipeline from Arrow’s tenement boundary to QGC’s Bellevue Central Processing Plant (CPP) , a ~14 km High Density Polyethylene (HDPE) gas pipeline from Arrow’s tenement boundary to QGC’s McNulty FCS and a ~14 km High Density Polyethylene (HDPE) raw water pipeline from Arrow’s tenement boundary to QGC’s McNulty pond (co-located with the HDPE gas line)
- Kenya Treated Water Return Pipeline (Kenya TWRP) – a 13 km low pressure HDPE treated water return line from the QGC Kenya Central Water Treatment Facility to Arrow’s tenement boundary
- Jammatt pipelines - two 9.5 km low pressure HDPE gas pipelines from Arrow’s tenement boundary to QGC’s Jammatt Field Compression Station (FCS) and a 12.5 km HDPE raw water pipeline from Arrow’s tenement boundary to QGC’s Kenya East Pond (the first 9.5 km being co-located with the gas line)
- Lynwood Export pipeline to Jordan – a 24 km medium pressure steel gas pipeline from Arrow’s tenement boundary to QGC’s Jordan CPP via QGC’s Harry FCS
- David pipelines - two 6.2 km low pressure HDPE gas pipelines from Arrow’s tenement boundary to QGC’s David FCS and a 6.4 km HDPE raw water pipeline from Arrow’s tenement boundary to QGC’s David Pond (the first 6 km being co-located with the gas line)
- Water pipe from Tipton dam to Glendower and Broadwater ponds – 13.5 km HDPE raw water pipeline from Arrow’s tenement boundary to QGC’s water ponds (partly co-located with the Lynwood export line and the Harry raw water line)
- Harry pipelines - two 3.5 km low pressure HDPE gas pipelines from Arrow’s tenement boundary to QGC’s Harry FCS (co-located for 2.7 km) and a 4 km HDPE raw water pipeline from Arrow’s tenement boundary to QGC’s Broadwater Pond (the first 1 km being co-located with the gas line and then co-located with the Lynwood export pipeline and Tipton water pipeline).

Queensland is divided into 13 bioregions based on broad landscape patterns that reflect the underlying geology, climate patterns and ecology. The Project area is located entirely within the Brigalow Belt South Bioregion. This bioregion is characterised by forests and woodlands of Brigalow (*Acacia harpophylla*), eucalypt and cypress pine on clay soils. The study area for the proposed action has been highly modified, now supporting a major pastoral and agricultural area with much of the natural vegetation cleared.

## 2.2 Components of the Project

Table 2.1 provides a summary of the project components and specifically addresses the dot point list of minimum project description information requirements listed by the Department (see Appendix A for Information Requirements). The components of the project are as follows:

- Medium pressure steel gas pipelines
- Low pressure high density polyethylene (HDPE) pipelines
- HDPE raw water pipelines
- Inlet Processing Facilities (IPFs)
- Electrical infrastructure required for the distribution of power (e.g. underground high voltage and low voltage power cables, above ground power lines)

- Temporary facilities including work areas for storage of materials and equipment, and mobile construction camps.

Table 2.1 Summary of Project Components

Project Component Requirement	Description
Locations, construction process, width (in metres) of the pipeline right-of-way (ROW) and design of all proposed water crossings	Sections 2.3
Maximum width (in metres) and a diagram of the pipeline RoW	Average 30 m (maximum up to 60 m in areas requiring cut and fill) (see Figure 2.2 for indicative RoW)
Maximum width (in metres) of the pipeline easement post-construction	10 - 15 m
Maximum length (in metres) of the trench which will be open during trenching activities at any one time	1,000 m
Average time (days) the trench will be open during trenching activities at any one time	10 - 20 days
Total footprint (in ha) of the project study area (i.e. 500m either side of centrelines)	8,760 ha
Total construction disturbance footprint (in ha)	280 ha
Predicted total post-construction footprint (in ha)	135 ha

## 2.3 Project activities

### 2.3.1 Construction Phase

#### *Pipeline construction*

Pipeline construction requires the following activities to be undertaken:

- Detailed survey of the RoW and construction areas
- Establishing access tracks and laydown areas where required
- Installing temporary gates and fences as required
- Installing erosion and sediment controls
- Clearing vegetation, where required, and grading the RoW to prepare a safe construction working area (on average the RoW may vary from 25 to 60 m; see Figure 2.2 for a typical RoW; with the actual width depending on size and number of pipelines, areas with side slopes; rough terrain or crossing points)
- Separating and stockpiling topsoil and subsoil to protect and preserve topsoil
- Crossing watercourses, roads and existing buried pipelines by open cut, boring or alternate trenchless technology (e.g. Horizontal Directional Drilling (HDD) or thrust boring methods) depending upon the type and nature of the crossing (see further details below)
- Delivering pipe sections along the RoW
- Welding the HDPE and carbon steel pipe sections together to form a 'string' (including non-destructive testing of welds for the steel pipelines)

- Creating a trench in which to lay the pipeline. The trench is excavated by a trenching machine and may include the use of a chain or bucket trencher, excavators, rock hammers or blasting in hard rock terrain
- Lowering the pipeline strings into the trench and placing padding (e.g. screened trench subsoil) around the pipe to protect the coating from external damage
- Returning the subsoil and topsoil to their original horizons (i.e. backfill and compaction)
- Testing the integrity of the pipeline by pneumatic testing or filling it with water and pressurising it to above the maximum allowable operating pressure (i.e. hydrostatic pressure testing)
- Low pressure nitrogen packing of gas lines in preparation for commissioning
- Cleaning up, restoring and progressively rehabilitating the construction RoW and all temporary tracks, gates and fences
- Installing permanent gates and signage where required.

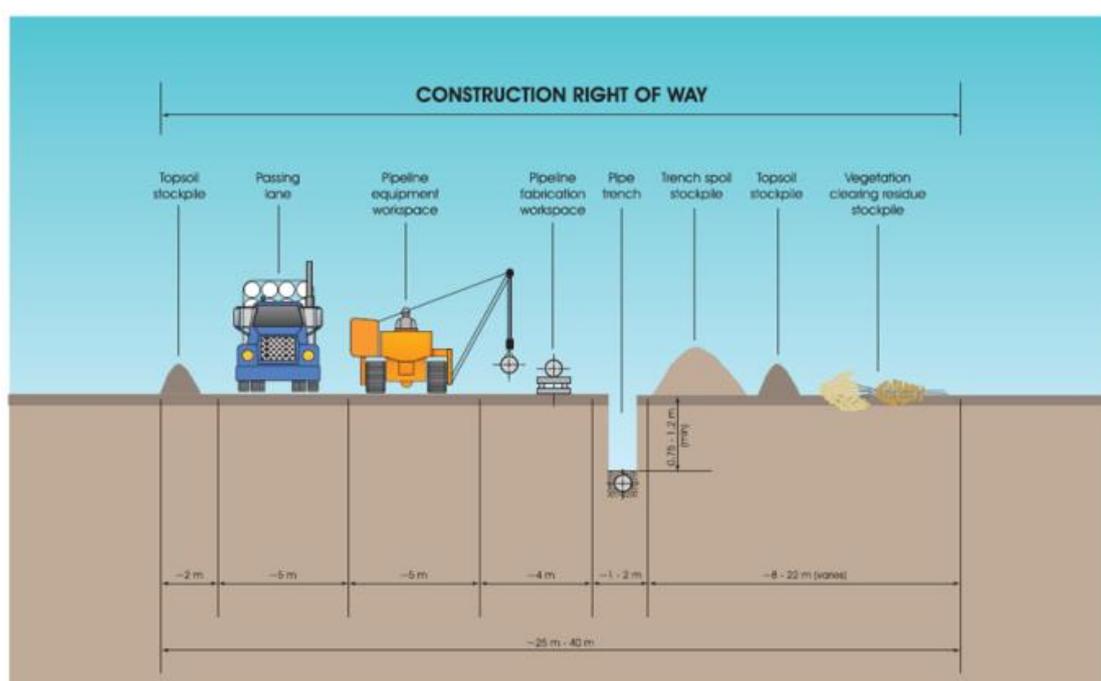


Figure 2.2 Typical Profile Right-of-Way (RoW) Layout

### **Watercourse crossings**

There are no permanent watercourses to be crossed by any of the pipelines. All crossings are of minor tributaries with most watercourse pools likely to dry during an average rainfall year. Watercourse crossings will preferentially occur during the dry season when the water flow is non-existent or low and the likelihood of rainfall is less.

Common pipeline construction methods used for trenching watercourses include open-cut trenching, open-cut trenching with flow diversion, horizontal directional drilling (HDD) and thrust boring. The method to select the most appropriate watercourse crossing is outlined in Table 2.2.

Table 2.2 Watercourse construction methodology

Sensitivity	Sensitivity Criteria	Technique
Low	<ul style="list-style-type: none"> <li>- Ephemeral stream, or no flow at time of construction</li> <li>- In-stream habitat highly modified or disturbed</li> <li>- Poor riparian vegetation with a high percentage of introduced species and the presence of weed species</li> </ul>	Open trench
Moderate	<ul style="list-style-type: none"> <li>- Flow at time of construction</li> <li>- Some good quality in-stream habitat</li> <li>- Moderate riparian vegetation, with some native species present</li> </ul>	Open trench with flow diversion
High	<ul style="list-style-type: none"> <li>- High flow at time of construction</li> <li>- Near natural/good quality in-stream habitat</li> <li>- Good intact native riparian vegetation</li> <li>- Highly sensitive downstream water users</li> </ul>	HDD / thrust boring or flow diversion with site specific mitigation measures

### *Open trench*

Most watercourses including all drainage lines will be constructed using standard open-cut (trenching) methods. This technique is most suited to dry or low flow conditions. It involves establishing a stable working platform either side of the watercourse and creating a trench using excavators or other trenching equipment. Tie-in points will be located on high ground.

Trench spoil removed from the watercourse will be placed beyond the high bank. Trench and backfill activities will be undertaken to ensure that the bed and bank materials are stockpiled separately and returned to the trench to match original conditions to the extent possible.

In areas of watercourse crossings and potential flood inundation the carbon steel medium pressure pipe may be concrete coated to give negative buoyancy. In such areas the low pressure HDPE pipe may utilise saddle weights and screw anchors.

Welded pipe will be laid in the trench and spoil material returned to the trench. Rock protection may be placed over the trench in the stream bed where required, to prevent potential scouring during water flow conditions.

### *Open trench with flow diversion*

Flow diversion is a modification of the standard open-cut method and is used when the watercourse at the time of construction has a moderate flow (e.g. typically less than 1,000 L/s). Techniques include:

- Concentrating the flow through a flume pipe to prevent siltation that may be created during trenching, lowering in and backfilling. This method is not suitable for watercourses with broad channels, low gradients and permeable substrates;
- Pumping water around the work area by constructing barrier dykes or head walls above and below the trenched area keeping the work area relatively dry. This method is suitable for low gradient streams with a discharge of less than 1,000 L/s.

If access is required across the watercourse, the water is directed through a diversion pipe and a causeway constructed over the watercourse to allow the passage of construction traffic.

### *Horizontal directional drill (HDD) / thrust boring*

Permanent flowing watercourse crossings may be constructed using a trenchless technique such as HDD or thrust boring, in which a hole is drilled under the watercourse bed and the pipeline section is pulled through the hole. Once the pipe string is installed and tied into the main section of the pipeline, the entry and exit points are remediated and excess material is reused in the trench, as padding or backfill, or incorporated into the RoW.

### **Sealed road crossings**

Sealed road and railway line crossings may be undertaken using thrust boring, micro tunnelling or open cut techniques. Construction of these crossings will be timed to minimise disruption to users.

### **Construction water**

Potable water is required within the small construction camps for cooking, drinking, ablutions, laundry and cleaning. An allowance of 250 L per person per day is typically allocated. Potable water for use in the camps will meet the Australian Drinking Water Guidelines (2004).

Raw water (or non-potable water) is also required for construction activities and this water will be obtained by the construction contractor under all necessary permits and licences. The options for supply include landholder bores, turkey's nests or similar dams, watercourses or tapping into existing piped raw water supplies. In sourcing water, consideration will be given to minimising cartage distances to limit emissions, cost, travel time and the environmental impacts associated with vehicle movements and disturbance.

The volume of water used to hydrostatically pressure test the pipeline will vary depending on the number and length of sections tested at any given time. Current estimates suggest that between 1 and 5 ML per km test section would be used. This water will either be reused on an adjacent test section or disposed into the raw water gathering lines. Disposal of hydrotest water will be undertaken after testing of water has occurred and compliance with the Queensland Government Environmental Authority conditions for the release of water to land has been achieved. Water deemed unsuitable for release will be stored temporarily in a poly tank or lined temporary holding dam (e.g. turkey's nest) for treatment and/or removal to an approved treatment facility. Water storage required for construction water, hydrotest water and discharge water will be tanks or turkey's nests that will not capture overland flow.

### **Quarry material**

Quarry material may be required to be sourced from external third party borrow pits, or small quarry sites, during the construction period. The material may be used for:

- Soft earth or sand for pipeline padding during trench backfilling where trench spoil is unsuitable for placing around the pipe
- Road base material to construct or upgrade roads and access tracks
- Rubble material to construct hard stands, laydown areas and the stable platforms for lined fuel or chemical storage bunding
- Rocky material for stream bank stabilisation
- Soft earth or sand for bedding of electrical and communication cables within trenches.

Where practicable, borrow material will be sourced from existing sites in the vicinity of the RoWs and is not expected to exceed the Environmentally Relevant Activity (ERA) threshold (i.e. will be <5,000 tonnes per annum of material). Where Arrow is required to establish and/or operate a borrow pit, Arrow will confirm and obtain, as required, any required landholder, cultural heritage consents and regulatory approvals prior to extraction.

### **Power**

Any or all of the following electrical items may be installed within the same RoW as the pipelines: underground high voltage and low voltage power cables; above ground power lines and electrical infrastructure required for the distribution of power. The power cables may be installed within the same trench as pipelines, or in a separate trench nearby.

### **Communications**

Communications cables may be installed in the same RoW as gas pipelines, either in the same trench as other services or in separate trenches. Communications cable pits and above ground joint boxes would also be installed in the RoWs.

### **Temporary Facilities**

A range of temporary facilities will be required during pipeline construction. These include work areas for storage of materials and equipment, and temporary construction camps. The facilities will typically be required in any given location for a period of 6-8 months. This duration may extend up to 12 months if the laydown is to be used for other Arrow purposes beyond an area to land the pipe sections before distribution to the right-of-way (e.g. if the already prepared laydown area is then used for storage of rehabilitation materials and equipment). The specific location and duration of use of these sites will be determined during the detailed design and planning phase and all necessary permits/licenses/agreements will be obtained as required. The selection of sites will employ the principles of avoid and minimise so as to limit impact on sensitive places. The following objectives will be applied to the selection of sites:

- No clearing of remnant vegetation
- Not to be located within 100m of a watercourse
- Avoid or reduce flooding risk
- Documented evidence that camp sites and pipe storage areas have received cultural heritage clearance
- Restoration of site to equivalent surrounding condition or as agreed with the landowner.

### **Work areas for storage of materials and equipment**

Arrow is proposing local manufacture and/or to transport pipe from the port/s for direct use along the RoW or short-term storage in a temporary facility as described above. To accommodate the need for temporary storage, several pipe storage areas will be used along the alignments. Where these pipe storage areas are required, they will be located within close proximity to the RoW and proposed access routes and in a location agreed with landholders.

A range of materials and equipment will be used, and may be stored in temporary work areas adjacent to the RoW and/or co-located with construction camps. Materials may include:

- Earth moving and pipeline equipment
- Markers, posts and signs
- Sand bags for trench breakers and pipe stringing
- Diesel and unleaded fuels
- Lubricants
- Emergency response equipment and spill kits
- Electrical overhead line towers or poles
- Temporary stockpiles of sand, soil, gravel, rocks and other quarried materials.

Diesel fuel will be stored in accordance with AS1940 and transported to machinery on the RoW, as required.

Field joint coating materials will be stored in accordance with the manufacturer's requirements.

### ***Pipeline Markers***

Above ground pipeline markers will be designed and installed in accordance with the APGA Code of Practice for Upstream Polyethylene Gathering Networks (for HDPE pipelines) and the Australian Standard AS2885 (for steel pipelines) to indicate the location of the pipelines.

The markers will be erected at intervals along the pipeline where they are visible and will be positioned at points such as road and water crossings, fence lines and at changes in direction along the pipeline route.

### ***Cable Markers***

Above ground cable markers will be installed to indicate the location of buried electrical power cables and communications cables.

### ***Inlet Processing Facilities***

An Inlet Processing Facility (IPF) will be installed at each of the gas pipelines, nominally located downstream of the low-pressure gas pipelines (pending confirmation through engineering and design). The IPF removes water slugs, water droplets and solids from the gas to make it suitable for processing. Other functions of the IPF are gas flaring in interrupt situations (e.g. scheduled or emergency shutdowns) and power distribution within the facility. 'Pig' receiving facilities will be located downstream of the medium pressure gas pipelines ('Pig' refers to the device used within a pipeline for various cleaning and maintenance operations). The IPFs will be preferentially located on approximately 4 ha of previously cleared land and operated in accordance with the Environmental Authority conditions.

### 2.3.2 Operation, Rehabilitation and Maintenance Phase

The pipelines will be operated in accordance with approved Queensland Environmental Authority conditions, an Operations Environmental Management Plan, Australian Standard AS2885 and the APGA Code (Code of Environmental Practice: Onshore Pipelines 2009). Unscheduled pipeline outages are not expected as the pipeline will be pneumatically or hydrostatically tested to pressures in excess of the Maximum Allowable Operating Pressure (MAOP).

Operational maintenance activities will ensure that the pipeline integrity is maintained over the life of the project. Skilled staff will be deployed to undertake scheduled or unscheduled maintenance activities. Additional specialist personnel will be engaged on a short-term basis for activities such as pipeline pigging or minor earthworks related to erosion and sediment control.

Arrow will either establish or utilise an existing pipeline operational control facility, where pipeline operators will use the Supervisory Control And Data Acquisition (SCADA) system to monitor pipeline facilities' operating parameters, equipment status and control. Capability for local monitoring and control will also be provided at key above-ground facilities. Both an operational control facility and a back-up control facility will be installed. The operational control facility is a remote facility.

It is proposed that all gas flows be metered. The information will then be cross-checked against the volume of gas within the proposed pipeline and any significant imbalance which may be indicative of a rupture will be investigated.

Preventing damage due to third party activity will be achieved by:

- Burying the pipeline to an appropriate depth (750 mm – 2,000 mm depending on the pipe location)
- Sign-posting the pipeline
- Provision of a 24-hour telephone hotline
- Extensive and regular landholder and other stakeholder liaison
- Regular inspection of the pipeline
- Communicating the implications of undertaking excavation, fencing or other related activities in proximity of the pipeline
- Warning marker tape buried above the pipes.

As the completed pipelines will be underground, land users will be able to resume previous land use activities over the pipeline easement. Some limitations exist such as excavation and building activities on the easement.

An operation and maintenance program will be implemented to ensure early detection of events that may cause pipeline failure or create hazardous conditions. The maintenance program will be in accordance with the relevant section of the APGA Code of Environmental Practice: Onshore Pipelines (2009) and/or AS 2885.3:2012. For example, it will include leak detection surveys, ground and aerial patrols, pigging and cleaning of the pipeline, corrosion monitoring and remediation, and easement maintenance. Aerial and ground inspections will monitor vegetation growth, including the presence of weed species, erosion and subsidence and rehabilitation progress of the RoW.

After the initial disturbance to allow the safe installation of the pipelines, the RoWs will be reduced to 10-15 m in width rehabilitated to provide a stable, non-polluting landform. All areas that have

been disturbed during the construction phase that are not being or intended to be utilised by Arrow or the landholder, will be rehabilitated to meet the following acceptance criteria (noting that this criteria is typically included within the Queensland Government pipeline Environmental Authorities and will be monitored by Arrow):

- any contaminated land (e.g. contaminated soils) is remediated and rehabilitated
- rehabilitation is undertaken in a manner such that any actual or potential acid sulphate soils on the area of significant disturbance are treated to prevent or minimise environmental harm in accordance with the Instructions for the treatment and management of acid sulfate soils (2001)
- for land that is not being cultivated by the landholder:
  - groundcover, that is not a declared pest species is established and self-sustaining
  - vegetation of similar species richness and species diversity to pre-selected analogue sites is established and self-sustaining
- for land that is to be cultivated by the landholder, either left fallow or cover crop is revegetated, depending on discussions with the landholder.

### 3. Habitat Assessment

#### 3.1 Assessment Methodology

The following was undertaken to understand the habitats within the study area and their potential for supporting EPBC listed threatened species and communities:

- **Desktop review of relevant ecological information and databases:** relevant information was used from the three previous Environmental Impact Statements (EIS) conducted in the area (Arrow Energy Surat to Gladstone Pipeline Project EIS (EPBC 2009/5029), Arrow Energy Surat Gas Project EIS (EPBC 2010/5344) and BG International Ltd and QGC Ltd Surat Basin Coal Seam Gas Field Development EIS (EPBC 2008/4398)); the EPBC Protected Matters Search Tool; Birdlife atlas database; EPBC Species Profile and Threats (SPRAT) database and relevant Recovery Plans; Wildnet database; Queensland Herbarium Herbreccs database; *Vegetation Management Act 1999* Status and Biodiversity Status of Pre-clearing and Remnant Regional Ecosystems of Queensland mapping; Queensland Government Essential Habitat spatial layer; Queensland Wetland Data; Matters of State Environmental Significance datasets; Australia's Virtual Herbarium for vouchered specimen records; and the *Nature Conservation Act* protected plants flora survey trigger map spatial layer.
- **December 2017 wet season ecological field surveys / habitat assessments:** a seven (7) day survey was conducted from 8 – 14 December in areas of granted landholder access and representative of the remnant vegetation and habitat types with the study area. The study area being a 1 km wide corridor, 500 m either side of the centreline, of each proposed pipeline easement. A total of 376 survey sites were assessed.
- **December 2018 wet season ecological field surveys / habitat assessments:** a nine (9) day survey was conducted from 3 – 11 December in areas of granted landholder access and

representative of the remnant vegetation and habitat types with the study area. An additional 118 survey sites were assessed.

- **Habitat mapping:** the results from the above mentioned desktop and field surveys are then used to create maps that show areas of known habitat and potential habitat for each MNES. The terminology used below is consistent with that used in Arrow's EPBC approvals provided for the Surat Gas Project (i.e. the Environmental Impact Statement; Supplementary Report to the Environmental Impact Statement; SGP Species Impact Management Plan; and SGP Stage 1 Offset Strategy). These habitat descriptions consider the Department's habitat use specifications (e.g. breeding, foraging, dispersal habitat). For the purpose of this report, the mapping categories are defined as:
  - **Core habitat known:** habitat surrounding a known record. A species-specific buffer distance is used to generate Core Habitat Known based on each species movement potential. The rules for core habitat known mapping for each individual species are provided in Appendix B Surat Gas Project Off-Tenure Terrestrial Ecology Assessment.
  - **Core habitat possible:** habitat which is perceived to be highly suitable for the species and, if present, provides suitable resources to support a stable population. The rules for core habitat possible mapping for each individual species are provided in Appendix B.
  - **General habitat:** habitat which is less optimal, or sub-optimal, and has a low likelihood of supporting a population or significantly contributing to its long-term survival. General habitat does not constitute a significant impact as per the Department's Significant Impact Guidelines 1.1. In areas that were previously considered General Habitat but have been found to support dispersing animals like the Koala these habitat areas have been remapped as Core habitat known and / or possible (see Appendix B). The rules for general habitat mapping for each individual species are provided in Appendix B.

For the purpose of providing context to the quality of habitat assessed within the pipelines study area, the method applied in the EPBC Act Offset calculator has been applied. It is recognised that this method does not equate to impact criteria as per the EPBC Significant Impact Guidelines, however it does provide useful information to inform the suitability of habitat within the study area for the various MNES species. The 'Habitat Quality' from the EPBC Act Offset calculator uses three components: Site Context, Site Condition and Species Stocking Rates. These are weighted as 30%/30%/40% and result in an overall score out of 10 (i.e. 3+3+4). Following advice provided by DotEE (Vaughn Cox *pers. comm*, 5 September 2018) these components have been calculated using the methodology summarised below and detailed in Section 2.4.3 of Appendix B. No scores have been calculated for the Murray Cod due to the lack of any suitable habitat.

### Site Context

Site Context has been calculated using a subset of attributes from the Queensland 'Guide to determining terrestrial habitat quality' (DEHP 2017). Using these attributes, the 'Site context' will score out of a maximum 56 and be converted into a score out of three for inclusion into the calculator. For example, a site context score of 44 would be converted for use in the EPBC Act calculator as 2.36;  $(44/56) \times 3$ .

Using the DEHP (2017) methodology, 'site context' is an estimation of the extent of remnant habitat within one kilometre of the BioCondition site. Following advice from DotEE, 'context' was modified to include both remnant and regrowth vegetation (when considered suitable for the target species) based on the following buffer distances:

- Dunmall's Snake – 5 km, and
- Greater Glider and Koala – 20 km.

No specific buffer distance has been advised for Murray Cod, Yakka Skink and Squatter Pigeon. A buffer of either 5 km (Yakka Skin) or 20 km (Squatter Pigeon) has been applied for these species. For plants and TECs, a 1km buffer was applied and species mobility is not calculated meaning site context is scored out of a maximum possible score of 46.

### **Site Condition**

Site Condition has been calculated using the attributes from DEHP (2017). Each attribute is evaluated by comparing the BioCondition data against published benchmarks for the Brigalow Belt Bioregion (Queensland Herbarium 2016). Where benchmarks are not available, BioCondition site data from the ecology assessment for the Surat Gas Project Supplementary EIS (3D Environmental 2013) was used if suitable benchmark data had been collected. Where no benchmark data was available surrogate REs were utilised and were supplemented with site-based observations of vegetation condition and disturbance. The attributes are recruitment of woody perennial species, native species richness (for trees, shrubs, grasses and forbs), tree canopy height, tree canopy cover, native perennial grass cover, organic litter, large trees (i.e. hollows), coarse woody debris, non-native plant cover, quality and availability of food and foraging habitat, quality and availability of shelter).

These attributes provide a score out of a possible 100 and have been converted to a score out of three for inclusion in the EPBC Act Calculator. For plants and TECs, data is scored out of a maximum 80 points as factors relating to food and foraging resources are not considered.

### **Species Stocking Rates**

'Species Stocking Rates' have been evaluated as a score out of 4 using the following definitions:

0. No evidence of the species being present at the site (i.e. historical records are not a consideration)
1. Evidence of species at the site during surveys conducted for the purpose of the EPBC environmental assessment (note species density will be required to demonstrate attainment of score = 2)
2. There is a statistically significant increase in species density relative to the species density determined for a score of 1 or species density is equal to or greater than the species density at a reference site (not required to be an important population)
3. Equivalent to the species density at a reference site associated with an important population

4. Equivalent to the maximum species density measured at a DoEE agreed number of reference sites associated with important populations.

Remnant vegetation communities in Queensland are termed Regional Ecosystems (REs). They are categorised by a three number sequence where the first number represents the geographic area (or bioregion), the second number the Land Zone (describes the major geology / landform) and the third number the type of vegetation. Recognising that both remnant and regrowth vegetation can provide suitable habitat for listed threatened species, the mapping undertaken for this project has included both (see Figures 3.1 to 3.4 for mapped REs within the study area). It is also noted that the area calculations of potential habitat for each MNES within the study area and the impacted areas includes both remnant vegetation and regrowth vegetation.

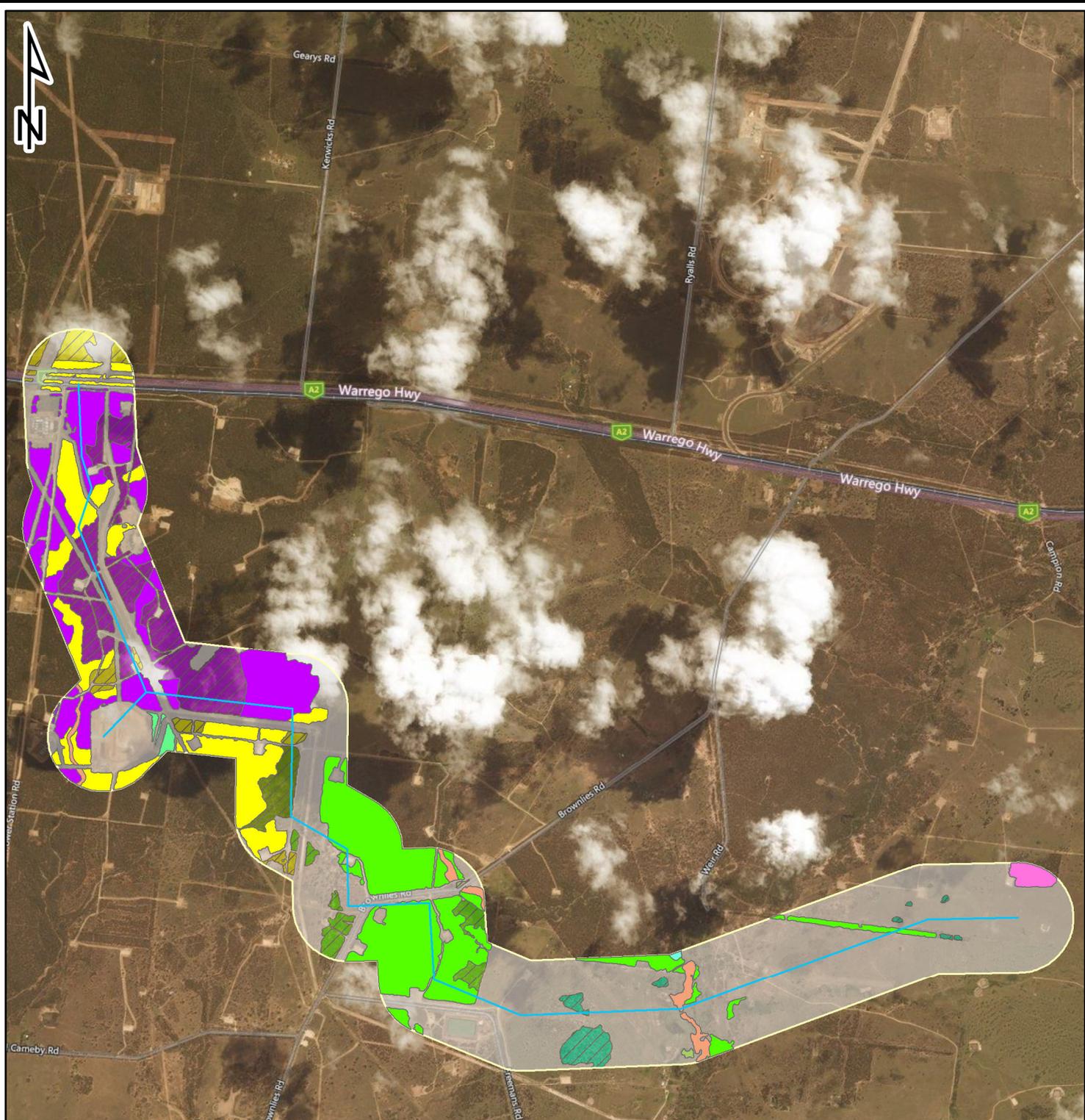
The following sections provide a summary of the habitat findings for each of the six MNES noted in the DoEE additional information requirement (Koala, Dunmall's Snake, Greater Glider, Squatter Pigeon, Murray Cod and Yakka Skink) plus the three MNES observed within the study area during our field surveys (Painted Honeyeater, Kogan Waxflower and Brigalow). Appendix B of this report provides the full ecological assessment report for the study area.

### 3.2 Survey Techniques and Effort

There have been two separate studies commissioned for the off-tenure pipelines: EcoSmart Ecology and 3D Environmental, 2018 and 2019. These were 7 and 9 day surveys, conducted in December 2017 and December 2018 respectively, and involving two to six suitably qualified ecologists. Days involved at least 10 hours active searching, with 60 person hours of survey effort in 2017 and 240 person hours of survey effort in 2018. Both studies involved diurnal area searches, random meander surveys, bird surveys and habitat assessments, and the 2018 study also included nocturnal spotlighting.

Appendix B (Section 2.3.2) describes the following specific survey techniques:

- 40 diurnal area searches, each with 3+ persons, each lasting 20+ minutes. A total of at least 40 person search hours. Note, this is a conservative estimate as often four or more staff undertook searches for longer than 20 minutes.
- Area searches included rolling rocks/logs and raking debris. This technique is suitable for Dunmall's Snake and Yakka Skink. They also included searching under Koala food trees for scat evidence. Bird species were also noted during these area searches and would have detected Painted Honeyeater and Squatter Pigeon if present. The spatial distribution of search locations is shown in Figure 2.2 of Appendix B.
- Six hours of spotlighting by three ecologists (18 person hours) was also undertaken. This method is suitable for Koala and Greater Glider. This effort was conducted mostly in the eastern alignment where there was potential for Greater Glider. This species is at the western limits of its range in the area. Koala scat searches were used in the more western alignments where the Greater Glider's absence negated the need for spotlighting.
- Information regarding the vegetation in which any individuals were identified is also detailed in Appendix B.



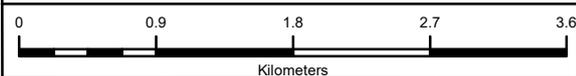
### Legend

- Pipeline
- Pipeline Buffer (500m)
- Regional Ecosystems**
- 11.3.25
- 11.3.27i
- 11.4.3
- 11.5.1
- 11.5.20
- 11.7.2
- 11.7.4
- 11.7.7
- 11.5.1 - Regrowth
- 11.3.25 - Regrowth
- 11.4.3 - Regrowth
- 11.5.1a - Regrowth
- 11.7.4 - Regrowth
- 11.7.7 - Regrowth
- Cleared Area

**Figure 3.1** Regional Ecosystems in the Miles survey area

Client

ARROW ENERGY



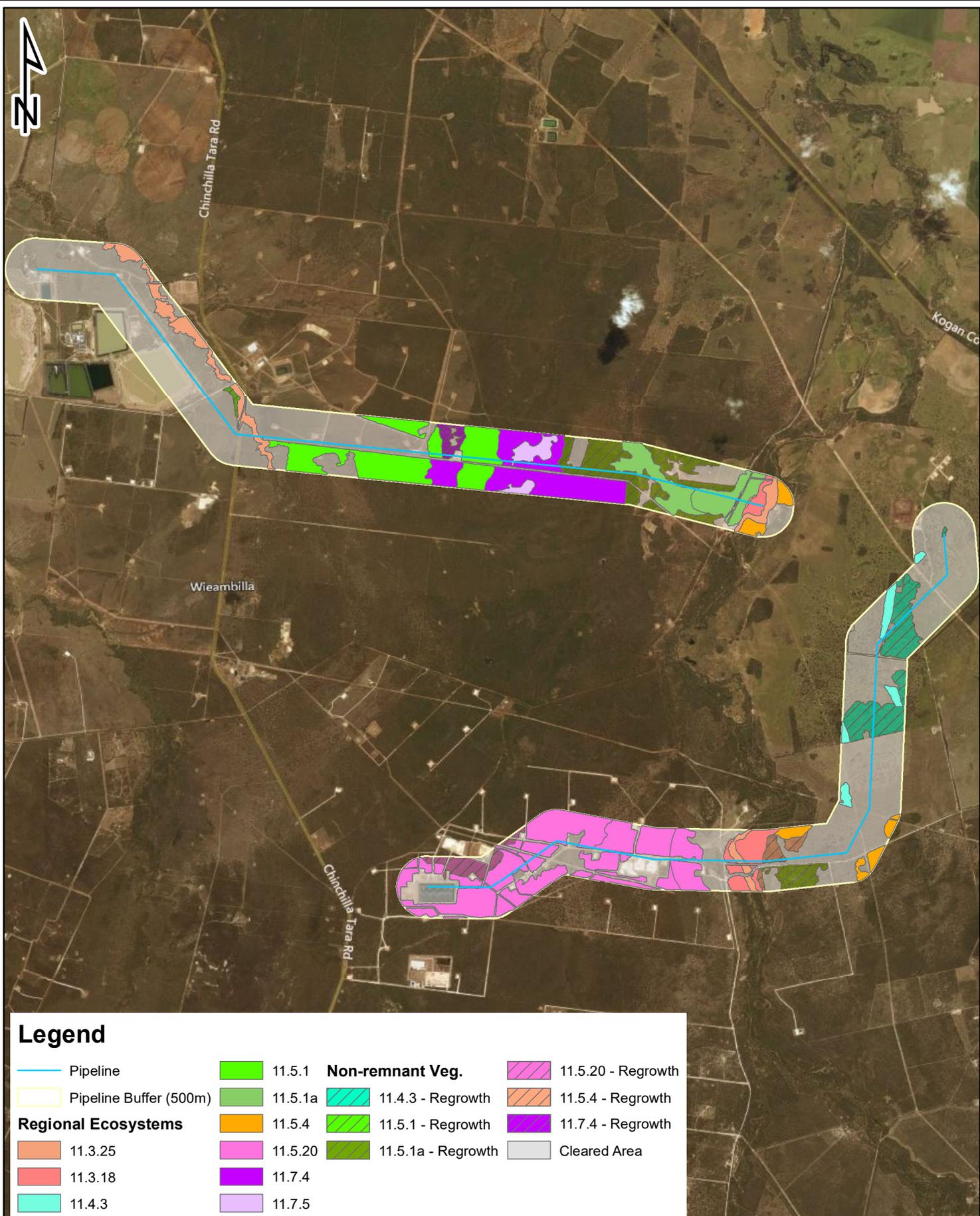
Scale 1:50,000 Drawn By DG Date 29-Jan-19 A4

### 3D Environmental

Vegetation Assessment & Mapping Specialists

P. O. Box 959  
Kenmore, Qld 4069  
Mobile: 0447 8227 119  
www.3denvironmental.com.au





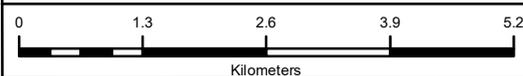
### Legend

Pipeline	11.5.1	<b>Non-remnant Veg.</b>	11.5.20 - Regrowth
Pipeline Buffer (500m)	11.5.1a	11.4.3 - Regrowth	11.5.4 - Regrowth
<b>Regional Ecosystems</b>	11.5.4	11.5.1 - Regrowth	11.7.4 - Regrowth
11.3.25	11.5.20	11.5.1a - Regrowth	Cleared Area
11.3.18	11.7.4		
11.4.3	11.7.5		

**Figure 3.2** Regional Ecosystems in the Wieambilla survey area.

Client

ARROW ENERGY



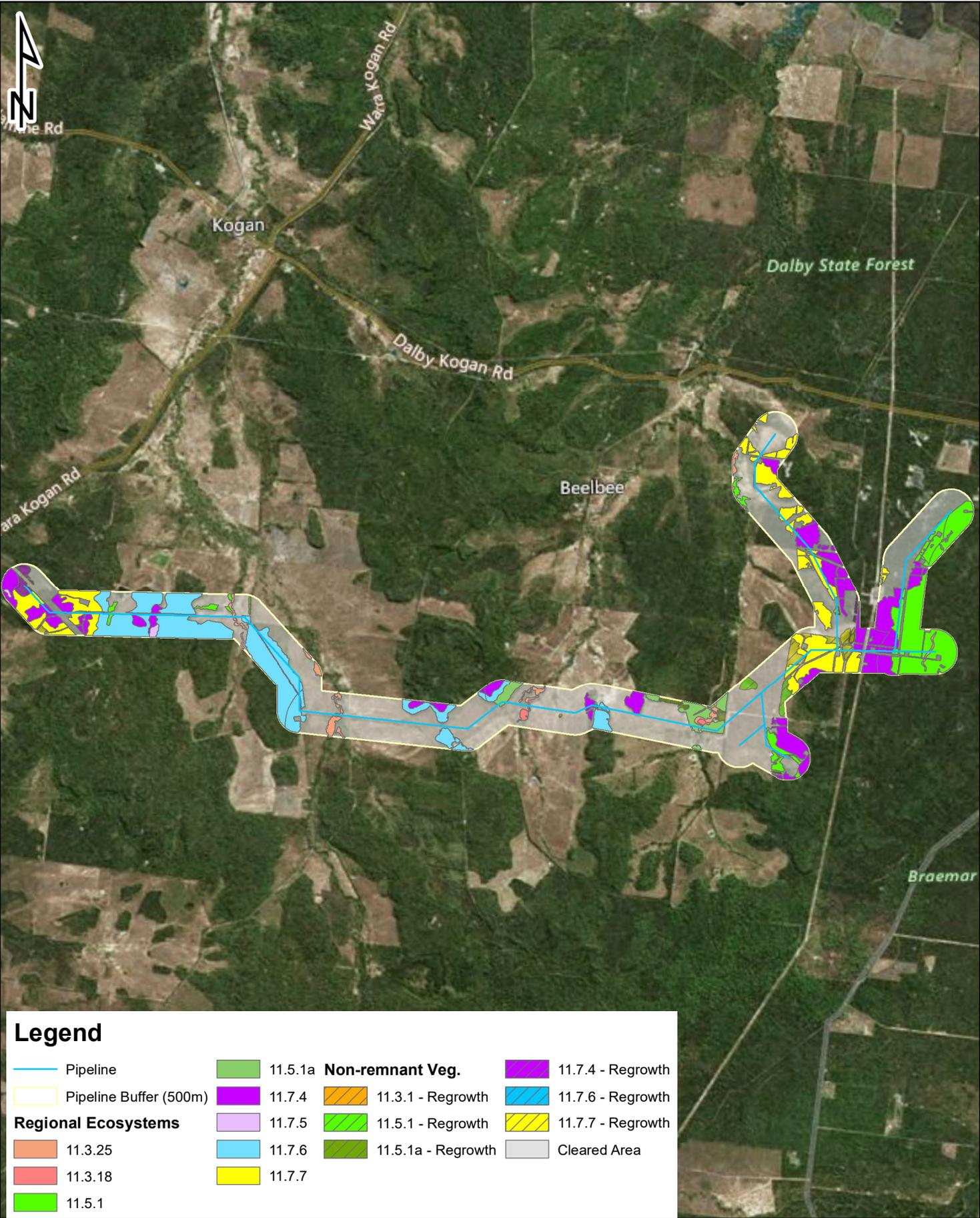
Scale 1:80,000 Drawn By DG Date 29-Jan-19 A4

### 3D Environmental

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**Legend**

- Pipeline
- Pipeline Buffer (500m)
- Regional Ecosystems**
- 11.3.25
- 11.3.18
- 11.5.1
- 11.5.1a **Non-remnant Veg.**
- 11.7.4
- 11.7.5
- 11.7.6
- 11.7.7
- 11.3.1 - Regrowth
- 11.5.1 - Regrowth
- 11.5.1a - Regrowth
- 11.7.4 - Regrowth
- 11.7.6 - Regrowth
- 11.7.7 - Regrowth
- Cleared Area

**Figure 3.3** Regional Ecosystems in the Kogan survey area

**Client**  
ARROW ENERGY

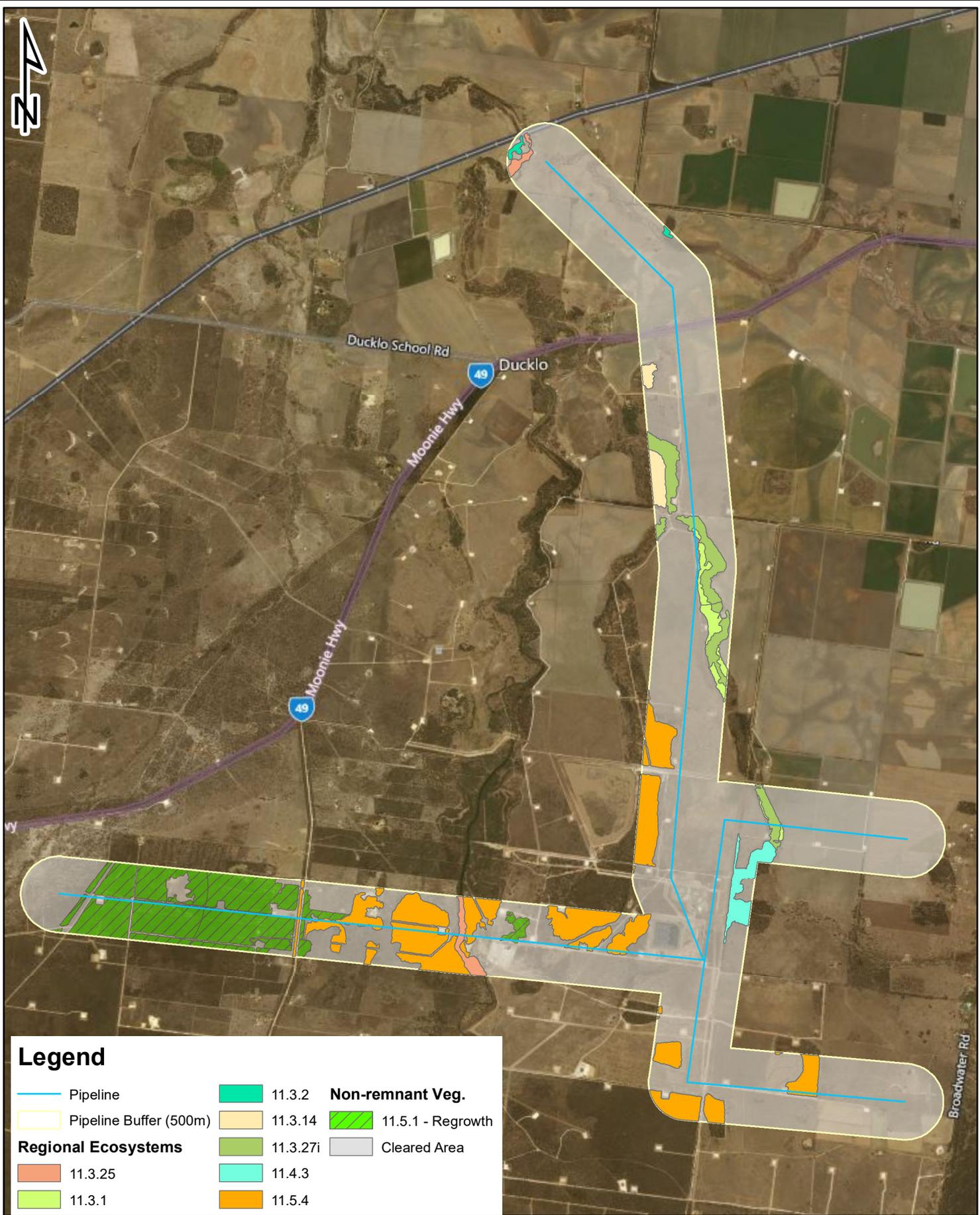
0 1.8 3.6 5.4 7.2  
Kilometers

Scale 1:113,000	Drawn By DG	Date 29-Jan-19	A4
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**3D Environmental**  
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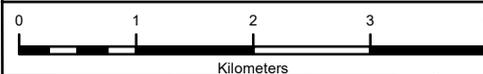


### Legend

- Pipeline
- Pipeline Buffer (500m)
- Regional Ecosystems**
- 11.3.25
- 11.3.1
- 11.3.2
- 11.3.14
- 11.3.27i
- 11.4.3
- 11.5.4
- 11.5.1 - Regrowth
- Cleared Area
- Non-remnant Veg.**

**Figure 3.4** Regional Ecosystems in the Braemar survey area

**Client**  
ARROW ENERGY



Scale 1:65,000 | Drawn By DG | Date 29-Jan-19 | A4

### 3D Environmental

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The surveys were undertaken in accordance with relevant departmental standards/guidelines for each MNES. It is also noted that the Department's guidelines state: *"These guidelines are not mandatory. Proposals that fail to meet these survey guidelines because of efficiency, cost or validity will not necessarily mean that referral is required (that is, that a significant impact is likely), especially where the proponent provides an evidence-based rationale for an alternative survey approach. Alternatives to a dedicated survey may also be appropriate. For example, a desktop analysis of historic data may indicate that a significant impact is not likely. Similarly, a regional habitat analysis may be used to determine the importance of a site to the listed species."*

### 3.3 Koala

#### **General Habitat Description**

The EPBC Act Referral Guidelines for the Vulnerable Koala (Commonwealth of Australia 2014) note that the Koala has one of the largest distributions of any terrestrial threatened species listed under the Act. It occupies a variety of vegetation types across this large distribution.

The EPBC Species Profiles and Threats (SPRAT) database notes that Koalas naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by *Eucalyptus* species (commonly known as gum trees). Koala habitat is broadly defined in the SPRAT database as any forest or woodland containing species that are known koala food trees, or shrubland with emergent food trees, this can include remnant and non-remnant vegetation in natural, agricultural, urban and peri-urban environments. Koala habitat is defined by the vegetation community present and the vegetation structure; the Koala does not have to be present for an area to be deemed habitat. The SPRAT database also notes that Koalas have been observed sitting in or eating up to 120 species of eucalypt, however within any given area they show a strong preference for one or only a few tree species and select individual trees. They are not restricted to eating *Eucalyptus* leaves but may also feed on the other gum tree genus' (*Corymbia* and *Angophora*), and box trees (*Lophostemon* spp.), tea trees (*Leptospermum* spp.) and paperbarks (*Melaleuca* spp.).

Based on information provided in the SPRAT database and associated EPBC Koala referral guidelines, there are no specific definitions for foraging, breeding or dispersal habitat for the Koala. As such, it is not possible to separate foraging, breeding and dispersal habitat requirements for this species.

With regards to Koala movement, the SPRAT database notes that while they may be capable of moving long distances (for example young males may occasionally travel several kilometres during the breeding season when they are dispersing to find a mate or being displaced by other breeding males), Koalas tend to move limited distances under most conditions, changing trees only a few times a night. They also spend a lot of time alone and devote limited time to social interactions. Home ranges vary in size from 1-2 hectares in optimum habitat, and up to 135 hectares in marginal habitat like semi-arid regions (Ellis et al. 2002; Martin and Handasyde 1999).

The breeding season occurs between October and May with females producing up to one offspring per year (Martin and Handasyde 1999). Juveniles become independent from one year of age with males living for over 12 years and females living for over 15 years (Martin and Handasyde 1999). Breeding occurs from two years of age, and is often determined by the establishment of a male hierarchy as males become vocal and fiercely fight for females (Martin and Handasyde 1999).

There is a growing body of evidence that identifies the importance of shelter (non-food) trees to Koalas. Crowther and colleagues (2013) expand on this and suggest that shelter trees are equally important as food trees and should be weighted as such when assessing habitat suitability. Shelter

trees play an essential role in thermoregulation and are likely to be selected based on height, canopy cover and elevation (trees occurring in gullies are preferable) (Crowther et al. 2013). The difficulty in regards to shelter trees is that, unlike food trees, there is no identified sub-set of forest and woodland trees known to be shelter trees. The use of a particular tree species, or individual trees within a species, is highly contextual and variable (Crowther et al. 2013).

### Project-Specific Habitat Description and Survey Outcomes

The study area has been highly modified, now supporting a major pastoral and agricultural area with much of the natural vegetation cleared or thinned (see Plates 3.1 to 3.4). Having said that, there are patches of native vegetation within the pipeline corridors, and given the broad habitat requirements of the Koala, there are large areas that provide opportunities for foraging, shelter and / or dispersal and have been mapped as known and potential habitat.

More than 70 Koala records are now known from the wider SGP area and a further 34 records were added during the field surveys in the off-tenure assessment areas (see Figure 3.5). All of these 34 records are based on scat evidence, with no sightings of live animals during the two field surveys undertaken for this assessment. This suggests that Koala population numbers in the study area are low.

Koalas are more frequently observed in the areas to the east of the wider SGP area, which is the on-tenure area of the SGP shown on Figure 3.5. In these areas they are also found to associate with both watercourse vegetation (i.e. riparian) and non-riparian habitats. In the study area the subject of this Preliminary Documentation assessment, Koalas are less commonly observed and become increasingly more restricted to riparian habitats (i.e. Land Zone 3). Plate 3.5 illustrates an area of good quality Koala habitat located on Land Zone 3.

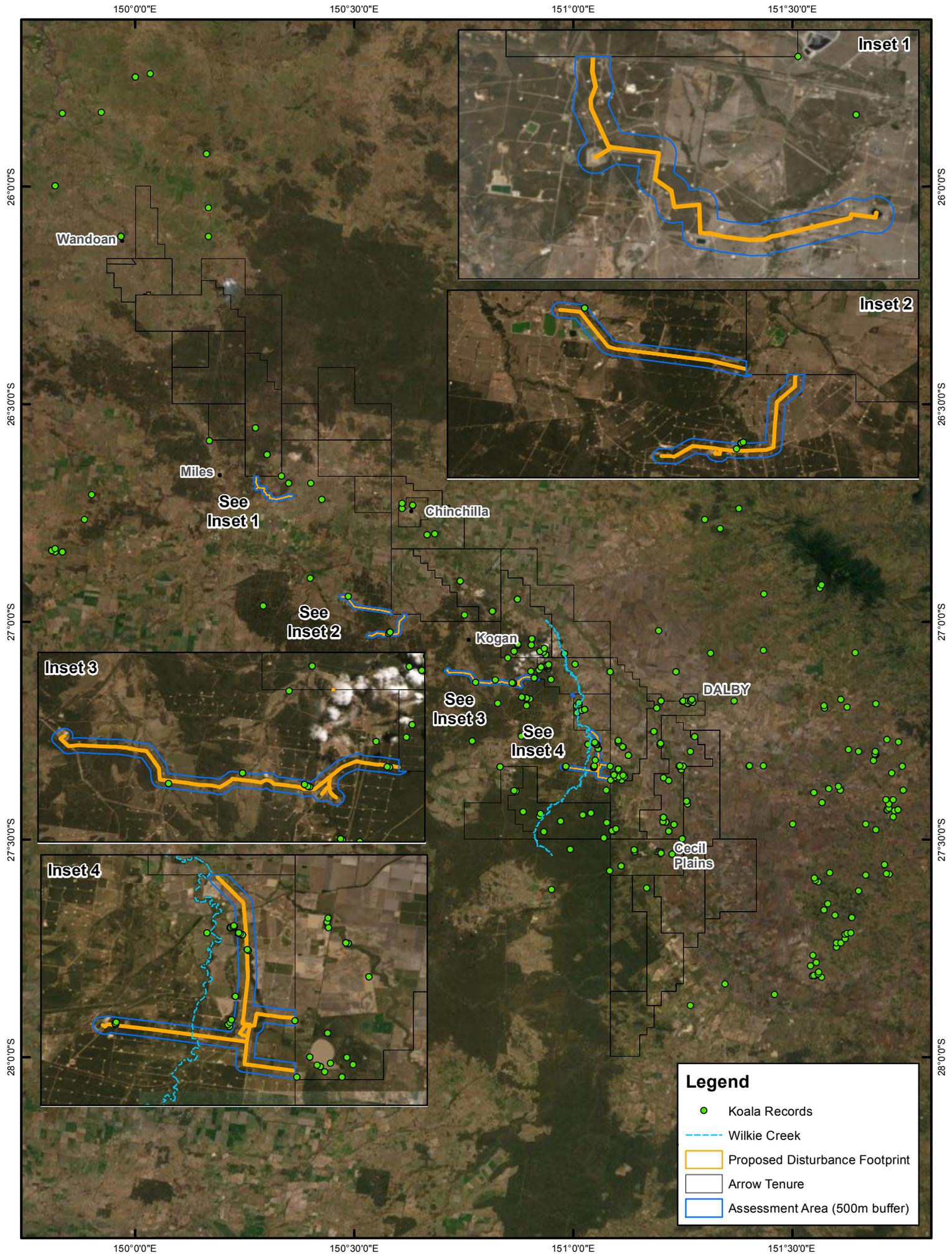
With regards to vegetation composition and structure, favoured feed tree species in the study area include River Red Gum (*E. camaldulensis*), Poplar Box (*E. populnea*) and Baradine gum (*E. chloroclada*). Table 3.1 shows the vegetation community types (REs) and the tree species that occur in the study area and are known or likely to provide foraging, shelter and dispersal habitat for the Koala. Table 3.1 also provides the density of eucalypt trees within the various vegetation types, an indication of the likely use of the area by the Koala and a score out of 10 representing the ability of the area to support Koalas on the basis of Koala food trees (see Appendix B for further details).



**Plate 3.1** Example of cleared / degraded



**Plate 3.2** Example of grazing paddock



**Legend**

- Koala Records
- - - Wilkie Creek
- Proposed Disturbance Footprint
- Arrow Tenure
- Assessment Area (500m buffer)

**Coordinate System: GCS GDA 1994**

Date: 28/06/2019



**Figure 3.5 Koala records**



Plate 3.3 Example of degraded woodland (RE11.5.4)



Plate 3.4 Example of roadside strip

Table 3.1 Habitat characteristics from vegetation types (REs) which contribute to Koala habitat in the study area

RE	Vegetation composition and structure	Eucalypt tree density/ha <sup>1</sup>	Likely habitat use	Quality and availability of food score
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	0 (1)	Foraging, shelter and dispersal	1
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	Not sampled	Foraging, shelter and dispersal	10
11.3.14	<i>Eucalyptus spp.</i> , <i>Angophora spp.</i> , <i>Callitris spp.</i> woodland on alluvial plains	100 (1)	Foraging, shelter and dispersal	5
11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	326.7 (3)	Foraging, shelter and dispersal	10
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	236.7 (6)	Foraging, shelter and dispersal	10
11.3.27i	<i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> woodland to open woodland with sedgeland ground layer	220 (4)	Foraging, shelter and dispersal	10
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	0 (3)	Foraging, shelter and dispersal	1
11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	143.3 (6)	Foraging, shelter and dispersal	10 (due to <i>E. populnea</i> )
11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	152 (5)	Foraging, shelter and dispersal	10 (due to <i>E. chloroclada</i> )

RE	Vegetation composition and structure	Eucalypt tree density/ha <sup>1</sup>	Likely habitat use	Quality and availability of food score
11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains	213.3 (3)	Foraging, shelter and dispersal	5
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust	210 (6)	Foraging, shelter and dispersal	5
11.7.6	<i>Corymbia citriodora</i> or <i>Eucalyptus crebra</i> woodland on Cainozoic lateritic duricrust	210 (2)	Foraging, shelter and dispersal	5

<sup>1</sup> the number of sampling locations within each RE is provided in parenthesis

### Mapping of Suitable Habitat

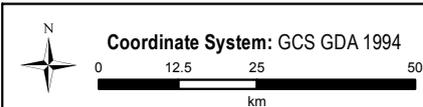
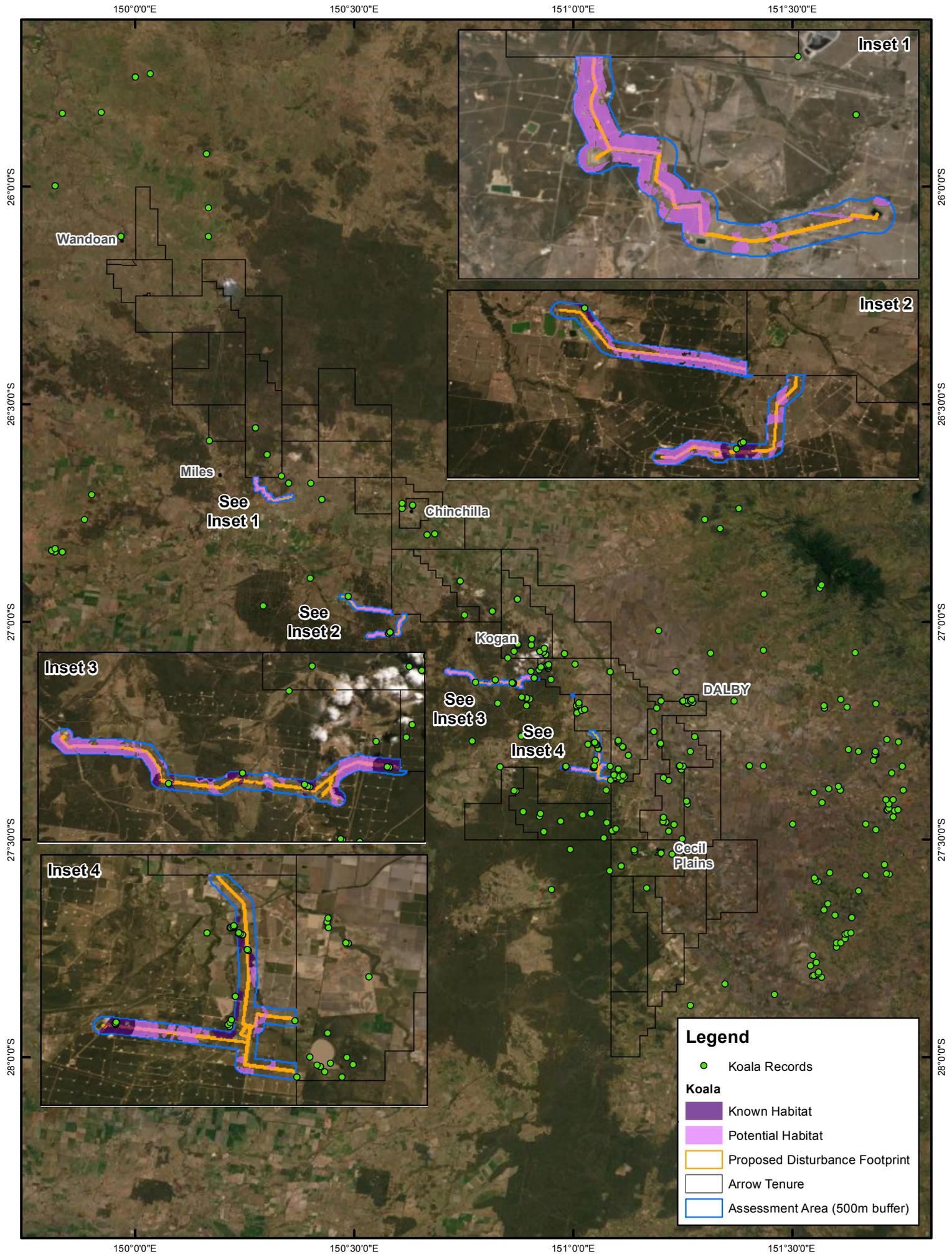
Figure 3.6 shows the mapping of Koala habitat within the study area. The mapping identifies areas categorised as:

- **Core habitat known:** being areas of the 12 vegetation types that are known or likely to support the Koala in terms of feed trees, shelter and/or dispersal in the study area that are within 1 km of an observation of Koala evidence (i.e. an observation of an individual Koala, scat or characteristic scratch mark on a smooth barked tree). The 12 vegetation types correlate to RE numbers 11.3.1, 11.3.2, 11.3.14, 11.3.18, 11.3.25, 11.3.27, 11.4.3, 11.5.1, 11.5.4, 11.5.20, 11.7.4 and 11.7.6.
- **Core habitat possible:** the mapping of this unit contains all areas of potential foraging, shelter and/or dispersal for the Koala because it includes all areas of the above mentioned 12 vegetation types (remnant, regrowth and disturbed) located within the study area.

Buffering known records by 1 km is consistent with Queensland Essential Habitat mapping. Core Habitat Known is not intended to reflect all possible habitation, but rather habitat surrounding a known occurrence. . We note that a 1 km radius equates to 314 ha and that this area covers several individual home ranges in the marginal habitat that is applicable to this project. All possible habitat is indicated by Core Habitat Possible and provides a very conservative mapping for the species because it covers all areas within the proposed pipeline corridors of potential foraging, shelter and/or dispersal habitat for the Koala.

It is noted that important habitat characteristics for the Koala are well understood and can be readily matched to regional ecosystem descriptions. On this basis the mapping provided in Figure 3.6 is considered to have a high accuracy.

Within the 8,760 ha of the study area (i.e. 500 m buffer on either side of the pipeline centrelines), a total of 4,985 ha has been mapped as potential habitat for the Koala (being 1,342 ha mapped as core habitat known and 3,643 ha mapped as core habitat possible) (see Figure 3.6). Section 4.2 of this report discusses the potential impacts on the Koala as a result of the construction and operation of the proposed pipeline projects.



Date: 28/06/2019



Figure 3.6 Koala habitat and impact areas

Uncontrolled (B)



**Plate 3.5** Example of good quality Koala habitat within the study area (RE 11.3.27i)

## 3.4 Dunmall's Snake

### General Habitat Description

The EPBC Conservation Advice (DotEE 2014) for Dunmall's Snake habitat is open forest, particularly Brigalow (*Acacia harpophylla*) forest and woodland growing on floodplains of deep-cracking black clay and clay loam soils (Covacevich et al., 1988, Cogger et al., 1993). More specifically, the distribution of this species noted in the Advice is 'Brigalow (*Acacia harpophylla* dominant and co-dominant) EPBC Act-listed threatened ecological community'.

The EPBC SPRAT database broadens the habitat description for Dunmall's Snake by noting that it has been found in a range of habitats, including:

- Forests and woodlands on black alluvial cracking clay and clay loams dominated by Brigalow (*Acacia harpophylla*), other Wattles (*A. burowii*, *A. deanii*, *A. leioclyx*), native Cypress (*Callitris* spp.) or Bull-oak (*Allocasuarina luehmannii*) (Brigalow Belt Reptiles Workshop 2010; Covacevich et al. 1988; Stephenson and Schmida 2008).
- Various Blue Spotted Gum (*Corymbia citriodora*), Ironbark (*Eucalyptus crebra* and *E. melanophloia*), White Cypress Pine (*Callitris glaucophylla*) and Bulloak (*Allocasuarina luehmannii*) open forest and woodland associations on sandstone derived soils (Brigalow Belt Reptiles Workshop 2010; Stephenson and Schmida 2008, Threatened Species Network 2008).
- Also, one specimen was found on the edge of dry vine scrub near Tarong Power Station, Queensland, whilst another was found in hard ironstone country (Queensland Regional Ecosystem Land Zone 7) at Lake Broadwater near Dalby, Queensland.

Dunmall's Snake is confined to the Brigalow Belt bioregion of south-eastern Queensland and north-eastern New South Wales. Captive specimens indicate that it is a nocturnal species, sheltering under

fallen timber and in deep soil cracks and other cavities. Its diet consists of small skinks and geckos (DERM 2010).

### Project-Specific Habitat Description and Survey Outcomes

This species has not been found in the SGP area for over 18 years despite thousands of hours of search effort (see below). Records of the species from the wider SGP area are as follows:

- A record from the year 2000, approximately 5.5 km north of the proposed Kenya treated water pipeline
- A record from 1978, approximately 8.5 km west of the Girrahween export pipelines
- Six records, four dated as 1770 and one each from 1984 and 1993, from Lake Broadwater, approximately 2.5 km east of the Harry and Lynwood pipelines. It is noted that the four 1770 records are likely to be duplicates captured in multiple databases. There is some location ambiguity surrounding all six records.

The off-tenure pipeline surveys (EcoSmart Ecology and 3D Environmental, 2018 and 2019) were in accordance with the EPBC Act draft referral guidelines for the nationally listed Brigalow Belt reptiles (2011). These guidelines mention suitable techniques as 'transects' (which are comparable to the habitat area searches described above), spotlighting, road driving, and pitfall/funnel trapping. Spotlighting and area habitat searches were undertaken during the surveys. Habitat searches were undertaken throughout the day, from morning to afternoon. Spotlighting was conducted at night, starting at least 30 mins after dusk. The guidelines suggest spotlighting a min of 1.5hrs/ha over 3 nights targeting large habitat patches, water-inundated gilgais, wetlands, riparian habitats and the surrounding environment (e.g. roads) and large logs.

During this specific survey (EcoSmart Ecology and 3D Environmental, 2019; see below for others in the area), 18 person hours of spotlighting was conducted over two nights, targeting the most likely habitats within the total 7,396 ha of potential habitat along the off-tenure pipeline study area. Published survey guidelines are designed for small-property assessments (typically < 50 – 500 ha) and are not practical for broad area assessments such as the Surat Gas Project (e.g. achieving > 3 million trap nights for Spotted-tailed Quoll is unrealistic). While the current surveys do not strictly achieve the suggested survey effort, the surveys comply with the intent of these guidelines by stratifying the vegetation in to Broad Vegetation Groups, identifying core habitats for each species, and undertaking targeted surveys using suitable methods during suitable conditions. This approach maximised the chance of detection.

Habitat area searches, spotlighting, road driving, and pitfall/funnel trapping were also conducted on-tenure for the broader SGP seasonal terrestrial flora and fauna surveys (see Appendix B of the 'Surat Gas Project Terrestrial Ecology Report' (EcoSmart Ecology and 3D Environmental, 2017) for total survey effort) and many other studies in the area. For example, there have been several detailed studies undertaken in the SGP area totalling thousands of hours of search effort. Many of these major studies have been commissioned by Arrow, such as: the Surat Gas Project Environmental Impact Statement (3D Environmental and Ecosmart Ecology, 2011); the Supplementary Report to the Surat Gas Project Environmental Impact Statement (3D Environmental and Ecosmart Ecology, 2013); Detailed fauna assessments of the Surat to Gladstone gathering line infrastructure by AECOM (2012) and Ecosure (2013a-d); Daandine Projects EPBC Terrestrial Flora and Fauna Surveys (Ecosmart Ecology, 2014a & b); SGP seasonal terrestrial flora and fauna surveys (EcoSmart Ecology and 3D Environmental, 2017), and the Threatened Reptile Research Project (Worley Parsons 2014).

Arrow has also commissioned several other detailed surveys specifically targeting Dunmall's Snake in areas of possible habitat for smaller projects which went well over the survey effort suggested in EPBC Act surveys guidelines (i.e. at Daandine (EcoSmart Ecology, November 2018) and Tipton

(EcoSmart Ecology, March 2019)). Despite this enormous effort over many years and capturing similar species, like Red-naped Snake (*Furina diadema*) of the same Genus and Dwyer's Snake (*Parasuta dwyeri*), Dunmall's Snake has not been detected.

One of the most important studies Arrow has commissioned in regard to understanding Dunmall's Snake occurrence in the SGP area was completed by the late Dr Simon Hudson (a world renowned herpetologist) who led a threatened reptile research project in the Surat Basin (Worley Parsons 2014) across 24 sites ranging from Downfall in the north to Lynwood in the south, four of which were located in close proximity to the project area. The total survey effort was:

- Artificial refuge monitoring: 180 hours.
- Diurnal active searches: 123 hours.
- Nocturnal passive searches: 41 hours.
- Vehicle transects: 30 hours (150 km).

Given the genuine scarcity and therefore lack of scientific understanding for this species, Arrow has taken a conservative approach in identifying habitat for this species and included all Regional Ecosystems (REs) that correlate with the broader SPRAT database habitat descriptions (which includes all Brigalow and non-Brigalow related REs that occur in the project area). Table 3.2 lists these REs and discusses the habitat features and resource availability for each vegetation community.

Table 3.2 Habitat characteristics from REs which contribute to Dunmall's Snake habitat

Regional Ecosystem (RE)	Vegetation composition and structure	Available microhabitat features (shelter resources)	Foraging resource availability	Possible habitat use	Habitat Quality Score
11.3.1 (including advanced regrowth)	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	Deep cracking dark clays, gilgai, fallen small logs and debris (including bark strips)	Abundant small ground-dwelling lizards, limited ground-dwelling geckos	Foraging, shelter and dispersal	3.12
11.3.14	<i>Eucalyptus spp.</i> , <i>Angophora spp.</i> , <i>Callitris spp.</i> woodland on alluvial plains	Some soil cracks and fallen debris surrounded by thick grass	Low to moderate abundance of small ground-dwelling reptiles	Foraging, shelter and dispersal	3.55
11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	Limited soil cracks, some larger fallen timber	Low abundance of ground-dwelling reptiles	Foraging, shelter and dispersal	3.69
11.4.3 (including advanced regrowth)	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	Deep cracking dark clays, gilgai, abundant fallen logs and debris (including bark strips); larger logs and log piles absent or rare	Abundant small ground-dwelling lizards, limited ground-dwelling geckos	Foraging, shelter and dispersal	2.99
11.5.1 (including advanced regrowth)	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	Moderate to abundant fallen timber and debris; limited or no larger log piles	Moderately abundant ground-dwelling skinks and geckos	Foraging, shelter and dispersal	3.40
11.5.4 (including advanced regrowth)	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	Moderate to abundant fallen timber and debris; limited or no larger log piles	Moderately abundant ground-dwelling skinks and geckos	Foraging, shelter and dispersal	3.62
11.5.20 (including advanced regrowth)	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains	Low to moderate fallen debris, limited soil cracks	Moderate to abundant ground-dwelling reptiles	Foraging, shelter and dispersal	4.60
11.7.2	<i>Acacia spp.</i> woodland on Cainozoic lateritic duricrust. Scarp retreat zone	Low, generally no fallen debris, but thick shrub cover	Moderate, some ground-dwelling reptiles likely	Foraging, shelter and dispersal	4.25
11.7.4 (including advanced regrowth)	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus spp.</i> , <i>Corymbia spp.</i> , <i>Acacia spp.</i> , <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust	Moderate to abundant fallen debris; open low native grasses and low small shrubs; some locations with scattered grasstrees ( <i>Xanthorrhoea</i> ) and deep leaf litter; some larger, but isolated, larger logs	High ground-dwelling reptile abundant	Foraging, shelter and dispersal	4.50

Regional Ecosystem (RE)	Vegetation composition and structure	Available microhabitat features (shelter resources)	Foraging resource availability	Possible habitat use	Habitat Quality Score
11.7.6 (including advanced regrowth)	<i>Corymbia citriodora</i> or <i>Eucalyptus crebra</i> woodland on Cainozoic lateritic duricrust	Abundant fallen debris including larger logs and some timber dumps; some steeper slopes with medium-sized surface rocks (rarely forming piles); rarely rocky ledges; open low native grasses and areas with deeper leaf litter	Ground-dwelling reptiles likely to be abundant	Foraging, shelter and dispersal	3.62
11.7.7 (including advanced regrowth)	<i>Eucalyptus fibrosa subsp. nubilis</i> +/- <i>Corymbia spp.</i> +/- <i>Eucalyptus spp.</i> woodland on Cainozoic lateritic duricrust	High to very high density of fallen timber/debris, including larger log piles and timber dumps; open low native grasses and low shrubs	Ground-dwelling reptiles likely to be abundant	Foraging, shelter and dispersal	4.28

### Mapping of Suitable Habitat

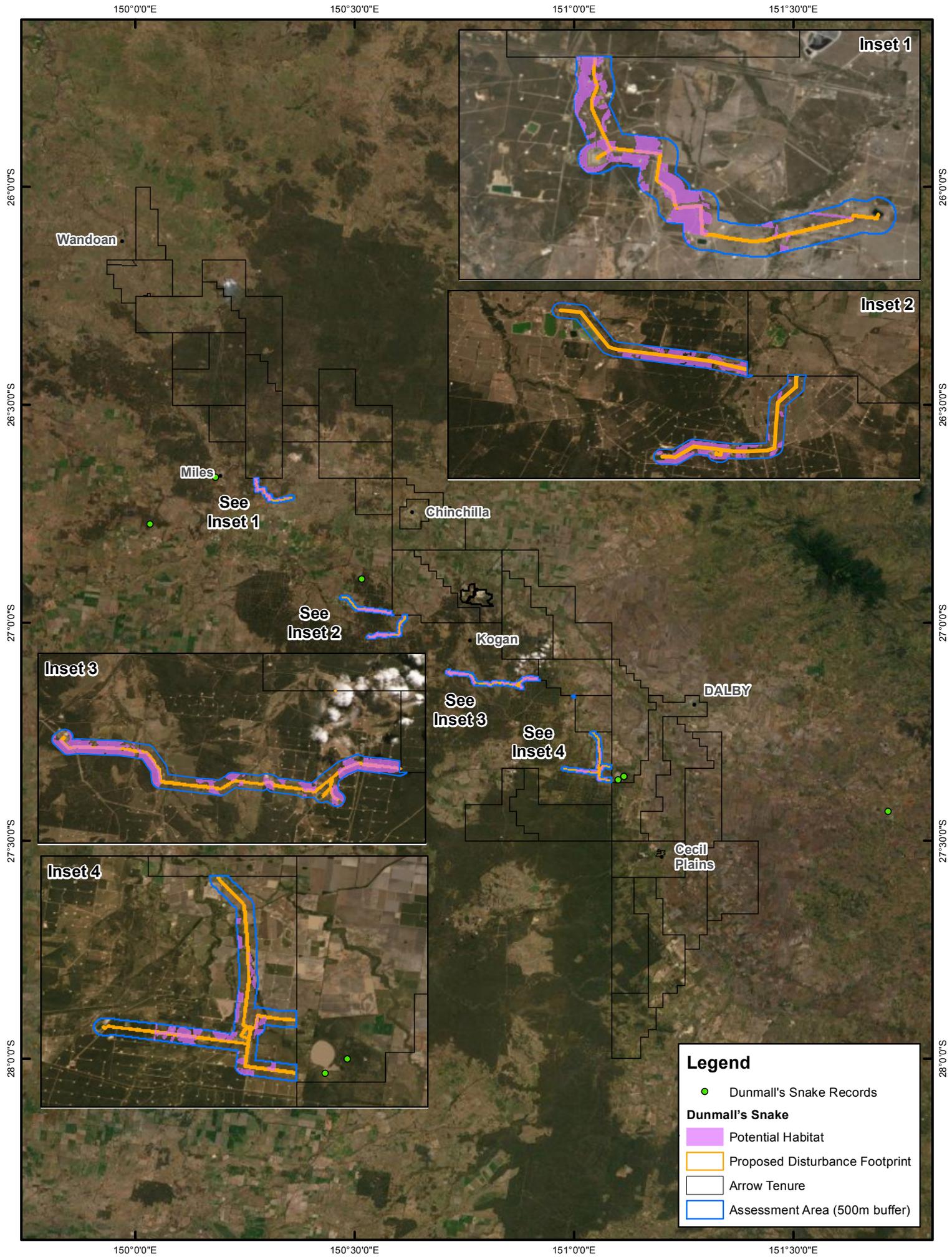
Figure 3.7 shows the mapping of Dunmall's Snake habitat within the study area. The mapping identifies areas categorised as:

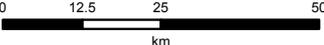
- **Core habitat known:** no areas have been mapped under this category within the study area because there are no previous records from the study area and no observations during the two field surveys conducted as part of this assessment.
- **Core habitat possible:** all areas of the above mentioned 11 vegetation types (remnant, regrowth and disturbed) located within the study area have been mapped as core habitat possible. As noted above, this is extremely conservative given that no individuals have been recorded in the wider SGP area for the last 18 years despite thousands of hours of search effort.

Within the 8,760 ha of the study area (i.e. 500 m buffer on either side of the pipeline centrelines), a total of 7,396 ha has been mapped as potential habitat for the Dunmall's Snake (all mapped as core habitat possible) (see Figure 3.7). If we were to take a less conservative approach by just including the Brigalow communities as per the EPBC Conservation Advice habitat description for this species, then the total area of suitable habitat would reduce from 7,396 ha to 175 ha. Plate 3.6 provides an example of the habitat identified within the study area as suitable for Dunmall's Snake. However, we have taken the more conservative approach to estimating potential habitat for this species and large areas of habitat are mapped as 'core habitat possible', most of which is not Brigalow.

To provide further context to the suitability of habitat in the study area for this species, four sites were surveyed within the Brigalow REs and the habitat quality score for the Dunmall's Snake at these sites was 3.12, 3.57, 2.98 and 2.43 (out of a possible score of 10). This suggests that the project area does not provide habitat critical to the survival of the species.

Section 4.3 of this report discusses the potential impacts on the Dunmall's Snake as a result of the construction and operation of the proposed pipeline projects.




**Coordinate System: GCS GDA 1994**  



**Figure 3.7: Dunmall's Snake habitat and impact areas**  
 Date: 23/07/2019



**Plate 3.6** Example of Dunmall's Snake habitat within the study area (RE 11.7.4)

## 3.5 Greater Glider

### General Habitat Description

The EPBC SPRAT database does not include a habitat description for the Greater Glider but refers the reader to the EPBC Conservation Advice. The Advice notes that the Greater Glider is an arboreal (tree-dwelling) nocturnal marsupial, largely restricted to eucalypt forests and woodlands where it feeds mainly on eucalypt leaves and occasionally flowers. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees (>50 cm diameter at breast height) and abundant hollows (Andrews et al., 1994; Smith et al., 1994, 1995; Kavanagh 2000; Eyre 2004; van der Ree et al., 2004; Vanderduys et al., 2012). During the day it shelters in tree hollows, with a particular selection for large hollows in large, old trees (Henry 1984; Kehl and Borsboom 1984; Lindenmayer et al., 1991; Smith et al., 2007; Goldingay 2012).

The Advice also notes that in southern Queensland, Greater Gliders require at least 2–4 live den trees for every 2 ha of suitable forest habitat (Eyre 2002) and that home ranges are typically small (1–4 ha: Henry 1984; Kehl and Borsboom 1984; Comport et al., 1996; Gibbons and Lindenmayer 2002; Pope et al., 2005), but are larger in lower productivity forests and more open woodlands (up to 16 ha: Eyre 2004; Smith et al., 2007).

Based on the information provided in the Advice, there are no specific definitions for foraging, breeding and dispersal habitat for the Greater Glider. However, it is likely that foraging, breeding and dispersal habitats share the same characteristics, particularly as the Greater Glider requires large hollows to shelter in during the day, limiting the distance it can travel away from habitats that provide these hollows. Smith and colleagues (2007) noted that den tree species included the same species used for foraging. Individuals of the species tend to use a small number of 'primary dens' but will use as many hollows as they have available to them. Additionally, they appear to use hollows opportunistically, indicating that minor reductions in hollow-bearing trees may not impact on localised populations.

## Project-Specific Habitat Description and Survey Outcomes

While the SGP and the associated areas assessed for this work overlap entirely with the distribution of the Greater Glider, they are located at the species western extremity. West of Toowoomba the species becomes increasingly patchy, often apparently absent from otherwise seemingly suitable habitat. There are 11 records of this species from the wider SGP area, but none from the study area the subject of this assessment.

In areas west of the Great Dividing Range, they are found in low woodlands (McKay 2008) but being reliant on large tree hollows they are typically restricted to riparian vegetation associated with creek lines. Table 3.3 provides an overview of the habitat characteristics in each RE assessed as Greater Glider potential habitat.

The current survey effort for Greater Glider associated with the off-tenure pipelines is described in Section 2.3.2 of Appendix B. Apart from habitat area searches (300 person hours), 18 person hours of spotlighting was conducted. This was predominantly in the eastern alignment because alignments further west are largely outside of this species' distribution. While hollow density was not estimated for every patch of vegetation surveyed, nor were hollows inspected, the density of large hollows in areas mapped as core habitat possible for Greater Glider was at least 2-4 large hollows per 2 ha as noted in the SPRAT profile, "*in southern Queensland, greater gliders require at least 2-4 live den trees for every 2 ha of suitable forest habitat (Eyre 2002)*".

**Table 3.3 Habitat characteristics from REs which contribute to Greater Glider habitat**

RE	Vegetation composition and Structure	Hollow Availability	Possible habitat use	Habitat quality score <sup>1</sup>
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	Variable, some areas have numerous very large, old trees with moderate hollow density, other areas have low hollow density	Foraging, shelter and dispersal	4.1
11.3.27i	<i>Eucalyptus camaldulensis</i> or <i>E. tereticornis</i> woodland to open woodland with sedgeland ground layer			3.6

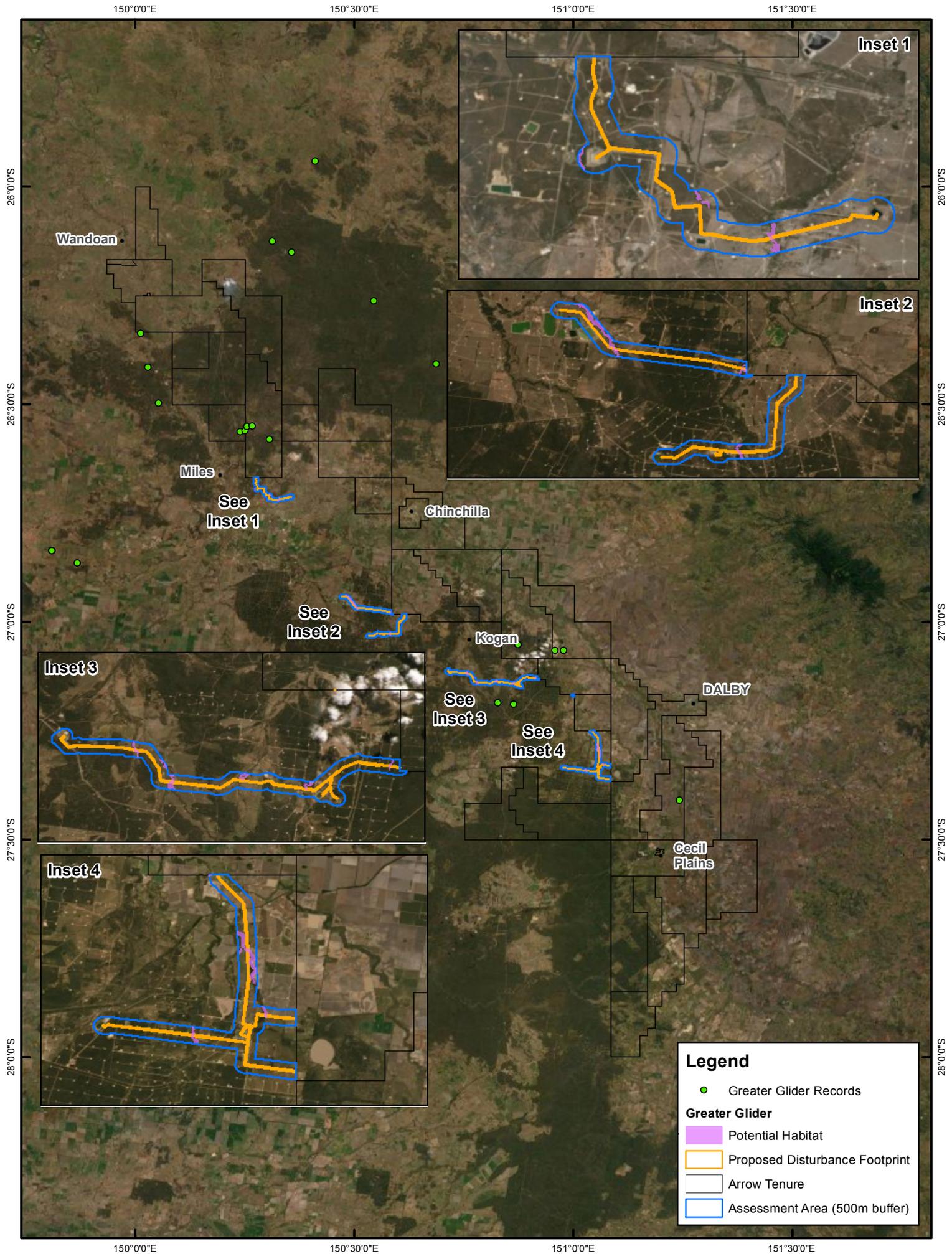
<sup>1</sup> – average score of assessed sites, being 6 sites in RE 11.3.25 and 4 sites in 11.3.27i

### Mapping of Suitable Habitat

Figure 3.8 shows the mapping of Greater Glider habitat within the study area. The mapping identifies areas categorised as:

- **Core habitat known:** no areas have been mapped under this category within the study area because there are no previous records from the study area and no observations during the two field surveys conducted as part of this assessment.
- **Core habitat possible:** all areas of the two above mentioned vegetation types (including remnant, regrowth and disturbed) located within the study area have been mapped as core habitat possible. These two REs represent the communities within the study area that reflect the habitat description provided by the EPBC Conservation Advice noted above. Plate 3.7 provides an example of the habitat identified within the study area as suitable for the Greater Glider.

Within the 8,760 ha of the study area (i.e. 500 m buffer on either side of the pipeline centrelines), a total of 285 ha has been mapped as potential habitat for the Greater Glider (all mapped as core habitat possible) (see Figure 3.8).




**Coordinate System: GCS GDA 1994**  




**Figure 3.8 Greater Glider habitat and impact areas**

**Uncontrolled (B)**

Section 4.4 of this report discusses the potential impacts on the Greater Glider as a result of the construction and operation of the proposed pipeline projects.



**Plate 3.7** Example of Greater Glider habitat within the study area (RE 11.3.25)

## 3.6 Squatter Pigeon

### General Habitat Description

The EPBC SPRAT database notes that Squatter Pigeon foraging and breeding habitat is generally defined as open-forests to sparse, open-woodlands and scrub that are mostly dominated in the overstorey by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* species; remnant, regrowth or partly modified vegetation communities; and within 3 km of waterbodies or watercourses (for foraging habitat) and within 1 km of a suitable permanent or seasonal waterbody (for breeding habitat) (Baldwin 1975; Beruldsen 1972; Cooper et al. 2014; EPA 2006; Frith 1982; Leach 1988; North 1913-14; Squatter Pigeon Workshop 2011). The preferred ground-layer vegetation conditions (patchy, native, perennial tussock grasses, or a mix of perennial tussock grasses and low shrubs or forbs that does not cover more than 33% of the ground) tend to occur on well-draining, sandy or gravelly soils low, gently sloping, flat to undulating plains and foothills, lateritic (duplex) soils on low 'jump-ups' and escarpments. These habitat conditions correlate with the RE Land Zones 3, 4, 5, 7 and 10. Dispersal habitat is described as any forest or woodland occurring between patches of foraging or breeding habitat that facilitates movement between patches of foraging habitat, breeding habitat and/or waterbodies. Dispersal habitat also includes vegetation where the groundcover layer has been thinned through current land use practices in a way that suits the species (e.g. light cattle grazing). The species does disperse into highly modified or degraded habitats, including cleared areas that are within 100 m of remnant trees or patches of habitat.

### Project-Specific Habitat Description and Survey Outcomes

The off-tenure areas occur entirely within the distribution of the Squatter Pigeon. However, Squatter Pigeons have been recorded on only six occasions within 20 km of the SGP tenements and/or off-tenure areas since 2010. The nearest record of the Squatter Pigeon is 7 km to the north of the northern most pipeline alignment, the Girrahween export pipeline (see Figure 3.9). There are no permanent watercourses within the pipelines easements and only one mapped watercourse with

150°0'0"E

150°30'0"E

151°0'0"E

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Cecil Plains

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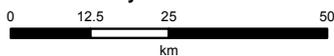
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**Legend**

- Squatter Pigeon Records
- Condamine River
- Proposed Disturbance Footprint
- Arrow Tenure
- Assessment Area (500m buffer)
- Lake Broadwater



Coordinate System: GCS GDA 1994



Date: 28/06/2019



**Figure 3.9 Squatter Pigeon records**

riparian vegetation to be traversed by the northern Girrahween export pipeline (see Figure 3.9 and the riparian vegetation mapped as RE 11.3.25; *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines). This is a particularly important point given that foraging and breeding habitat is described in the EPBC SPRAT database as being within 3 km and 1 km respectively of a waterbody.

On average the species is recorded less than once a year in the wider SGP area, despite being a relatively easy species to observe and locate. There are no repeat records from the same location or general area, not even at Lake Broadwater which would probably be the best Squatter Pigeon habitat within the eastern Condamine Catchment because it is the only natural semi-permanent water body in the area (see Figure 3.9). The three Squatter Pigeons recorded from this greater area since 2010 are suspected transient individuals and no resident or breeding populations are known to occur. No individuals have been observed within the study area the subject of this application, which is not surprising given the absence of suitable waterbodies and thus lack of preferred foraging and breeding habitat.

The off-tenure pipeline surveys (EcoSmart Ecology and 3D Environmental, 2018 and 2019) were in accordance with the Guidelines for detecting birds listed as threatened under the EPBC Act (2010). Random meander visual searches were conducted throughout the survey area totalling a conservative estimate of 300 person hours. This includes area searches at 40 locations (40 person hours). This survey technique is consistent with the survey guidelines for this species.

The recommended survey effort (15hrs/50ha) is not practical over large areas. This is noted within the guidelines, “*a linear increase in sample number with area will become impractical at very large study areas*”. Other surveys and factors attributing to the conclusion on squatter pigeon include:

- The SGP area and associated pipelines have been the subject of many environmental studies since 2010. These have included extensive bird surveys, frequent traverses and many thousands of hours.
- Much of the SGP area is accessible with many public access roads. Squatter Pigeons are relatively easy to observe and many naturalists will have visited or travelled through the area and noted their findings on Wildnet and other databases.
- Pre-clearing surveys have been extensively conducted by Arrow ecologists throughout their operational areas on the SGP. These surveys, which will have accumulated additional thousands of hours and have been conducted by staff trained in Squatter Pigeon identification.
- Despite this intensive effort, Squatter Pigeon have only been recorded six times since 2010 within 20km of the SGP area and only three times within the SGP area.

This constitutes considerable evidence that the species is infrequent, even scarce, within the SGP and surrounds. It is highly unlikely that birds are resident, otherwise there would be more records and more frequent reports. At best, habitats within the area may be used for ‘dispersal’. However, in recognition that some areas ‘could’ hold more value should the species be resident (which it is not), these have been mapped as ‘core habitat possible’ – i.e. open woodlands along creek lines (REs 11.3.2, 11.3.25 and 11.3.27).

### Mapping of Suitable Habitat

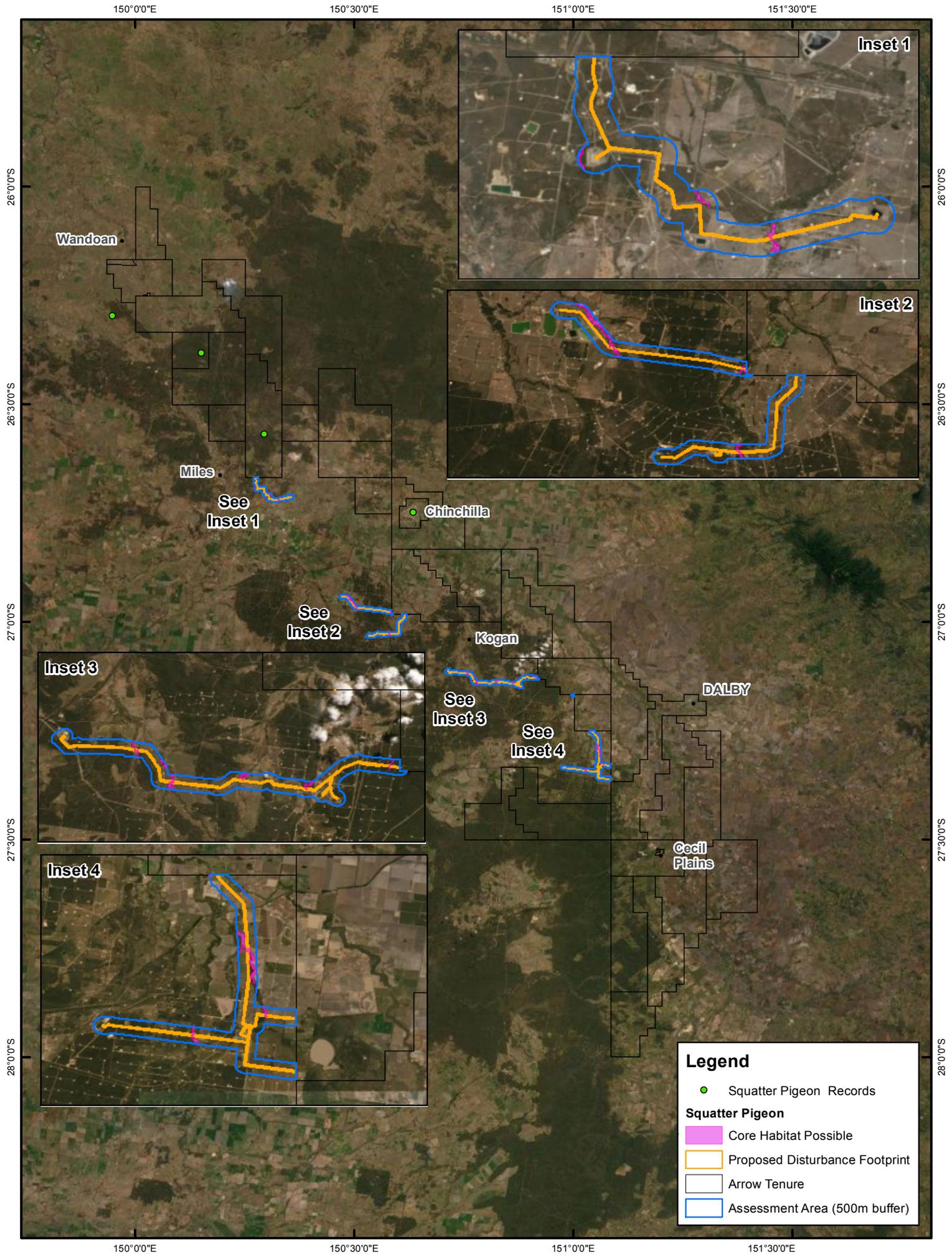
Based on the lack of frequent or repeated representation within or near to Arrow tenements, or any evidence of resident/seasonal populations within the region, and the lack of foraging and breeding habitat in the area, previous assessments have considered Squatter Pigeons to be a 'transient' species and no detailed habitat mapping has been undertaken.

To comply with DotEE requirements to include habitat mapping for this species, new rules have been developed for this assessment. However it is noted that the mapped habitats are unlikely to represent areas inhabited by a population that is important for the species' survival (in that the mapped areas do not provide preferred foraging, breeding or dispersal habitat as per the EPBC SPRAT database descriptions). Rather, they likely represent habitats that might be used if the species was to undergo expansion.

Within the 8,760 ha of the study area (i.e. 500 m buffer on either side of the pipeline centrelines), a total of 269 ha has been mapped as potential expansion/dispersal habitat for the Squatter Pigeon (see Figure 3.10). This mapping includes small areas of REs 11.3.2, 11.3.25 and 11.3.27i. Plate 3.8 provides an example of habitat within RE 11.3.25 considered suitable for the Squatter Pigeon. Habitat assessments were undertaken in two of these vegetation types and they returned habitat scores out of ten for the Squatter Pigeon averaging 4.2 (from six sites in RE 11.3.25) and 3.6 (from four sites in RE 11.3.27i)(see Appendix B for details).



**Plate 3.8** Example of potential Squatter Pigeon habitat within the study area (RE 11.3.25)



**Legend**

- Squatter Pigeon Records
- Core Habitat Possible
- Proposed Disturbance Footprint
- Arrow Tenure
- Assessment Area (500m buffer)

Coordinate System: GCS GDA 1994

Date: 28/06/2019



Figure 3.10 Squatter Pigeon records

## 3.7 Murray Cod

### General Habitat Description

The EPBC SPRAT database notes that the Murray Cod utilises a diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW (including the ACT), to slow-flowing, turbid lowland rivers and billabongs (McDowall 1996). Murray Cod are frequently found in the main channels of rivers and larger tributaries. The species is, therefore, considered a main-channel specialist. Murray Cod tend to occur in floodplain channels and anabranches when they are inundated (Koehn 1997, 2006; Koehn and Harrington 2005 cited in National Murray Cod Recovery Team 2010), but the species' use of these floodplain habitats appears limited (Koehn and Harrington 2006; Koehn and Harrington 2005; King and Koehn n.d. cited in National Murray Cod Recovery Team 2010).

The SPRAT database also notes that preferred microhabitat consists of complex structural features in streams such as large rocks, snags (pieces of large submerged woody debris), overhanging stream banks and vegetation, tree stumps, logs, branches and other woody structures. Such structures reduce or influence stream flows and provide Murray Cod with shelter from fast-flowing water (Koehn 2009). They also serve as predatory ambush points for foraging, particularly during the day (Schultz 2006).

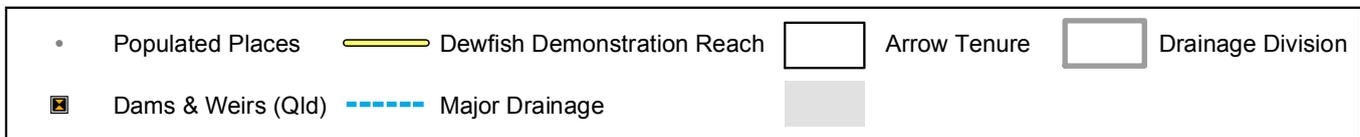
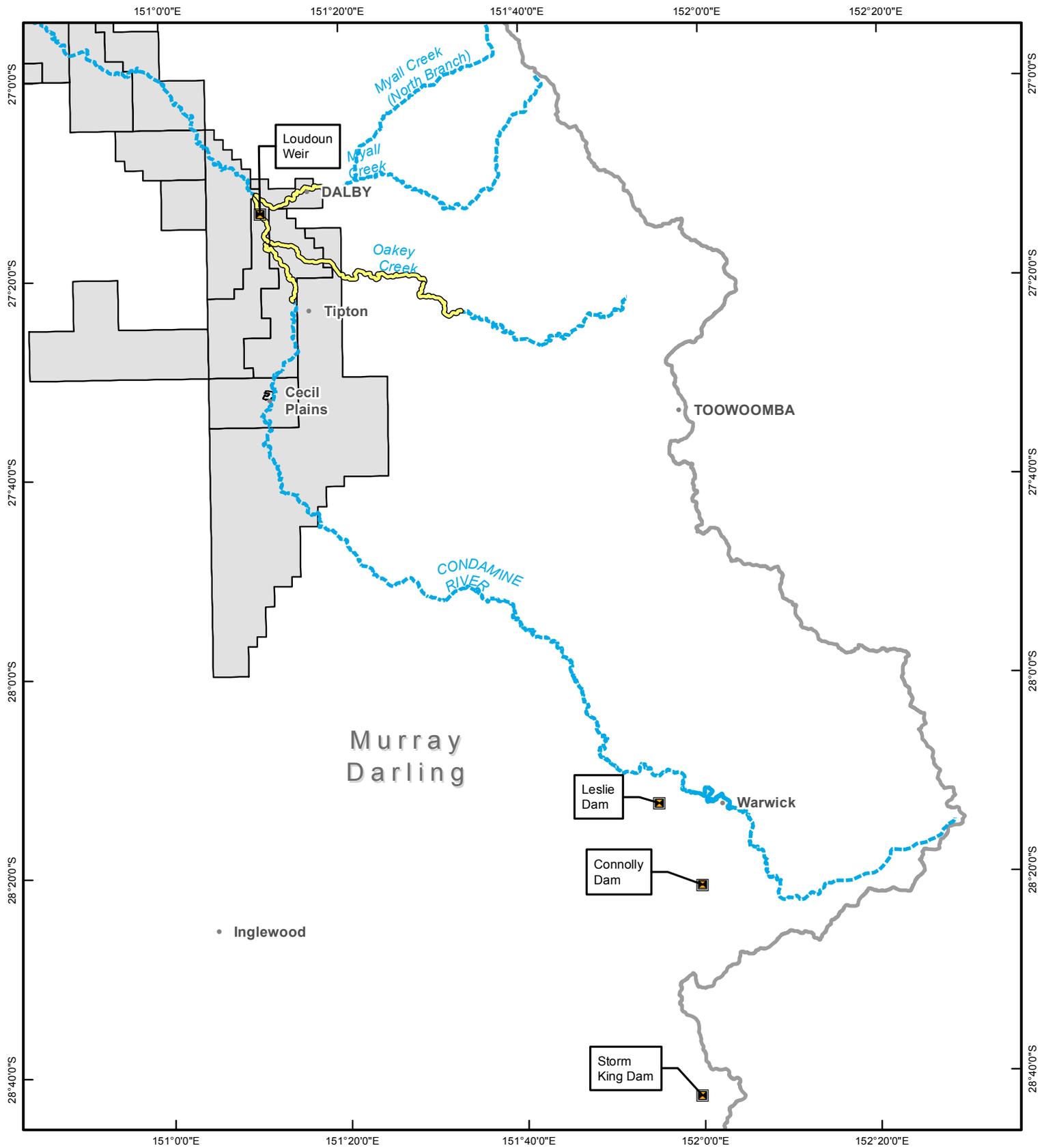
The natural distribution of the Murray Cod (*Maccullochella peelii*) encompasses approximately 13,245 km of major and moderate watercourses throughout the Murray-Darling Basin (FRC Environmental 2017), which extends from Victoria and New South Wales into Queensland and the southern section of the Brigalow Belt Bioregion (i.e. the Bioregion within which the SGP and off-tenure pipelines area are located).

### Project-Specific Habitat Description and Survey Outcomes

Arrow is intimately aware of the Murray Cod and its habitats within the SGP area because of our research funding provided for the species. For example, on 29 November 2013 Arrow extended its partnership support with the Condamine Alliance with a \$745,000 contribution for a three-year program of works to deliver:

- new research, including fish excluding screens around irrigation pumps; methods to propagate and plant aquatic vegetation for small fish species; and identification of barriers between fish populations
- on-ground works, like creating fish hotels and cod holes, and revegetating river banks
- restocking of Murray Cod (and golden perch) in Oakey Creek, Myall Creek and the Condamine River
- pest management, including carp traps and carp fishing days
- community engagement and planning.

The above-mentioned funds contributed to the Dewfish Demonstration Reach, a joint project of the Condamine Alliance River Rescue Program, Murray Darling Basin Authority and the Queensland Department of Agriculture and Fisheries. In addition to Arrow Energy, these partners are working with the Western Downs Regional Council, Toowoomba Regional Council, Oakey Freshwater Fish Stocking Association and landholders adjoining a 110 km stretch of waterway in the Condamine catchment (see Figure 3.11 for location of the target watercourses).



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Author: tstringer

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Dept. Envir. and Resource Mgmt.



Coordinate System: GDA 1994 MGA Zone 56

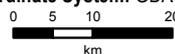


Figure 3.11  
Murray Cod habitat east of  
Proposed Pipelines



Date: 1/7/2019

Uncontrolled (A)

The resulting Monitoring and Evaluation Report (Department of Agriculture and Fisheries 2015) stated that:

- The surveys indicate that many of the intervention activities are having a positive impact, both singularly and in an integrated manner. The fish assemblage and riparian habitat has improved at all intervention sites in the Dewfish Demonstration Reach since rehabilitation activities have commenced.
- The abundance of golden perch, Murray Cod and bony bream in the Oakey Creek intervention sites have increased significantly since re-snagging and have remained high. Murray Cod and golden perch are now consistently being caught from introduced woody debris in Oakey Creek and the Condamine River at Warwick [it is noted that the report also states that catch data for the Murray Cod in both river and tributary sites remains low].
- To boost natural Murray Cod recruitment, spawning structures (hollow logs, pipes) have been introduced into Oakey Creek and in the Condamine River at Warwick. Habitat preference trials have demonstrated that juvenile Murray Cod show a strong preference for rocky rubble habitats.
- The snags, cod pipes and fish hotels which have been introduced are being well utilised by native fish. Golden perch, Murray Cod, eel-tailed catfish, spangled perch and bony bream have all been caught from these structures.
- At Loudoun Weir golden perch and Murray Cod were historically absent from the survey catch, even after the fish-way was made more functional in allowing these species to migrate upstream past the weir. It wasn't until fish hotels were installed that these species were consistently captured.

The Warwick District Recreational Fish Stocking Association noted in January 2017 that Murray Cod fingerlings and 165 artificial habitat structures have been introduced to the Condamine River and the Leslie, Connolly and Storm King dams (see Figure 3.11).

### Mapping of Suitable Habitat

Specific to the off-tenure pipelines the subject of this application, all river/riparian habitats within the off-tenure assessment area are minor tributaries. None contain permanent water with most pools likely to dry during an average rainfall year. Further, these channels are typically shallow and do not have abundant submerged timber/debris. No suitable habitat for the Murray Cod occurs within the assessment areas.

## 3.8 Yakka Skink

### General Habitat Description

The EPBC SPRAT database notes that the Yakka Skink is known to occur in open dry sclerophyll forest, woodland and scrub (Brigalow Belt Reptiles Workshop 2010; Cogger 2000; Wilson and Knowles 1988). Individuals of the species are found in cavities under and between partly buried rocks, logs or tree stumps, root cavities and abandoned animal burrows. They often take refuge in large hollow logs and have been known to excavate deep burrow systems, sometimes under dense ground vegetation (Cogger 2000; Ehmann 1992; Wilson and Knowles 1988). In cleared habitat, this species can persist where there are shelter sites such as raked log piles, deep gullies, tunnel

erosion/sinkholes and rabbit warrens. The species has also been found sheltering under sheds and loading ramps (Brigalow Belt Reptiles Workshop 2010; Threatened Species Network 2008). The core habitat of this species is within the Mulga Lands and Brigalow Belt South Bioregions (Threatened Species Network 2008). The SPRAT database also notes that the species occurs in a wide variety of vegetation types within Queensland Regional Ecosystem Land Zones (Brigalow Belt Reptiles Workshop 2010):

- Land Zone 3 - Alluvium (river and creek flats)
- Land Zone 4 - Clay plains not associated with current alluvium
- Land Zone 5 - Old loamy and sandy plains
- Land Zone 7 - Ironstone jump-ups
- Land Zone 9 - Undulating country on fine-grained sedimentary rocks
- Land Zone 10 - Sandstone ranges.

Whilst Land Zone 8 is not considered to be representative of core habitat for the Yakka Skink, the species may still occur in this Land Zone (DotEE 2019). It is noted however that there is no Land Zone 8 within the study area the subject of this project.

The SPRAT database identifies the following common woodland and open forest types for this species (Brigalow Belt Reptiles Workshop 2010; QLD DERM 2010):

- Brigalow (*Acacia harpophylla*)
- Mulga (*A. aneura*)
- Bendee (*A. catenulata*)
- Lancewood (*A. shirleyi*)
- Belah (*Casuarina cristata*)
- Poplar Box (*Eucalyptus populnea*)
- Ironbark (*Eucalyptus* spp.)
- White Cypress Pine (*Callitris glaucophylla*).

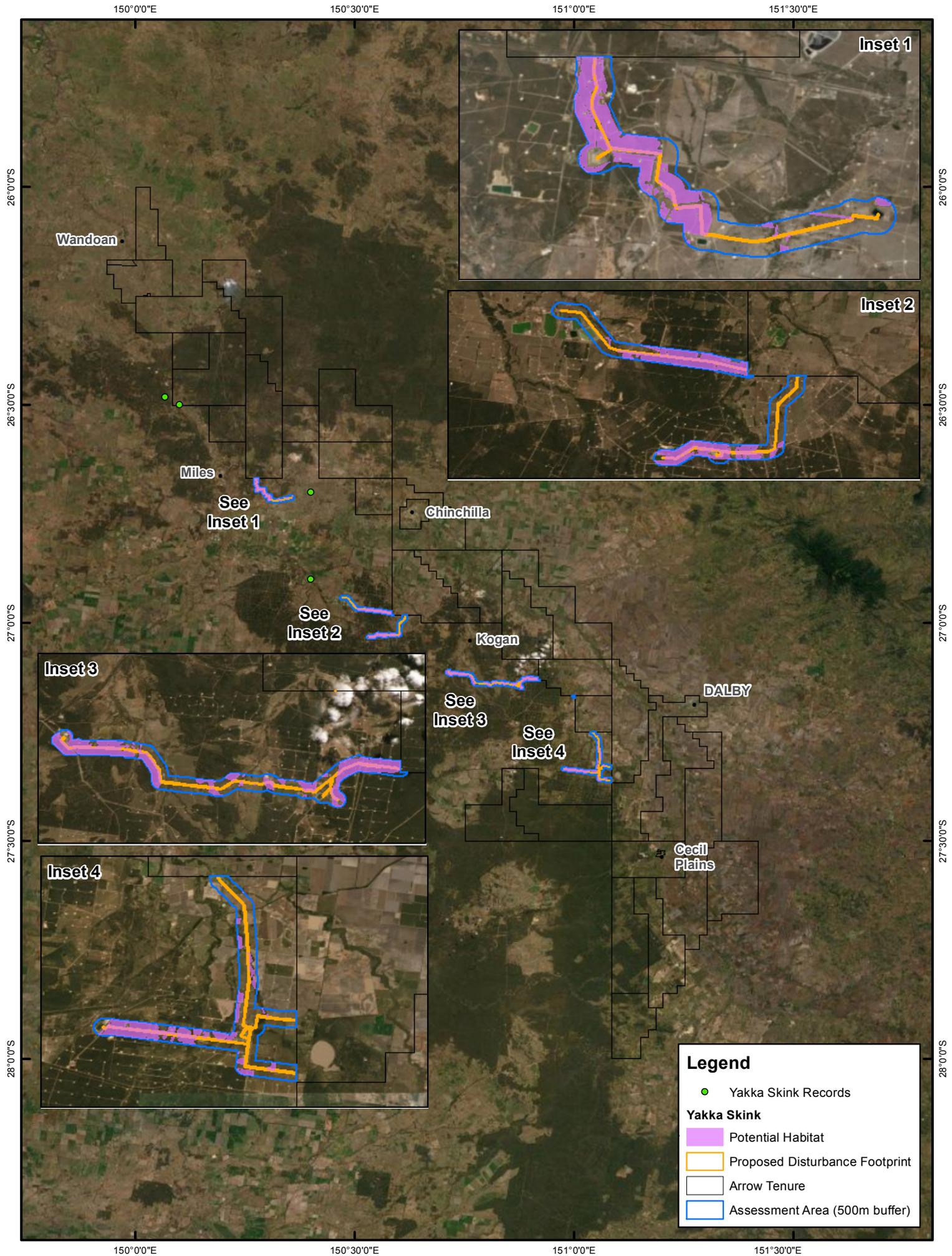
### Project-Specific Habitat Description and Survey Outcomes

Records of Yakka Skink are scattered from Mungkan Kandju National Park (NP) on Cape York Peninsula to near St George and Billa Billa in southern QLD. They are coastal around Bundaberg and extend inland to near Charleville. Most records are centred on the Brigalow Belt between St George and Emerald, Chinchilla and Charleville. The off-tenure assessment areas are within the species distribution, but are located near its eastern extent. Few records are located south and east of Chinchilla and the species is regularly absent from seemingly suitable habitat.

Only four Yakka Skink records have been recorded within 25 km of the SGP or the off-tenure assessment areas (see Figure 3.12):

- Approximately 4 km to the east of the eastern most section of the Girrahween export pipeline, record dated from 1987 (i.e. 32 years ago)
- Approximately 8 km to the north-west of the western most section of the Kenya Treated Water Return Pipeline (no date is associated with this record)
- Two records approximately 25.5 km and 27 km north-west of the Girrahween export pipeline, record dated from 1998 (i.e. 31 years ago).

The surveys were in accordance with the EPBC Act draft referral guidelines for the nationally listed Brigalow Belt reptiles (2011). The guideline mentions suitable techniques as 'Transects' (comparable



**Figure 3.12 Yakka Skink habitat and impact areas**

**Uncontrolled (B)**

to habitat area searches detailed above), spotlighting, pitfall/funnel trapping and Elliot trapping. Spotlighting and area searches were undertaken during the off-tenure pipeline surveys as detailed above (Section 3.2). Habitat searches were undertaken throughout the day, from morning to afternoon. Spotlighting was conducted at night, starting at least 30 mins after dusk. The guidelines suggest spotlighting a minimum of 1.5hrs/ha over 3 nights targeting large habitat patches, water-inundated gilgais, wetlands, riparian habitats and the surrounding environment (e.g., roads) and large logs. During this specific survey (see below for others in the area), 18 person hours of spotlighting was conducted over two nights, targeting the most likely habitats within the total 4,567 ha of potential habitat along the off-tenure pipeline study area.

Published survey guidelines are designed for small-property assessments (typically < 50 – 500 ha) and are not practical for broad area assessments such as the Surat Gas Project. While the surveys do not strictly achieve survey effort, the surveys comply with the intent of these guidelines by stratifying the vegetation in to Broad Vegetation Groups, identifying core habitats for each species based on habitat use specifications (e.g. foraging, dispersal, shelter), and undertaking targeted surveys using suitable methods during suitable conditions. This approach maximised the chance of detection of individuals and for the mapping of potential habitat.

Habitat area searches, spotlighting, pitfall/funnel trapping, Elliot trapping, road driving, and pitfall/funnel trapping were also conducted on-tenure for the broader SGP seasonal terrestrial flora and fauna surveys (see Appendix B of the ‘Surat Gas Project Terrestrial Ecology Report’ (EcoSmart Ecology and 3D Environmental, 2017) for total survey effort) and many other studies in the area (see below). For example, there have been several detailed studies undertaken in the SGP area totalling thousands of hours of search effort. Many of these major studies have been commissioned by Arrow, such as: the Surat Gas Project Environmental Impact Statement (3D Environmental and Ecosmart Ecology, 2011); the Supplementary Report to the Surat Gas Project Environmental Impact Statement (3D Environmental and Ecosmart Ecology, 2013); Detailed fauna assessments of the Surat to Gladstone gathering line infrastructure by AECOM (2012) and Ecosure (2013a-d); Daandine Projects EPBC Terrestrial Flora and Fauna Surveys (Ecosmart Ecology, 2014a & b); SGP seasonal terrestrial flora and fauna surveys (EcoSmart Ecology and 3D Environmental, 2017), and the Threatened Reptile Research Project (Worley Parsons 2014).

One of the most important studies Arrow has commissioned in regard to understanding Yakka Skink occurrence in the SGP area was completed by the late Dr Simon Hudson (a world renowned herpetologist) who led a threatened reptile research project in the Surat Basin (Worley Parsons 2014) across 24 sites ranging from Downfall in the north to Lynwood in the south, four of which were located in close proximity to the project area. The total survey effort was:

- Artificial refuge monitoring: 180 hours.
- Diurnal active searches: 123 hours.
- Nocturnal passive searches: 41 hours.
- Vehicle transects: 30 hours (150 km).

To comply with DotEE requirements to include habitat mapping for this species, Table 3.4 identifies the vegetation types and associated habitat quality scores within the study area that correlate with the Land Zones and vegetation types identified in the SPRAT database.

Table 3.4 Habitat characteristics from REs which may contribute to Yakka Skink habitat

RE	Vegetation composition and structure	Available microhabitat features (shelter resources)	Possible habitat use	Habitat quality score
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	Limited, some potential in uninspected areas that might have large log piles, but none observed during surveys. The dark clay soils expand and compromising warren stability.	Shelter, breeding, possibly dispersal subject to spatial context	3.0
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains	Limited, some potential in uninspected areas for log piles and/or tunnel erosion, but none observed during surveys.	Shelter, breeding, possibly dispersal subject to spatial context	A BioCondition assessment was not undertaken for RE11.3.2 due to the limited extent of this habitat. A maximum site condition score is assumed for this habitat.
11.3.14	<i>Eucalyptus spp.</i> , <i>Angophora spp.</i> , <i>Callitris spp.</i> woodland on alluvial plains	Limited, no obvious log piles or tunnel erosion found in the two areas of 11.3.14 during surveys.	Shelter, breeding, possibly dispersal subject to spatial context	3.43
11.3.18	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> , <i>Allocasuarina luehmannii</i> shrubby woodland on alluvium	Limited, no obvious logs piles or tunnel erosion in inspected areas, low probability of these occur in uninspected areas. These habitats had loose sandy soils compromising warren/burrow stability.	Shelter, breeding, possibly dispersal subject to spatial context	3.53
11.5.1	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> , <i>Callitris glaucophylla</i> , <i>Angophora leiocarpa</i> , <i>Allocasuarina luehmannii</i> woodland on Cainozoic sand plains and/or remnant surfaces	Scattered and uncommon, isolated larger fallen trees, only a few with hollows were observed during the survey; no partially buried log piles located. Some possibility in uninspected areas of larger log piles or hollow logs.	Shelter, breeding, and dispersal	3.31
11.5.4	<i>Eucalyptus chloroclada</i> , <i>Callitris glaucophylla</i> , <i>C. endlicheri</i> , <i>Angophora leiocarpa</i> woodland on Cainozoic sand plains and/or remnant surfaces	Scattered and uncommon, isolated larger fallen trees, only a few with hollows were observed during the survey; no partially buried log piles located. Some possibility in uninspected areas of larger log piles or hollow logs.	Shelter, breeding, and dispersal	3.50
11.5.20	<i>Eucalyptus moluccana</i> and/or <i>E. microcarpa</i> and/or <i>E. woollsiana</i> +/- <i>E. crebra</i> woodland on Cainozoic sand plains	Scattered and uncommon, isolated larger fallen trees, only a few with hollows were observed during the survey; no partially buried log piles; one larger treefall with hollows represented the best possible Yakka Skink microhabitat observed anywhere during the survey but no evidence (latrines) was located despite careful inspection. Some possibility in uninspected areas of larger log piles or hollow logs.	Shelter, breeding, and dispersal	4.50
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus spp.</i> , <i>Corymbia spp.</i> , <i>Acacia spp.</i> , <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust	Soil structure generally suitable for burrow stability; large fallen trees with hollows most abundant in this RE (and RE11.7.6), but still scattered; no observed partially buried log-piles. Potential for suitable microhabitats in uninspected areas	Shelter, breeding, and dispersal	4.45

RE	Vegetation composition and structure	Available microhabitat features (shelter resources)	Possible habitat use	Habitat quality score
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks	Shallow soils prevent burrow creation in many locations, most likely where anthropogenic disturbance has created partially buried log piles, but no such disturbance identified during surveys.	Shelter, breeding, possibly dispersal subject to spatial context	A BioCondition assessment was not undertaken for RE11.7.5 due to the limited extent of this habitat. A maximum site condition score is assumed for this habitat.
11.7.6	<i>Corymbia citriodora</i> or <i>Eucalyptus crebra</i> woodland on Cainozoic lateritic duricrust	Soil structure generally suitable for burrow stability; large fallen trees with hollows most abundant in this RE (and RE11.7.4), but still scattered; no observed partially buried log-piles. Potential for suitable microhabitats in uninspected areas	Shelter, breeding, and dispersal	3.62
11.7.7	<i>Eucalyptus fibrosa</i> subsp. <i>nubilis</i> +/- <i>Corymbia</i> spp. +/- <i>Eucalyptus</i> spp. woodland on Cainozoic lateritic duricrust	Soil structure generally suitable for burrow stability; large fallen trees with hollows scattered; no observed partially buried log-piles. Many areas historically logged, removing larger trees which might create large treefalls/log piles. Potential for suitable microhabitats in uninspected areas	Shelter, breeding, and dispersal	4.16

### Mapping of Suitable Habitat

Based on the dates of previous records and the species poor representation within or near to Arrow tenements, this species has been previously considered 'unlikely' to occur and has not been the subject of habitat mapping. New rules have been generated for this species, with the resulting habitat mapping considered to have low accuracy (see Appendix B for details).

Within the 8,760 ha of the study area (i.e. 500 m buffer on either side of the pipeline centrelines), a total of 4,567 ha of the 12 REs listed in Table 3.4 and having a combined remnant and/or advanced regrowth vegetation patch size >50 ha has been mapped as potential habitat for the Yakka Skink (see Figure 3.12). The minimum patch size was set at 50 ha because occurrence becomes increasingly less likely as the patch size decreases and isolation increases. Also, patch sizes of suitable habitat less than 50 ha reflect a point at which the likelihood of the area supporting a persistent population of the species becomes unlikely. Larger, more extensive populations are more resilient to extinction pressures, and those with better connectivity are more likely to be repopulated if a local extinction does occur.

With regards the habitat quality score out of 10 for the Yakka Skink, the average score is 3.8 over the 32 sites assessed from nine REs (see Appendix B for details). Plate 3.9 provides an example of habitat within RE 11.7.4 considered suitable for the Yakka Skink.



**Plate 3.9** Example of potential Yakka Skink habitat within the study area (RE 11.7.4)

### 3.9 Painted Honeyeater

This EPBC-listed species was not identified in the DotEE information request but was observed during the field surveys and therefore has been included in this Preliminary Documentation for completeness.

#### General Habitat Description

The EPBC SPRAT database does not include a habitat description for the Painted Honeyeater but refers the reader to the EPBC Conservation Advice (DotEE 2015). The Advice notes that the Painted Honeyeater is the most specialised of Australia's honeyeaters. Its diet mainly consists of mistletoe fruits, but also includes nectar (from flowering mistletoe, eucalypts and possibly banksias) and arthropods, especially in the non-breeding season (Garnett et al., 2011; Higgins et al., 2001; BirdLife International, n.d.).

The Advice also notes that the species inhabits mistletoes in eucalypt forests/woodlands, riparian woodlands of black box and river red gum, box-ironbark-yellow gum woodlands, acacia-dominated woodlands, paperbarks, casuarinas, callitris and trees on farmland or gardens. The species prefers woodlands which contain a higher number of mature trees, as these host more mistletoe. It is more common in wider blocks of remnant woodland than in narrower strips (Garnett et al., 2011), although it breeds in quite narrow roadside strips if ample mistletoe fruit is available (BirdLife International n.d.). The species builds a flimsy cup nest made of plant fibre, spider's webs and rootlets in the outer foliage of trees anywhere from 3m to 20m above the ground. The species appears to prefer mistletoe as a nest substrate and selects nest sites in habitats where mistletoe prevalence and parasitism rates are high (Barea 2008).

## Project-Specific Habitat Description and Survey Outcomes

The off-tenure assessment areas occur entirely within the distribution of the Painted Honeyeater and the species has been frequently recorded within 20 km of the SGP (see Figure 3.13). Prior to Arrow's December 2018 survey, the nearest record to the pipeline study area was restricted to the immediate vicinity of Lake Broadwater (see Figure 3.13 and Appendix B for details). The recent Arrow survey located Painted Honeyeater at a small Brigalow fragment within the northern section of the Jammatt pipeline (see Figure 3.14).

The painted honeyeater was not listed at the time the Guidelines for detecting birds listed as threatened under the EPBC Act (2010) were prepared and therefore is not specifically included/covered. Area searches and random meander visual searches are suitable methods to detect this species. Random meander visual searches were conducted throughout the surveys totalling a conservative estimate of 300 person hours. This includes area searches at 40 locations (40 person hours). This survey technique is consistent with the general principles of detection methods for birds contained within the survey guidelines.

Painted Honeyeaters inhabit woodlands which have abundant Mistletoe. Within the southern Brigalow belt vegetation which supports abundant Needle-leaved Mistletoe (*Amyema cambagei*) and Grey Mistletoe (*A. quandang*) are particularly favoured. Needle-leaved Mistletoe is typically located on *Casuarina cunninghamiana* and *C. cristata*, while Grey Mistletoe is associated with larger Acacia species (especially *A. harpophylla*). Riparian woodlands (e.g. *E. camaldulensis* waterways) can also be utilised if mistletoe is abundant.

Table 3.5 provides an overview of the two REs that correlate with the suitable vegetation types and habitat characteristics of this species.

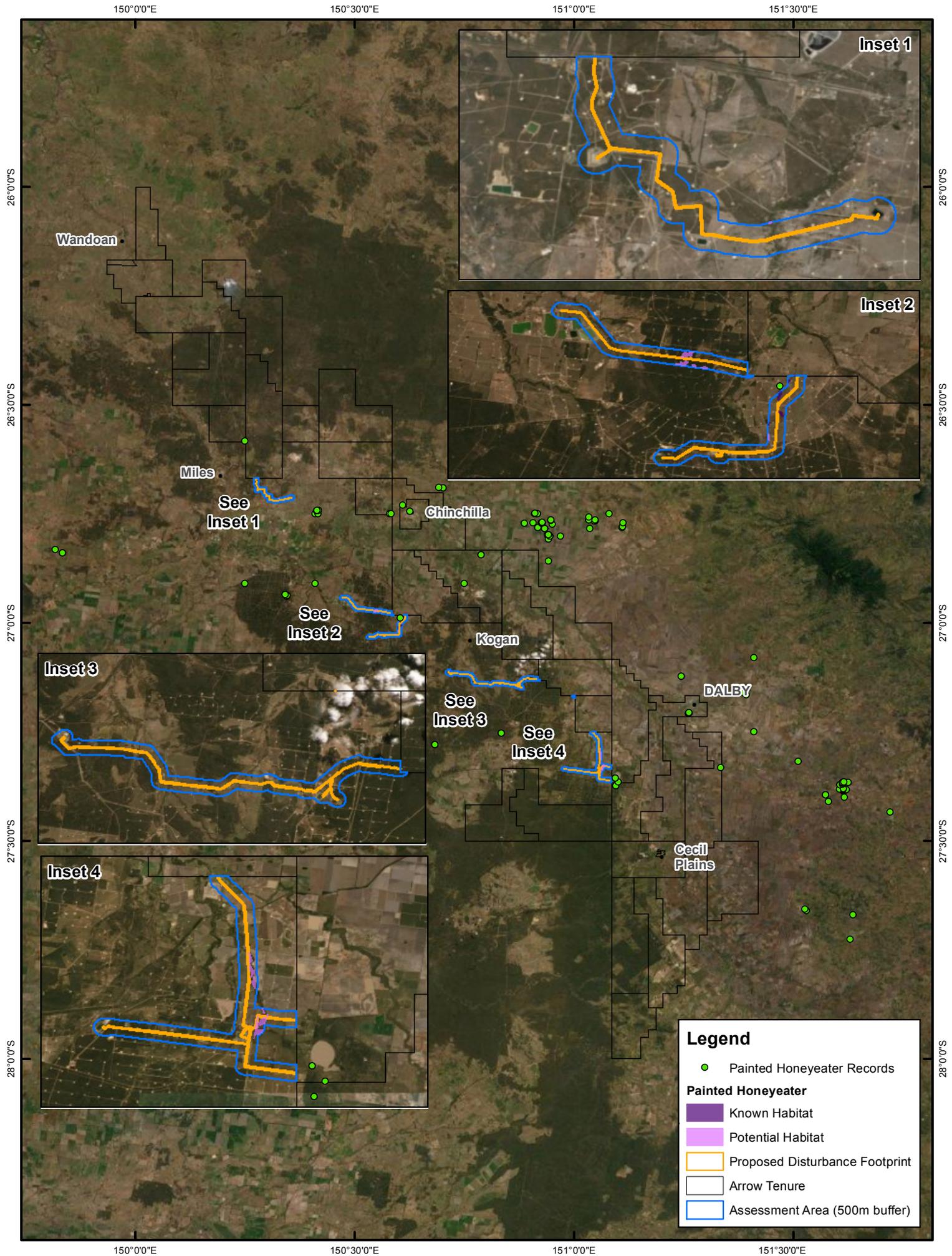
**Table 3.5 Habitat characteristics from REs which contribute to Painted Honeyeater habitat**

RE	Vegetation composition and structure	Available microhabitat features (water availability and ground cover)	Possible habitat use	Habitat quality score
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	Mistletoe density variable, but abundant mistletoe was often noted in this RE type.	Foraging and breeding	3.6
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	Mistletoe density variable, but abundant mistletoe was often noted in this RE type.	Foraging and breeding	4.54

## Mapping of Suitable Habitat

Within the 8,760 ha of the study area (i.e. 500 m buffer on either side of the pipeline centrelines), a total of 88.5 ha of potential habitat has been mapped within the study area (being 22.7 ha of core habitat known and 65.8 ha of core habitat possible) (see Figure 3.13). Plate 3.10 provides an example of habitat within RE 11.4.3 from which the Painted Honeyeater was observed.

With regards the habitat quality score out of 10 for the Painted Honeyeater, the average score is 4.3 over the four sites assessed from the two REs (see Appendix B for details).



**Legend**

- Painted Honeyeater Records
- Painted Honeyeater**
  - Known Habitat
  - Potential Habitat
- ▭ Proposed Disturbance Footprint
- ▭ Arrow Tenure
- ▭ Assessment Area (500m buffer)

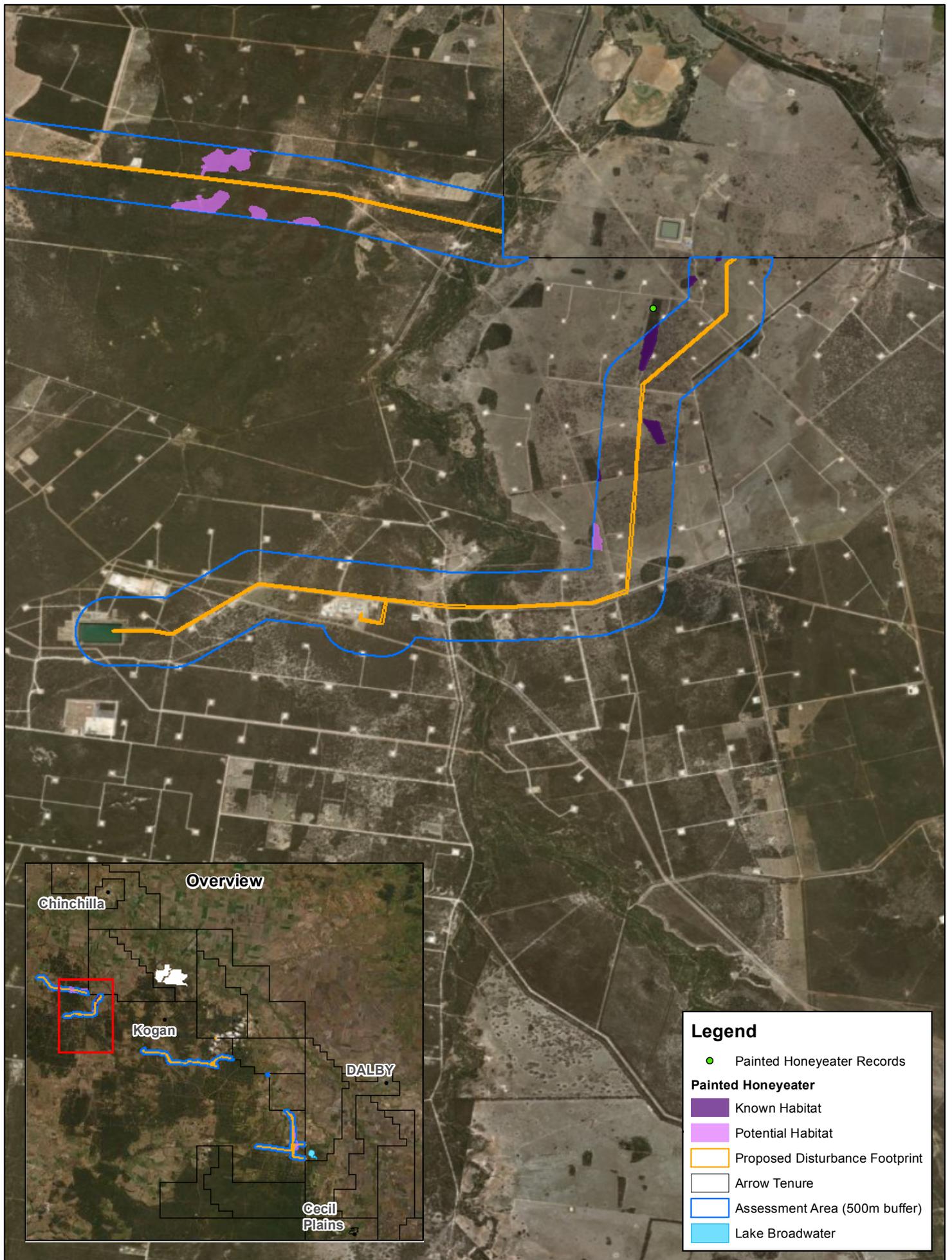
Coordinate System: GCS GDA 1994

Date: 28/06/2019



**Figure 3.13 Painted Honeyeater habitat and impact areas**

**Uncontrolled (B)**



**Legend**

- Painted Honeyeater Records
- Painted Honeyeater**
  - Known Habitat
  - Potential Habitat
- Proposed Disturbance Footprint
- Arrow Tenure
- Assessment Area (500m buffer)
- Lake Broadwater

**Coordinate System:** GCS GDA 1994

Date: 28/06/2019



**Figure 3.14 Painted Honeyeater record (at a small Brigalow fragment within the Weambilla Assessment Area)**

**Uncontrolled (B)**



**Plate 3.10** Habitat within which the Painted Honeyeater was observed (RE 11.4.3)

### 3.10 Kogan Waxflower

This EPBC-listed species was not identified in the DotEE information request but was observed during the field surveys and therefore has been included in this Preliminary Documentation for completeness.

#### General Habitat Description

The EPBC SPRAT database notes that the Kogan Waxflower (*Philotheca sporadica*) occurs within the Condamine River catchment on soils derived from low fertility laterised Cretaceous sandstones (Kumbarilla Beds). Soils are shallow uniform sandy loams to clay loams or shallow texture contrast soils with loamy surfaces and medium clay subsoils. Ironstone gravel is usually present within the soil column. Topography of these areas is undulating to flat with low dissected flat top or rounded hills (Dawson 1972; Halford 1995p). Some sites have duricrust surfaces (Powerlink Queensland 2005).

Kogan Waxflower is a Queensland and bioregional endemic known from just north of Tara, to approximately 12 km east of Kogan (TSSC 2008). Of the 11 known populations, seven occur on road verges, seven (including some that extend from road verges) are on freehold land, and one population is within Braemar State Forest (Halford 1995, TSSC 2008).

The majority of records are in low open forest and woodland of *Acacia burrowii*, *Eucalyptus exserta*, *Eucalyptus crebra*, *Eucalyptus fibrosa* subsp. *nubila* and *Callitris glaucophylla* (Halford 1995, TSSC 2008), and also on residual hills which are remnants of laterised Cretaceous sandstones, where the soils are shallow, uniform sandy loams to clay loams of extremely low fertility and poor condition (TSSC 2008).

### Project-Specific Habitat Description and Survey Outcomes

Field survey in the wider SGP area indicates that the species occurs almost exclusively within RE 11.7.4 (*Eucalyptus decorticans* and/or *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp., *Lysicarpus angustifolius* on lateritic duricrust) and possibly RE 11.7.5 with a few individual plants overlapping with RE 11.7.7. The species has a tendency to form dense, locally restricted populations, particularly on scalded areas with limited soil.

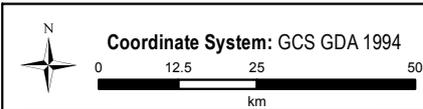
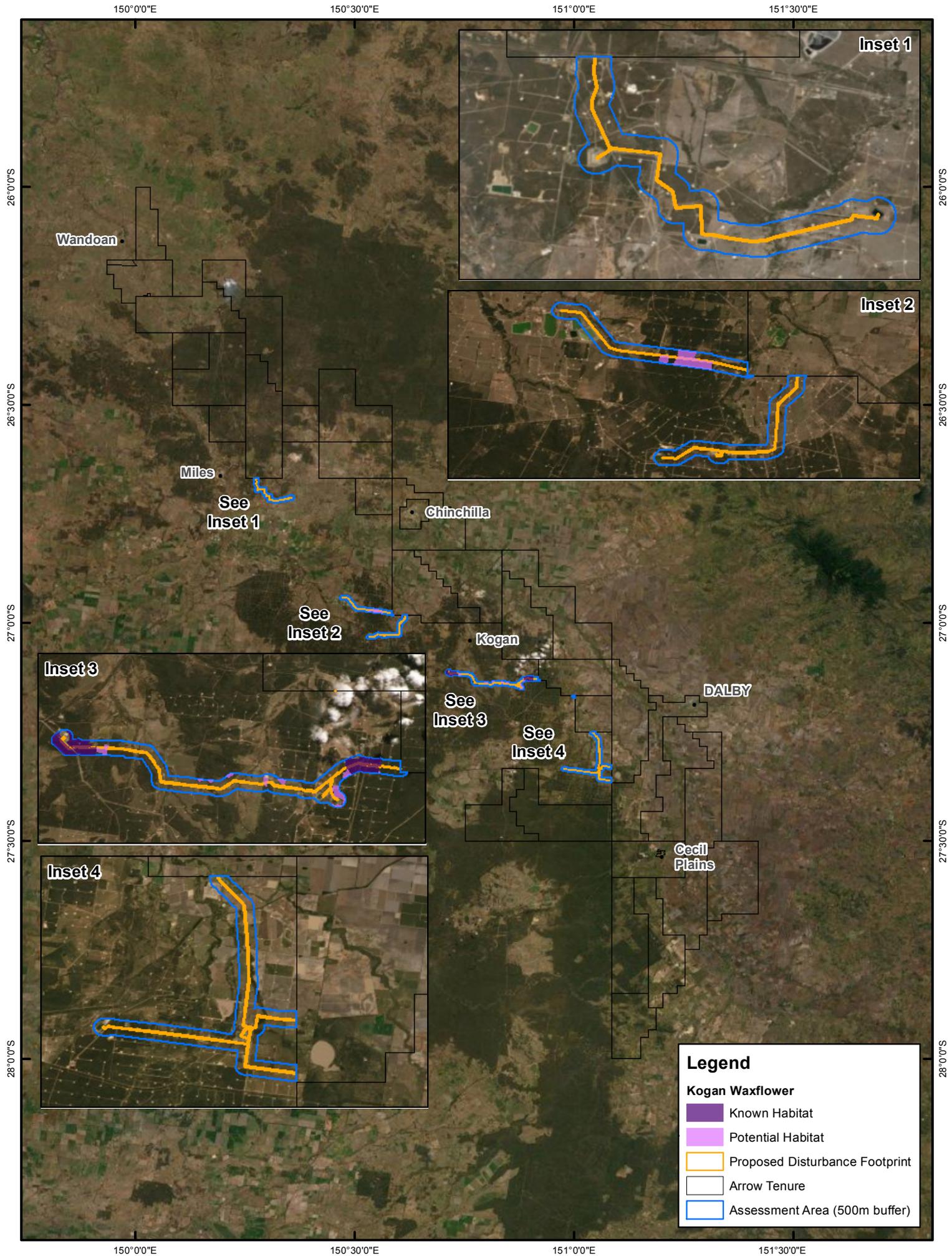
The survey effort is estimated at 300 person hours over the two separate field studies (EcoSmart Ecology and 3D Environmental, 2018 and 2019):

- EcoSmart Ecology and 3D Environmental (2018): 1,770 ha of remnant vegetation was mapped. Surveys collected floristic data consistent with Queensland Herbarium standards (Neldner et al. 2012) and included secondary, tertiary and quaternary sites. The location of these sites was selected using aerial photograph analysis, or opportunistically during traverse, to ensure that the field survey targeted a representative range of habitats. Several populations of the EPBC Listed threatened species, Kogan waxflower (*Philotheca sporadica*), were identified and mapped during the assessment.
- EcoSmart Ecology and 3D Environmental (2019): Flora methods were adopted from the Guide to determining terrestrial habitat quality – Version 1.2 (DEHP 2017) and the Queensland BioCondition Assessment Manual (Eyre et al. 2015). BioCondition sites were supplemented with quaternary sites (as per Nelder et al. 2017) specifically for the purpose of increasing mapping confidence and allowing extrapolation of BioCondition scores to habitats (REs) throughout the assessment area. In total 9,374.9 ha of remnant vegetation was mapped. A total of 78 flora survey sites were recorded during the assessment including 47 BioCondition and 31 quaternary sites. Within the assessment area populations of Kogan waxflower were identified at two locations, both associated with RE 11.7.4 and 11.7.5 (Figure 3.3). A total of 408.6 ha of ‘Core Habitat Known’ is mapped within the off-tenure assessment areas (Figure 3.15).

Within the assessment area populations were identified at two locations, both associated with REs 11.7.4 and 11.7.5. Table 3.6 provides average habitat quality scores for each RE included for Kogan Waxflower known and potential habitat, the average habitat score from all 12 sites across the three REs is 4.10. Plate 3.11 shows one of the areas from which the Kogan Waxflower was recorded (RE 11.7.5).

**Table 3.6 Average habitat quality for REs which contribute to Kogan Waxflower habitat**

RE	Vegetation composition and structure	Habitat quality score
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> on lateritic duricrust	4.62
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks.	A BioCondition assessment was not undertaken for RE11.7.5 due to the limited extent of this habitat. A maximum site condition score is assumed for this habitat.
11.7.6	<i>Corymbia citriodora</i> or <i>Eucalyptus crebra</i> woodland on Cainozoic lateritic duricrust.	2.96
11.7.7	<i>Eucalyptus fibrosa</i> subsp. <i>nubila</i> ± <i>Corymbia</i> spp. ± <i>Eucalyptus</i> spp. on Cainozoic lateritic duricrust.	3.90



Date: 1/07/2019



Figure 3.15 Kogan Waxflower habitat and impact areas

### Mapping of Suitable Habitat

Within the 8,760 ha of the study area (i.e. 500 m buffer on either side of the pipeline centrelines), a total of 959.5 ha of potential habitat has been mapped within the study area (being 408.6 ha of core habitat known and 550.9 ha of core habitat possible) (see Figure 3.15).



**Plate 3.11** Habitat within which the Kogan Waxflower is present (RE 11.7.5)

## 3.11 Brigalow

This EPBC Threatened Ecological Community (TEC) was not identified in the DotEE information request but was observed during the field surveys and therefore has been included in this Preliminary Documentation for completeness.

### General Habitat Description

The EPBC SPRAT database notes that this TEC is characterised by the presence of Brigalow (*Acacia harpophylla*) as one of the three most abundant tree species (Butler 2007). Brigalow is usually dominant in the tree layer or co-dominant with other species such as Belah (*Casuarina cristata*), other species of *Acacia*, or species of *Eucalyptus*. Occasionally Belah, or species of *Acacia* or *Eucalyptus* may be more common than Brigalow within the broad matrix of Brigalow vegetation.

The structure of the vegetation ranges from open forest to open woodland. The height of the tree layer varies from about 9 m in low rainfall areas (averaging around 500 mm per annum) to around 25 m in higher rainfall areas (averaging around 750 mm per annum) (Butler 2007). A moderately dense low tree layer or low to tall shrub layer is frequently present, with typical species including *Terminalia oblongata* (Yellowwood), *Eremophila mitchellii* (False Sandalwood) and/or *Geijera*

*parviflora* (Wilga). The ground layer of the community is typically sparse and comprised of graminoids such as *Enteropogon acicularis*, *Panicum decompositum*, *Paspalidium spp.* and the sedge *Cyperus gracilis*. Sub-shrubs such as *Clerolaena spp.* and *Enchylaena tomentosa* (Ruby Saltbush) are also commonly present. The ground layer of the community is typically dominated by a thick leaf litter layer and ample fallen woody debris.

The SPRAT database and EPBC Approved Conservation Advice (key diagnostic characteristics) further notes that in Queensland, the listed Brigalow TEC comprises the following 16 REs (TSSC 2001):

- RE 6.4.2 - *Casuarina cristata* +/- *Acacia harpophylla* open forest on clay plains
- RE 11.3.1 - *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains
- RE 11.4.3 - *Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains
- RE 11.4.7 - Open forest of *Eucalyptus populnea* with *Acacia harpophylla* and/or *Casuarina cristata* on Cainozoic clay plains
- RE 11.4.8 - *Eucalyptus cambageana* open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains
- RE 11.4.9 - *Acacia harpophylla* shrubby open forest with *Terminalia oblongata* on Cainozoic clay plains
- RE 11.4.10 - *Eucalyptus populnea* or *E. pilligaensis*, *Acacia harpophylla*, *Casuarina cristata* open forest on margins of Cainozoic clay plains
- RE 11.5.16 - *Acacia harpophylla* and/or *Casuarina cristata* open forest in depressions on Cainozoic sand plains/remnant surfaces
- RE 11.9.1 - *Acacia harpophylla* - *Eucalyptus cambageana* open forest on Cainozoic fine-grained sedimentary rocks
- RE 11.9.5 - *Acacia harpophylla* and/or *Casuarina cristata* open forest on Cainozoic fine-grained sedimentary rocks
- RE 11.9.6 - *Acacia melvillei* ± *A. harpophylla* open forest on Cainozoic fine-grained sedimentary rocks
- RE 11.11.14 - *Acacia harpophylla* open forest on deformed and metamorphosed sediments and interbedded volcanics
- RE 11.12.21 - *Acacia harpophylla* open forest on igneous rocks; colluvial lower slopes
- RE 12.8.23 - *Acacia harpophylla* open forest on Cainozoic igneous rocks
- RE 12.9-10.6 - *Acacia harpophylla* open forest on sedimentary rocks
- RE 12.12.26 - *Acacia harpophylla* open forest on Mesozoic to Proterozoic igneous rocks.

### Project-Specific Habitat Description and Survey Outcomes

Only two of the above-mentioned 16 REs associated with the EPBC Brigalow TEC occur within the study area. These are RE 11.3.1 and RE 11.4.3. Within the study area, the community is degraded in most occurrences as a result of extensive habitat fragmentation (see Table 3.7 and Plate 3.12), however assessment of the Brigalow TEC was made and areas that meet the EPBC Approved

Conservation Advice key diagnostic criteria and condition thresholds were mapped and are accounted for below and in the impact assessment for this TEC.

The most extensive occurrences are located on the clay soils in the study areas of the Lynwood Export Pipeline to Jordan and the Jammatt pipeline (see Figure 3.16). Typical canopy heights range from 14 to 21 m in better preserved examples where projected canopy covers ranges from 30 to 60%. Whilst *Acacia harpophylla* generally forms the dominant canopy, *Casuarina cristata* also occurs. The average habitat score from all four sites across the two REs is 2.59 (Table 3.7).

**Table 3.7 Average habitat quality for REs which contribute to the Brigalow TEC**

RE	Vegetation composition and structure	Habitat quality score
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains	2.82
11.4.3	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> shrubby open forest on Cainozoic clay plains	2.49

### Mapping of Suitable Habitat

Within the 8,760 ha of the study area (i.e. 500 m buffer on either side of the pipeline centrelines), a total of 195 ha of the two REs the correlate to the Brigalow community is present (see Figure 3.16).



**Plate 3.12** Example of Brigalow TEC from within the study area (RE 11.4.3)

150°0'0"E

150°30'0"E

151°0'0"E

151°30'0"E

26°0'0"S

26°30'0"S

27°0'0"S

27°30'0"S

28°0'0"S

26°0'0"S

26°30'0"S

27°0'0"S

27°30'0"S

28°0'0"S

Wandoan

Miles

See Inset 1

Chinchilla

See Inset 2

Kogan

See Inset 3

See Inset 4

DALBY

Cecil Plains

Inset 1

Inset 2

Inset 3

Inset 4

**Legend**

-  Brigalow TEC
-  Proposed Disturbance Footprint
-  Arrow Tenure
-  Assessment Area (500m buffer)



Coordinate System: GCS GDA 1994



Date: 28/06/2019



**Figure 3.16: Brigalow Dominant and Co-dominant Threatened Ecological Community (TEC) and impact areas**

**Uncontrolled (B)**

## 4. Impact Assessment

This section of the report provides an analysis of the likely impacts on each of the EPBC listed threatened species and threatened ecological community described in the section above. Section 4.1 provides a summary of the impacts on MNES and Sections 4.2 to 4.10 provide further details for each MNES.

Guiding documents and information that have been used to assist the analysis of and justify likely impacts on MNES are the EPBC Significant Impact Guidelines 1.1; the SPRAT database (particularly with regards to threats and Conservation Advice); the mapping generated by the habitat assessment described in the above section; and the use of GIS to generate calculations of the impacted areas when the proposed disturbance footprint is overlaid on the habitat mapping for each MNES. There are no Recovery Plans for any of the focal MNES in the SPRAT database.

### 4.1 Summary of potential impacts

Table 4.1 provides a summary of the potential direct impacts for the MNES relevant to this report.

Feedback from DotEE (November 2019) requested that this document also considers the following:

- *Downstream or downwind impacts, such as impacts on wetlands or ocean reefs from sediment, fertilisers or chemicals which are washed or discharged into river systems:* The nearest ocean reef and river system to the project area in a straight line is 240 km and 38 km respectively. As such no downstream impacts are predicted on these values because of the sheer distance that contaminants would need to travel. One of the proposed pipelines (the water pipeline from Tipton to the Glendower Ponds) traverses a permanent creek (Wilkie Creek). This crossing is approximately 3.2 km from Lake Broadwater, a conservation park and wetland. While the temporary and confined (i.e. 30 m right-of ways) nature of activities associated with pipeline installation would not generate significant volumes or concentrations of the above-mentioned contaminants, Sections 5 and 6 include mitigation measures to avoid downstream impacts on this wetland.
- *Upstream impacts such as impacts associated with the extraction of raw materials and other inputs which are used to undertake the action:* The bulk if not all of the materials required to install the pipelines will be sourced off-site from licensed third parties.
- *Facilitated impacts which result from further actions (including actions by third parties) which are made possible or facilitated by the action. For example, the construction of a dam for irrigation water facilitates the use of that water by irrigators with associated impacts. Likewise, the construction of basic infrastructure in a previously undeveloped area may, in certain circumstances, facilitate the urban or commercial development of that area:* The nature of this project, being privately-owned gas and water pipelines to existing privately-owned CSG processing facilities, does not lend itself to induced development. Furthermore, the area supports major and well established pastoral and agricultural activities that are not likely to change to urban or commercial development as a result of the proposed pipelines.

Table 4.1 Summary of potential impacts to MNES

MNES	Habitat Available in the Study Area (Ha)			Area to be Cleared (Ha)			Percentage of Habitat Cleared compared to Habitat Available in Study Area	Significant Impact Likely? <sup>1</sup>
	Core Habitat Known	Core Habitat Possible	Total	Core Habitat Known	Core Habitat Possible	Total		
Koala	1,342	3,643	4,985	12	53	65	1.3 %	Yes
Dunmall's Snake	0	7,396	7,396	0	45	45	0.6 %	No
Greater Glider	0	285	285	0	3	3	1.1 %	No
Squatter Pigeon	0	269	269	0	3	3	1.1 %	No
Murray Cod	0	0	0	0	0	0	0 %	No
Yakka Skink	0	4,567	4,567	0	54	54	1.2 %	No
Painted Honeyeater	22.7	65.8	88.5	0	2	2	2.3 %	No
Kogan Waxflower	408.6	550.9	959.5	7	0	7	0.7 %	No
Brigalow	195	NA	195	1.5	NA	1.5	0.8 %	Yes

<sup>1</sup> – assessment against the relevant criteria within the EPBC Significant Impact Guidelines

## 4.2 Koala

Table 4.1 provides an assessment of Koala habitat from within the study area in accordance with the *EPBC Act referral guidelines for the vulnerable Koala* (DotEE 2014). The Koala habitat assessment tool was applied once to the entire impact area of the proposed action.

**Table 4.1 Koala habitat assessment tool**

Attribute	Score	Inland (< 800 mm)	Comments
Koala occurrence	+2	Evidence of one or more Koalas within the last 5 years	Although no Koalas have been observed within the study area, the ecology surveys found evidence of Koalas (scats) on 34 occasions.
Vegetation composition	+1	Has forest, woodland or shrubland with emerging trees with only 1 species of known Koala food tree present	Ground-truthed REs included 11.3.1, 11.3.2, 11.3.14, 11.3.18, 11.3.25, 11.3.27i, 11.4.3, 11.5.1, 11.5.4, 11.5.20, 11.7.4 and 11.7.6. The number of known emergent Koala food tree species in any given vegetation type ranges from zero to two. Due to the broad range in the quality and availability of food across patches of vegetation, the mid-point score of +1 was chosen.
Habitat connectivity	+2	Area is part of a contiguous landscape $\geq$ 1,000 ha	Although the pipelines will clear minimal area and not cause a permanent barrier to dispersal, the pipeline corridors traverse and are adjacent to larger tracts of contiguous vegetation (see Figure 3.6).
Key existing threats	+1	Evidence of infrequent or irregular Koala mortality from vehicle strike or dog attack at present in the focal area	There is a high amount of traffic and number of dogs both feral and domestic in the area.
Recovery value	0	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context	The habitat does not constitute habitat refuges for the persistence of the species during droughts and periods of extreme heat. The majority of the habitat to be cleared does not constitute habitat critical to the survival of the species and will not affect permanent watercourses such as Wilkie Creek (i.e. likely refuges for individuals of the species). The clearing will not affect the quality, extent or connectivity of large areas of Koala habitat surrounding habitat refuges. The ROW will only be 30m wide and rehabilitated as soon as practicable after construction. Koalas are known to travel hundreds of meters along the ground between areas of suitable habitat.
<b>Total</b>	<b>6</b>	A score of five or more represents habitat critical to the survival of the Koala	The installation of the proposed pipelines is proposed to clear 12 ha of core habitat known and 53 ha of core habitat possible.

It is noted that 'Core Habitat Known' represents remnant and regrowth vegetation within 1 km of a known Koala record. This buffering of known records by 1 km is consistent with Queensland Government Essential Habitat mapping. It also recognises that Core Habitat Known is not intended to reflect all possible habitats that may be suitable for the Koala, but rather habitat surrounding a known occurrence. It is further noted that a 1 km radius equates to 314 ha, which is entirely appropriate when home ranges for the Koala vary in size from 1-2 ha in optimum habitat and up to 135 hectares in marginal habitat. Habitat that may be used by a Koala for foraging, shelter or dispersal is indicated by 'Core Habitat Possible'.

Koalas inhabit forests and woodlands dominated by Eucalypts, however not all Eucalypts are equal with particular species favoured over others (Moore and Foley 2000). These preferred 'food trees' can vary slightly between regions or seasons, and so habitat assessments should consider local Koala preferences (Phillips and Callaghan 2000, Phillips et al 2000). While not well studied, it is generally considered that the following *Eucalyptus* species are likely to have high value in the Surat Basin: *E. tereticornis*, *E. coolabah*, *E. populnea*, *E. thozetiana*, *E. melanophloia* and *E. camaldulensis* (Munks 1996, Sullivan 2003, Wu et al 2012). Evidence also suggests that in semi-arid and arid regions koala distribution and abundance is strongly influenced by the soil moisture availability, which likely increases leaf moisture content. As such, in semi-arid areas koalas are typically associated with riparian vegetation or low-lying clay-based soils (Melzer et al. 2000, Moore and Foley 2000). In Queensland these features are associated with Landzone 3 in the Regional Ecosystem (RE) mapping framework. Drawing on the above knowledge it was predicted that the following RE's would have the highest value for Koala and mapped as CHP: 11.3.2, 11.3.3, 11.3.4, 11.3.14, 11.3.17, 11.3.18, 11.3.25, 11.3.26, 11.3.27d and 11.3.27f.

The habitat assessment identified a total of 4,985 ha of suitable habitat for the Koala within the study area. When the proposed disturbance footprint is overlayed on the habitat mapping it shows that:

- 65 ha of suitable habitat would be cleared (this represents 1.3% of the suitable habitat within the study area)
- The 65 ha is not one large area, but rather 192 separate patches of vegetation (158 remnant and 34 regrowth). The average patch size to be cleared is 0.3 ha (which represents a 100 m long x 30 m wide RoW). The largest clearing in any given patch is 3.4 ha (which represents a 1.16 km long x 30 m wide RoW) and the smallest patch is less than 1 m long.
- Table 3.1 shows that six REs provide the best quality Koala habitat in the study area based on the presence of Koala feed trees, impacts on these vegetation communities are:
  - RE 11.3.2: no clearing proposed in this community
  - RE 11.3.18: total of 2.1 ha in this community (comprised of 5 habitat patches)
  - RE 11.3.25: total of 1.8 ha in this community (comprised of 14 habitat patches)
  - RE 11.3.27i: total of 0.9 ha in this community (comprised of 2 habitat patches)
  - RE 11.5.1: total of 23.4 ha in this community (comprised of 47 habitat patches)
  - RE 11.5.4: total of 5.7 ha in this community (comprised of 11 habitat patches)

With regards to impacts on the Koala, it is noted that the proposed clearing will be selective and staged over several years as the various pipelines are constructed and will not clear large patches of suitable vegetation in any given area because of the linear nature of the pipelines (only 30 m in width) and the geographic extent over which they will be installed. This in turn reduces the risk of displacing individuals as the project does not require clear-felling. Furthermore, the density of Koalas in the region is much lower compared with coastal areas (Sullivan et al. 2003) and decreases markedly west of the Wilkie Creek catchment (EcoSmart Ecology 2019). The level of fragmentation will also be relatively low given the clearing is for linear infrastructure to an average width of 30 m and koalas are known to travel hundreds of meters across areas devoid of habitat. Furthermore, Table 3.16 of Appendix B shows the eucalypt tree density per hectare for each of the 12 REs that provide possible habitat for the Koala in the study area. These densities

range from 0 trees to 326 trees per hectare and average 183 trees per hectare. As a hectare is 100 m x 100 m and the right of way is 30 m in width, this equates to an average of 55 trees per hectare located within the right of way. To place this in context and continuing to use these averages, there are 912,255 suitable Koala food / shelter trees within the study area and the proposed action it would impact 3,575 (or 0.39%) of the habitat trees available. In other words, a very low percentage (0.39%) of potential food or shelter trees for a Koala within their home range would be impacted by the proposed action.

With reference to the EPBC Significant Impact Guidelines, the impact would not lead to a long-term decrease in the size of an important population or reduce the area of occupancy of an important population. The EPBC SPRAT database notes that for the region of Queensland the subject of this project, Koala numbers average 0.01 per hectare (TSSC 2012). To provide context, the number of Koalas per hectare in areas considered to support important populations such as south-east Queensland is up to 3 Koalas per hectare (Melzer et al 2000 in the EPBC SPRAT database). This very low number of individuals in the study area is supported by no observations of Koalas by the suitably qualified ecologists that conducted the two surveys for this project (scat evidence only was detected).

In other words, the area of the proposed action is known to support a very low number of Koalas, and the project will impact a very low percentage (0.39%) of the available Koala foraging / shelter trees available in the study area, However, Arrow acknowledges that Table 4.1 shows that the DotEE habitat assessment tool returns a score of 6, which in turn means that clearing of this habitat triggers the critical habitat criteria of the Department's EPBC Significant Impact Guidelines. Therefore, Arrow will provide an offset for the Koala (see Section 7 and Appendix E for details).

Beyond direct impacts, the *EPBC Act referral guidelines for the vulnerable Koala* (DotE 2014) and the EPBC SPRAT database also identifies five aspects /threats to be considered to determine whether the action has the potential to interfere substantially with the recovery of the Koala. The following lists the five aspects /threats (in italics) and provides a response with regards to the proposed action (see also Section 5 of this report for further information about mitigation measures):

- *“Increasing koala fatalities in habitat critical to the survival of the koala due to dog attacks to a level that is likely to result in multiple, ongoing mortalities.”* – the pipeline installation project has no risk of increasing dog attacks to the Koala because pets are excluded from construction sites.
- *“Increasing koala fatalities in habitat critical to the survival of the koala due to vehicle-strikes to a level that is likely to result in multiple, ongoing mortalities.”* – the project will be constructed in daylight hours only and all project-related traffic will adhere to a maximum speed limit of 30 km/hr along the RoW. As such, the project has no risk of increasing vehicle strikes to the Koala.
- *“Facilitating the introduction or spread of disease or pathogens for example Chlamydia or Phytophthora cinnamomi, to habitat critical to the survival of the koala, that are likely to significantly reduce the reproductive output of koalas or reduce the carrying capacity of the*

*habitat.*” – the project has no risk of introducing the above mentioned disease or pathogens to the Koala and no risk of reducing the reproductive output of koalas.

- *“Creating a barrier to movement to, between or within habitat critical to the survival of the koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala.”* – the trenching for the pipelines will provide a temporary barrier for Koala movement, however this impact will be reduced by the use of ramps within the open trench and keeping the length of trench open at any time to a minimum. This temporary impact would not result in the long-term reduction in genetic fitness of the species in the area.
- *“Changing hydrology which degrades habitat critical to the survival of the koala to the extent that the carrying capacity of the habitat is reduced in the long-term.”* - the pipeline installation project has no risk of changing hydrology or degrading Koala habitat.

### 4.3 Dunmall’s Snake

Understanding the potential impacts of the proposed action on the Dunmall’s Snake is quite difficult because no individuals of the species have been trapped or even seen within 20 km of the project area for more than 18 years despite thousands of hours of searches conducted by the world renowned herpetologist Dr Simon Hudson. As such, Arrow has taken two approaches:

1. one that is conservative and assumes that the species occurs in the habitats identified for the species in the EPBC Conservation Advice
2. one that is even more conservative and assumes that the species may occur in the habitats identified for the species in the EPBC SPRAT database.

Using the first approach above, being the more specific habitat description for this species provided by the EPBC Conservation Advice (i.e. Brigalow habitat), a total of 195 ha of suitable habitat occurs within the study area and 1.5 ha (or 1%) would be cleared (comprised of 4 habitat patches). Four sites were surveyed within areas of this specific habitat and whilst the areas provided specific habitat features for this species (i.e. deep cracking clays, gilgai, small logs and debris), the average habitat quality score for the Dunmall’s Snake at these sites was 3.0 out of a possible score of 10 (see Table 3.7 in Appendix B). In other words the habitats in the study area are not considered by suitably qualified ecologists to provide good habitat for this snake species.

Using the second approach above, being the more conservative mapping that includes the broad habitat description for this species provided in the EPBC SPRAT database, a total of 7,396 ha of potentially suitable habitat for the Dunmall’s Snake occurs within the study area. In other words, possible habitat for this species in the study area calculated with the EPBC SPRAT database definition is 38 times larger than the area calculated using the EPBC Conservation Advice definition. Using this more conservative definition, 45 ha (or 0.6% of the possible habitat in the study area) would be cleared (comprised of 129 habitat patches). The average patch size to be cleared is 0.35 ha (which represents a 111 m long x 30 m wide RoW). The largest clearing in any given patch is 3.4 ha (which represents a 1.16 km long x 30 m wide RoW) and the smallest patch is less than 1 m long. Thirty-six sites were surveyed within areas of this broad habitat and the average habitat quality score for the Dunmall’s Snake at these sites was 3.8 out of a possible score of 10. The broader habitat types included in this second approach provide limited soil cracks, no gilgai and less fallen logs and debris than the Brigalow sites (see Table 3.6 of Appendix B). In other

words, there are more areas of possible habitat included but these areas are not considered by suitably qualified ecologists to provide good habitat for this snake species. In any case, Arrow has adopted the more conservative mapping for the impact assessment of Dunmall's Snake in this report.

As noted in Section 3.4, this species has not been found in the wider SGP area for over 18 years despite thousands of hours of search effort (Brigalow Belt Reptiles Workshop 2010; Richardson 2006; SEWPAC 2011; Worley Parsons 2014). Records of the species (2 records >20 years old and an additional 2 records 18 years old) are from the Dalby-Tara area of the Darling Downs (Hobson 2012). This area is approximately 25 km to the east of the nearest proposed pipeline.

With reference to the EPBC Significant Impact Guidelines, the EPBC SPRAT database and EPBC Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles (DSEWPac 2011) note that, 'given that the listed Brigalow Belt reptiles are difficult to detect and population information is limited, the department regards important habitat as a surrogate for important populations in the assessment of whether an action is likely to have a significant impact on one or more of these species.' It goes on to say that suitable habitat for any one of the listed Brigalow Belt reptiles is considered important if it is:

- *'habitat where the species has been identified during a survey'*: it is noted that no individuals were observed during the recent surveys or thousands of hours of surveys undertaken by a world renowned herpetologist over the last 18 years
- *'near the limit of the species known range'*: the modelled distribution for the Dunmall's Snake provided as Map 10 to the EPBC Referral guidelines shows that the study area is not near the limit of the species range
- *'large patches of contiguous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations'*: as noted above, the average habitat patch size to be impacted by the project is 0.35 ha and the land use of the project area is a highly modified major pastoral and agricultural area and therefore is not considered to meet the criteria of large patches of contiguous suitable habitat.
- *'a habitat type where the species is identified during a survey, but which was previously thought not to support the species'*: no individuals of the species have been recorded by survey in the area for the last 18 years.

Given the above consideration against the EPBC SPRAT database and EPBC Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles (DSEWPac 2011), the proposed clearing would not trigger any of the criteria for this species. In particular, it would not lead to a long-term decrease in the size of an important population; reduce the area of occupancy of an important population; or adversely affect habitat critical to the survival of the species. As such, the proposed disturbance for the pipelines project is not considered to represent a significant impact on this species.

To take an even more conservative approach, mitigation measures to further reduce potential impacts on this species have been included in Section 5.

#### 4.4 Greater Glider

There is no EPBC Recovery Plan, EPBC Threat Abatement Plan or information relevant to threats provided within the EPBC SPRAT database for this species. As such the EPBC Conservation Advice has been considered with regards to impacts. The threats listed in the Conservation Advice and the relevance to the project are discussed below:

- *Habitat loss*: As noted in Section 3.5, there are 11 previous records of this species from the wider SGP area but no records from the study area the subject of this assessment. The vegetation types that are recognised as suitable habitat for this species are associated with REs 11.3.25 and 11.3.27. Within the study area of the proposed action, a total of 285 ha of this suitable habitat occurs and 3 ha (or 1.1%) would be cleared (comprised of 16 habitat patches). Some of these vegetation patches have large old trees with a moderate to low density of hollows (see Table 3.12 of Appendix B). The EPBC Conservation Advice notes that Greater Gliders in northern NSW were absent from surveyed sites with fewer than 6 tree hollows per hectare (Smith et al. 1994; in EPBC Conservation Advice). In south-east Queensland the number of hollows required reduces to 1-2 per hectare (Eyre 2002; in EPBC Conservation Advice). For the purposes of this project Arrow have assumed that the loss of 3 ha (or 1.1% of the suitable habitat in the study area) is of habitat that could support the Greater Glider because the density of hollow-bearing trees in the surveyed areas was greater than 2 per hectare. Having said that, the average patch size to be cleared is 0.17 ha (which represents a 55 m long x 30 m wide RoW). The largest clearing in any given patch is 0.55 ha (which represents a 183 m long x 30 m wide RoW) and the smallest patch is less than 1 m long. Such small patches therefore provide considerable opportunity to avoid the clearing of large hollow-bearing trees. Ten sites were surveyed within areas of this specific habitat and the average habitat quality score for the Greater Glider at these sites was 3.9 out of a possible score of 10. Therefore, the areas to be cleared do provide suitable habitat, but not significant habitat, for the species.
- *Too intense or frequent fires*: the installation of pipelines which requires welding of the pipe sections during the construction phase is the only time that the project will pose a risk of fires in the riparian vegetation communities that may support Greater Gliders. The welding of pipes is common practice and numerous controls are put into place to avoid fires during these activities (see Table 5.3). Such controls include:
  - hot works (e.g. welding, grinding, oxy-cutting) will be conducted only in designated hot works areas, unless under the control of a Hot Work permit detailing the applicable safety and other fire prevention requirements
  - vegetation within 5 m of planned hot works will be protected by ‘humpy’ (or similar enclosure), fire blankets (or similar barrier), or thorough ‘wetting-down’ of vegetation
  - no combustible material in close proximity to hot works activities
  - appropriate and operable fire-fighting equipment to be carried with crews and personnel trained in its use
  - a water truck will generally be in the vicinity of crews (for dust suppression purposes) and will serve as an emergency water source in the event of a fire
  - hot works are undertaken on cleared ground and the sides of welding habitats (i.e. screens or similar) are down at all times
- *Timber production*: this threat is related to timber production logging and is therefore not relevant for this project
- *Climate change*: this threat is related to potential changes in vegetation lushness and terrain wetness affecting the suitability of habitats for the Greater Glider. These aspects will not be affected by the pipeline project
- *Barbed wire fencing (entanglement)*: no barbed wire (temporary or permanent) is installed as part of a pipeline project and therefore this is not relevant

- *Hyper-predation by owls*: this threat is related to predation from Powerful and Sooty owls. Neither of these species occur in the study area of the proposed pipeline works and the proposed works would not introduce these species into the area, and as such this threat is not relevant to this project
- *Competition from Sulphur-crested Cockatoos*: this threat in the EPBC Conservation Advice relates specifically to the increasing number of Sulphur-crested Cockatoos in the Blue Mountains which is not relevant to this project, nor would this project introduce more Sulphur-crested Cockatoos to the area.
- *Phytophthora root fungus*: this fungus affects the health of eucalypt trees (and some stone fruit trees). It is spread by spores when free water is present in nursery soil or on aerial plant surfaces (Queensland Government 2019 Information Sheet). The project will not introduce soil (particularly nursery soil) or mulch to the base of eucalypts and therefore this threat to the Greater Glider is not relevant for this project.

With reference to the EPBC Significant Impact Guidelines, the impact is not considered to trigger any of the criteria and would not in particular lead to a long-term decrease in the size of an important population; reduce the area of occupancy of an important population; or adversely affect habitat critical to the survival of the species. As noted above, the project would not significantly increase or introduce any of the threats for the species as noted in the EPBC Conservation Advice. As such, the proposed disturbance of 3 ha (or 1.1% of the suitable habitat for the Greater Glider within the study area) spread across 16 small patches of vegetation within the pipeline corridors is not considered to represent a significant impact on this species.

Mitigation measures to further reduce potential impacts on this species have been included in Section 5.

## 4.5 Squatter Pigeon

Section 3.6 highlights the scarcity of previous records and suitable habitat for this species in the wider SGP area despite it being a relatively easy species to observe and locate. It is genuinely considered by the suitably qualified ecologists that conducted the surveys for this project as being a transient species at best within the project area.

Sections 3.2 and 3.6 provide significant justification for why general habitat should not be included in the impact assessment as habitat for this species. Further, most areas mapped as general habitat are forest and yet Squatter Pigeon associates with open grasslands (including grazing land) rather than heavily wooded habitats. Those records from within wooded habitats usually represent birds along roadside verges, they are unlikely without this type of disturbance, and the record may not reflect the bird using remnant vegetation. Within the SGP, their best foraging habitat is along open grassy woodland creeks and grassy areas within 3 km of such watercourses. As noted in Section 3.6, the EPBC SPRAT database notes that breeding habitat for the species is within 1 km of a permanent watercourse/waterbody. There is only one permanent watercourse traversed by the pipeline alignments (the water pipeline from the Tipton Dam to the Glendower/Broadwater ponds traverses Wilkie Creek) and as such the potential for breeding habitat exists in this area. It is noted however that the closest record of the Squatter Pigeon to this crossing point is >80km to the north (near Chinchilla: see Figure 3.9) and given the relative ease with which this species can be observed it is highly unlikely the species uses this area for breeding.

To comply with the DotEE request and map the potentially suitable habitat for the species based on the SPRAT database description, a total of 269 ha of habitat occurs in the study area of which 2.7 ha (or 1.1%) would be cleared (comprised of 16 habitat patches). These patches are all of riparian vegetation (REs 11.3.25 and 11.3.27) with a relatively dense ground cover and a habitat quality score between 3.52 and 4.77 (see Table 3.9 of Appendix B for details of the vegetation structure and available microhabitat features for this species). It is noted that this habitat is considered more likely to represent an opportunity for population expansion or dispersal rather than current foraging or breeding habitat.

Threats to this species as per the EPBC SPRAT database are vegetation clearance, overgrazing by livestock and feral herbivores, introduced weeds, inappropriate fire regimes, thickening of understorey vegetation, predation by feral cats and foxes, trampling of nests by domestic stock and illegal shooting. Those of relevance to the proposed action are vegetation clearance, introduced weeds, fire regimes and illegal shooting. Mitigation measures to reduce potential impacts on this species have been included in Section 5.

With reference to the EPBC Significant Impact Guidelines, the impact is not considered to trigger any of the criteria and would not in particular lead to a long-term decrease in the size of an important population; reduce the area of occupancy of an important population; or adversely affect habitat critical to the survival of the species. As such, the proposed disturbance of this habitat is not considered to represent a significant impact on this species. This is largely due to the species not occurring in the area, the species ability to fly and therefore avoid direct impacts, the minimal clearing of potential foraging habitat (1.1% of that available in the study area) and the control measures that will be put in place to avoid indirect impacts such as introduced weeds and fire.

#### 4.6 Murray Cod

As noted in Section 3.7 and Table 4.1, Arrow is very familiar with this species and there is no potentially suitable habitat for the Murray Cod within the project area (no permanent water and most pools likely to dry up during an average rainfall year) and there is no likelihood of a significant impact on this species as a result of this project.

#### 4.7 Yakka Skink

The nearest dated record of this species to the proposed activities was recorded in 1987 (some 32 years ago) despite thousands of hours of survey effort conducted by the world renowned herpetologist Dr Simon Hudson. The record was 4 km to the east of the eastern most section of the Girrahween export pipeline. Based on the species poor representation within or near to Arrow tenements, this species has been previously considered 'unlikely' to occur and has not been the subject of habitat mapping.

The EPBC SPRAT database identifies six land zones and eight forest types that are considered suitable for this species. Within the study area, this broad habitat description correlates with five common REs and a total of 4,567 ha. Of this suitable habitat 54 ha (or 1.2%) would be cleared (comprised of 127 remnant habitat patches and 29 regrowth patches). The average patch size to be cleared is 0.35 ha (which represents a 111 m long x 30 m wide RoW). The largest clearing in any given patch is 3.8 ha (which represents a 1.27 km long x 30 m wide RoW) and the smallest patch is less than 1 m long. Thirty-two sites were surveyed within areas of this habitat and the average habitat quality score for the Yakka Skink at these sites was 3.7 out of a possible score of 10. Table 3.4 of Appendix B details the vegetation composition, structure, available microhabitat

features and possible habitat use for this species in the study area. Table 3.5 of Appendix B lists the habitat quality score for each of the 32 sites surveyed for the species and identifies that the habitat for this species is typically poor (scores ranging between 1.9 and 4.7 out of 10).

The assessment maps large areas as Core Habitat Possible, and as per the guidelines, this includes RE's on landzones 3, 5 and 7 (see Table 3.4; also Table 3.4 of Appendix B). REs that have been excluded from this mapping are typically subject to flooding (e.g. REs 11.3.2 and 11.3.27), which will compromise the integrity of burrows upon which the species relies. Please note the sheer paucity of species records from the SGP area detailed in the habitat assessment section above, and that the SGP area is at the very eastern limit of the species' occurrence. These factors, along with the specific survey effort detailed above (Section 3.8), suggest the species is unlikely.

Threats to this species as per the EPBC SPRAT database and EPBC Conservation Advice are the historic broadscale land clearing in the Brigalow Belt, habitat degradation, inappropriate roadside management, removal of woody debris and rock microhabitat features, ripping of rabbit warrens and predation by feral animals. The proposed pipeline project would not increase or introduce any of these threats in the study area. Mitigation measures to further reduce potential impacts on this species have been included in Section 5.

It is recognised that the area of potential habitat to be impacted is relatively high, however the species is unlikely to occur in the area and the quality of the habitat to support the species is low. Furthermore, with reference to the EPBC Significant Impact Guidelines, the impact is not considered to trigger any of the criteria and would not in particular lead to a long-term decrease in the size of an important population; reduce the area of occupancy of an important population; or adversely affect habitat critical to the survival of the species. As such, the proposed disturbance of this habitat is not considered to represent a significant impact on this species. This is largely due to the species not occurring in the area as evidence by the most recent record being 32 years ago and 4 km from the nearest pipeline despite thousands of hours of search effort by the world renowned herpetologist Dr Simon Hudson, the minimal clearing of potential habitat (1.2% of that available in the study area) and the linear and short-term construction phase nature of a pipeline project whereby the project would not undertake roadside maintenance, remove woody debris or rocks, rip rabbit warrens, or introduce feral animals.

## 4.8 Painted Honeyeater

This EPBC listed threatened species was not identified in the DotEE additional information request but has been included for completeness as the species was observed during the surveys conducted for this project.

As per the EPBC Conservation Advice, the Painted Honeyeater is the most specialised of Australia's honeyeaters, feeding mainly on mistletoe fruits. Regional Ecosystems within the off-tenure assessment areas that are considered potential habitat are 11.3.1 and 11.4.3.

The EPBC SPRAT database provides no information with regards to threats for this species. The EPBC Conservation Advice identifies habitat loss as the key threat to the species (largely due to clearing for agriculture and lack of regeneration resulting from grazing by livestock, macropods and rabbits).

Within the study area, a total of 88.5 ha of potential habitat occurs and 2 ha (or 2.3%) would be cleared (comprised of 4 habitat patches). The average patch size to be cleared is 0.36 ha (which represents a 121 m long x 30 m wide RoW). The largest clearing in any given patch is 1.29 ha (which represents a 432 m long x 30 m wide RoW) and the smallest patch 0.1 ha (which represents a 37 m long x 30 m wide RoW). Four sites were surveyed within these vegetation types

and the average habitat quality score for the Painted Honeyeater at these sites was 4.3 out of a possible score of 10. The small Brigalow fragment within the northern section of the Jammatt pipeline (see Figure 3.14) where an individual of the species was observed during the current surveys for this pipeline project will not be impacted by this project (see Section 5 for mitigation measures).

Although the Painted Honeyeater has been frequently recorded within 20 km of the SGP (see Figure 3.13 for location of records), until the off-tenure pipeline surveys (EcoSmart Ecology and 3D Environmental, 2018 and 2019) all historic records from the SGP area have been restricted to the immediate vicinity of Lake Broadwater. The current off-tenure pipeline survey located Painted Honeyeater at a small Brigalow fragment within the northern section of the Jammatt pipeline (see Figure 3.14). All Core Habitat Possible within 2km of a recent (1980+), accurate ( $\pm$  500m) record is classed as Core Habitat Known. This approach is based on QLD essential habitat mapping, but better accounts for the species mobility by increasing the buffer from 1km to 2km. A 2km buffer equates to 1,256 ha, which is much larger than this species' breeding territory (but it is acknowledged the species can move larger distances when non-breeding). No known habitat is impacted by the pipeline project. Thus the area of potential habitat to be impacted is low (2 ha or 2.3% of the species potential habitat in the study area), the quality of the habitat to support the species is relatively low (habitat quality score of 4.3 out of 10) and the species is highly mobile. In other words, 2 ha of potential foraging habitat for this species will be impacted by the project but this habitat has not proven to support an important population of the species as is evidenced by the few records in the area of the pipeline study area (see Figure 3.13). By contrast, in areas that are considered important for the species, observations of the species are relatively common (see the clusters of observations on Figure 3.13 approximately 40km east of Chinchilla (around Jandowae) and approximately 40 km north-east of Cecil Plains (around Jondaryan) – both areas being approximately 60km east of the proposed pipelines).

With reference to the EPBC Significant Impact Guidelines, the impact is not considered to trigger any of the criteria and would not in particular lead to a long-term decrease in the size of an important population (as per the explanation above); reduce the area of occupancy of an important population; or adversely affect habitat critical to the survival of the species. As such, with mitigation measures in place to avoid the small patch of Brigalow from which an individual was observed and to reduce impacts to this species in general, the proposed disturbance of this habitat is not considered to represent a significant impact on this mobile bird species.

Mitigation measures to further reduce potential impacts on this species have been included in Section 5.

## 4.9 Kogan Waxflower

This EPBC listed threatened species was not identified in the DotEE additional information request but has been included for completeness as the species was observed during the surveys conducted for this project.

Regional Ecosystems within the off-tenure assessment areas that are considered likely to contain the Kogan Waxflower are REs 11.7.4, 11.7.5, 11.7.6 and 11.7.7. Within the assessment area, populations were identified at 2 locations, associated with REs 11.7.4 and 11.7.5, both on the one pipeline alignment being the Lynwood export line to Jordan (see Figures 2.1 and 3.15) and both on or adjacent to property owned by QGC (and thus the locations of the populations are well known to the CSG industry).

Looking from the perspective of the vegetation types that may support the plant species rather than those that are known to support the species, and therefore from a very conservative point of

view because being a plant (i.e. not mobile) and relatively easy to identify, a total of 959.5 ha of suitable habitat occurs within the study area and of this mapped habitat 7 ha (or 0.7%) would be cleared (comprised of 46 remnant habitat patches and 3 regrowth patch). Twelve sites were surveyed within these vegetation types and the average habitat quality score for the Kogan Waxflower at these sites was 4.1 out of a possible score of 10. It is also noted that the EPBC Conservation Advice notes that species is found on residual hills which are remnants of laterised Cretaceous sandstones, where the soils are shallow. These areas are not favoured for the installation of pipelines because it is hard for trenching and therefore would be avoided wherever possible.

The EPBC SPRAT database and EPBC Conservation Advice identify threats to this species as being habitat loss, road works, habitat disturbance by forestry practices and recreational use in State Forests, introduced weeds, grazing and fire. Habitat loss is the only relevant threat for this project because the project does not have the potential to affect road works, forestry practices or grazing, and control measures will be implemented to avoid weed introductions and fire (see Section 5).

With regards to habitat loss, a small fraction of the available mapped habitat will be cleared (0.7 %), and the quality of the impacted habitat to support the species is low (score of 4.1 out of 10; see Appendix B). It is also noted that these mapped habitats will be avoided wherever possible because they are not favoured for the installation of pipelines. The impacted areas do not represent habitat critical to the survival of the species. This statement is made because as per the EPBC Conservation Advice, approximately 84% of known plants are from 2 populations and neither of these populations are located within the study area. Also, of the total 11 known populations of Kogan Waxflower, seven occur on road verges, which highlights that this species is able to tolerate significant levels of disturbance. In the two small impacted areas where this species currently occurs along the off-tenure pipelines, it will be avoided wherever possible and if individuals are impacted the species is likely to come back after the RoWs are rehabilitated.

With reference to the EPBC Significant Impact Guidelines, the impact is not considered to trigger any of the criteria and would not in particular lead to a long-term decrease in the size of an important population (as explained above); reduce the area of occupancy of an important population; or adversely affect habitat critical to the survival of the species. As such, the proposed disturbance of this habitat is not considered to represent a significant impact on this species.

Mitigation measures to further reduce potential impacts on this species have been included in Section 5.

#### 4.10 Brigalow

This EPBC listed threatened ecological community (TEC) was not identified in the DotEE additional information request but has been included for completeness as the community was recorded during the surveys conducted for this project.

The Brigalow Dominant and Co-dominant TEC has historically been highly fragmented throughout the study area, generally existing as linear remnants within roadside reserves and easements. Within the assessment area, the community is formed by two REs, being RE11.3.1 and RE11.4.3.

The EPBC SPRAT database identifies threats to this vegetation community as being clearing for agriculture, pastoral purposes or mining, high intensity fires, introduced pasture grasses such as Buffel Grass increasing the risk of high intensity fires and overgrazing. Habitat loss is the only relevant threat for this project because control measures will be implemented to avoid introductions of Buffel Grass and fire (see Section 5).

Within the study area, a total of 195 ha of Brigalow TEC occurs and 1.75 ha (or 0.9%) would be cleared (comprised of 1 habitat patch). As per the EPBC Conservation Advice, a Brigalow patch must be 0.5 ha or more in size in order to be considered the Brigalow ecological community. Four sites were surveyed within these vegetation types and the average habitat quality score at these sites was 2.59 out of a possible score of 10. Brigalow has been highly fragmented in the study area and generally exists as linear remnants within roadside reserves. Canopy heights range from 14 to 21m and 30-60% canopy cover in the better preserved communities. Shrub and ground coverage is variable (see Section 3.4.1 of Appendix B).

Although the area of the Brigalow TEC impacted is very low (0.9% of that present in the study area), and the habitat quality of the patches is very low (score of 2.59 out of 10), with reference to the EPBC Significant Impact Guidelines it will technically reduce the extent of the ecological community and therefore triggers the criteria for a significant impact. As such, Arrow will provide an offset for Brigalow (see Section 7 and Appendix E for details).

## 5. Avoidance, Safeguards and Mitigation Measures

### 5.1 Measures

Arrow has been assessing the proposed action since 2017 and has already implemented several measures to avoid or reduce impacts to MNES. The key measures implemented to date have been:

- Working closely with QGC to understand the environmental values on their tenures and selecting pipeline alignments to avoid these values where practicable
- Seeking opportunities to co-locate the proposed pipeline RoWs with existing, and therefore cleared, pipeline easements to reduce the width of the new easement and therefore to reduce impact areas and habitat fragmentation
- Completing field surveys in most areas of remnant vegetation to understand the likelihood of this vegetation to provide habitat for EPBC listed threatened species and communities
- Reviewing effective impact minimisation and mitigation measures based on scientific evidence for wildlife (e.g. Gleeson & Gleeson 2012).

The above measures have been very successful in avoiding and reducing impact to MNES. For example, the disturbance footprint required to install the pipelines on the original alignments (prior to environmental impact assessment) would have required the clearing of 147 ha of Koala habitat. The latest iteration of the pipeline alignment has reduced the 147 ha to 65 ha (thus reducing the impacts to Koala habitat by 82 ha).

Additional measures that will be undertaken to further avoid or reduce impacts to MNES are as described for each species below. These measures are gleaned from various published documents such as Gleeson & Gleeson (2012) and Arrow's recently approved Queensland Government and Australian Government Species Impact Management Plans for the Surat Basin and Surat Gas Project respectively (additional references are also included below where available). Arrow has been applying these measures with success in the Surat Basin for several years and will monitor the effectiveness of these measures as per the EPBC approved SGP Species Impact Management Plan (see Section 5.2). The approved Arrow Management Plans are available on our website at: <https://www.arrowenergy.com.au/environment/environmental-management-plans-and-reports>.

## Koala

- Koala food trees will be retained wherever possible (DotEE 2014)
- Speed limits will be restricted to <60 km/hr during dawn and dusk and at night on project-controlled roads to reduce the potential for vehicle collisions with wildlife (DotEE 2014)
- There is no EPBC Recovery Plan for this species. The following measures from the Nature Conservation (Koala) Conservation Plan 2017 (DEHP 2017) will be implemented:
  - clearing of the koala habitat trees is carried out in a way that ensures koalas on the area being cleared (the clearing site) have enough time to move out of the clearing site without human intervention
  - clearing for the pipelines will be carried out in stages and that between each stage and the next there is at least 1 period of 12 hours starting at 6p.m. on a day and ending at 6a.m. on the following day during which no trees are cleared on the site
  - no koala habitat tree in which a koala is present, and no koala habitat tree with a crown overlapping a tree in which a koala is present, will be cleared
  - a fauna spotter-catcher (FSC) will be present during clearing in a Koala habitat area where Koala habitat trees have a trunk of a diameter of more than 10 cm at 1.3 m above the ground
  - The FSC will conduct a pre-clearance fauna survey and operate as per Arrow's Fauna Spotter-Catcher Work Instruction (2019) which is in accordance with DES (2013) and Hanger & Nottidge (2009) among other documents, and includes but is not limited to:
    - Searching the area proposed to be cleared (including previously stockpiled material) for the presence of fauna species or fauna breeding places. If fauna or fauna signs are detected, assessing the most appropriate method to avoid or minimise impacts to the individual, habitat or breeding place. The following hierarchy of control shall be employed:
      - Avoid the habitat and/or feature containing the fauna species.
      - Minimise interfering with the habitat feature until the fauna has moved away on its own. If the species is a koala (*Phascolarctos cinereus*) the tree where it is located and any other tree with overlapping foliage shall not be felled until the animal has moved away. This may require the tree(s) being left standing overnight.
      - Minimise interfering with habitat features by preferentially retaining them in situ, but if removed they shall be cleared in a controlled manner and relocated. Hollow-bearing branches or logs shall be checked by the spotter-catcher prior to cutting.
      - Mitigate impacts to fauna when habitat features are cleared or relocated. The spotter-catcher shall inspect the habitat features for sheltering fauna. If fauna are discovered, then the spotter-catcher shall assess the most appropriate method to extract the fauna, if required. This may involve cutting hollow limbs from felled trees,

gently breaking open hollow logs or carefully excavating soil cracks. Habitat features may remain untouched if the spotter-catcher considers that the fauna is uninjured and could move away on its own. If fauna has been, or is likely to have been injured, then it shall be captured and contained in a hessian bag or pet carrier or similar for transport to the nearest qualified veterinary surgeon for assessment. With the exception being if the animal is badly injured and there is no hope for recovery then the animal may be euthanased on site.

- Mitigate impacts to the breeding cycle of fauna, i.e. if it is determined that a nest containing eggs or young should be moved then the authorised management actions as described in Table 5.1 must be followed. Where the breeding of threatened species, special least concern (SLC) species or colonial breeding species is concerned, then the Arrow Species Management Program (SMP Queensland) and/or Species Impact Management Program (SIMP Australian) must be followed. If a species is detected which is not covered in the SMP and/or SIMP then works will cease until negotiation with the relevant department can be finalised.

**Table 5.1 Authorised Management Actions for Animal Breeding Places**

Animal group	Breeding place status	Action
Extinct in the wild, endangered, vulnerable and near threatened animals (EVNT)	All	Follow approved Arrow Species Management Program (Queensland) and Species Impact Management Plan (Australian).
Least concern animals – special least concern or colonial breeding	All	Follow approved Arrow Species Management Program (Queensland).
Other least concern animals	Contains young or eggs	Avoidance of unnecessary disturbance; suitable qualified and experienced person removes animal breeding place and eggs and/or young rehabilitated by authorised wildlife carer.  Eggs may only be destroyed by an authorised person under an approved damage mitigation permit as a last resort.
	No eggs or young	Proceed with caution. Remove breeding place (if applicable).

- The following measures from the approved Surat Gas Project EPBC Species Impact and Management Plan (Arrow 2018) will be implemented:
  - Open trenches will be inspected and monitored as per the APIA Code of Environmental Practice and will be checked within two hours of sunrise and trapped fauna released
  - The time a trench is left open will be minimised. Fauna exit points will be incorporated when construction is within 1 km of native vegetation, using appropriate material. Fauna refuges, such as sawdust-filled bags, will be provided regularly through areas of high fauna activity
  - As soon as practical following pipe laying, the trench will be backfilled with excavated material, compacted and topsoil replaced and erosion controls implemented
  - Ensure construction activities do not extend beyond the work site boundaries
  - When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts
  - Arrow will manage food, waste and other project activities to prevent or minimise the potential for these to transport or attract pest animals such as wild dogs which may then impact the Koala
  - Disturbance or harassment of wildlife will be prohibited.

#### Dunmall's Snake

- There is no EPBC Recovery Plan for this species. The EPBC Conservation Advice for this species notes the main ongoing threats as being overgrazing by stock, modification for grazing and agriculture, pasture improvement, crop production and urban development (DotEE 2014). The proposed project will not contribute to or exacerbate any of these threats.
- The following measures from the approved Surat Gas Project EPBC Species Impact and Management Plan (Arrow 2018) will be implemented:
  - Open trenches will be inspected and monitored as per the APIA Code of Environmental Practice and will be checked within two hours of sunrise and trapped fauna released
  - The time a trench is left open will be minimised. Fauna exit points will be incorporated when construction is within 1 km of native vegetation, using appropriate material. Fauna refuges, such as sawdust-filled bags, will be provided regularly through areas of high fauna activity
  - As soon as practical following pipe laying, the trench will be backfilled with excavated material, compacted and topsoil replaced and erosion controls implemented
  - Appropriately trained personnel or a FSC will be used to capture injured wildlife, where possible. If further action is required, consult with a qualified vet to determine appropriate action
  - The FSC will be present during clearing. The FSC will be suitably qualified as per the definition provided in EPBC 2010/5344. The number of FSCs on site at the time of clearing will depend on the number of machines being used at any given time

- Speed limits on Project controlled roads will be developed with due consideration to reduce the potential for vehicle collisions with wildlife at least no greater than 60 km/hr
- The disturbance footprint and vegetation clearing will be the minimum required to safely install the infrastructure
- Construction activities will not extend beyond the work site boundaries
- Retain woody debris, logs and rocks for use in rehabilitation, spreading them over part or all of the corridor or, as a minimum, piled along the edge of the cleared corridor to provide refuge for fauna
- Fell trees away from existing stands where practicable. Where trees unavoidably fall into a stand, leave trees in situ to emulate natural tree fall and provide habitat for ground-dwelling species, where practicable
- Rehabilitation plans will be developed addressing ground preparation requirements, natural and constructed drainage patterns, soil erodibility, contamination, slope steepness and length, vegetation cover, land use and landowner requirements. Partial rehabilitation of linear infrastructure will be undertaken to reduce edge effects (including weed invasion)

### Greater Glider

- There is no EPBC Recovery Plan for this species. The following measures are proposed to address the relevant threats for this species listed in the EPBC Conservation Advice (DotEE 2016):
  - The disturbance footprint and vegetation clearing will be the minimum required to safely install the infrastructure
  - When clearing vegetation, Arrow will seek to avoid clearing hollow-bearing trees, creating gaps in stands or patches or isolating parcels of remnant vegetation
  - Fire-fighting equipment will be readily available on-site, inspected and serviced in accordance with relevant legislation and standards
  - hot works (e.g. welding, grinding, oxy-cutting) will be conducted only in designated hot works areas, unless under the control of a Hot Work permit detailing the applicable safety and other fire prevention requirements
  - vegetation within 5 m of planned hot works will be protected by 'humpy' (or similar enclosure), fire blankets (or similar barrier), or thorough 'wetting-down' of vegetation
  - no combustible material in close proximity to hot works activities
  - appropriate and operable fire-fighting equipment to be carried with crews and personnel trained in its use
  - a water truck will generally be in the vicinity of crews (for dust suppression purposes) and will serve as an emergency water source in the event of a fire
  - hot works are undertaken on cleared ground and the sides of welding habitats (i.e. screens or similar) are down at all times
  - no barbed wire (temporary or permanent) is installed as part of a pipeline project and therefore this is not relevant

- the project will not introduce soil (particularly nursery soil) or mulch to the base of eucalypts to avoid the threat of *Phytophthora* root fungus introduction.
- The following additional measures from the approved Surat Gas Project EPBC Species Impact and Management Plan (Arrow 2018) will be implemented:
  - Appropriately trained personnel or a FSC will be used to capture injured wildlife, where possible. If further action is required, consult with a qualified vet to determine appropriate action
  - The FSC will be present during clearing. The FSC will be suitably qualified as per the definition provided in EPBC 2010/5344. The number of FSCs on site at the time of clearing will depend on the number of machines being used at any given time
  - Assess trees prior to felling for potential nesting hollows. If identified, and if the tree cannot be avoided, fell trees in the presence of a qualified fauna spotter-catcher and roll them so that the hollows are facing upwards, allowing fauna to escape
  - Avoid damaging standing trees not identified for removal. Limit the scraping of standing tree trunks and breaking of limbs by equipment as far as practicable
  - Construction activities will not extend beyond the work site boundaries
  - Reduce light spill resulting from project activities to reduce disturbance to nocturnal fauna.

### Squatter Pigeon

- There is no EPBC Recovery Plan for this species. The following measures are proposed to address the relevant threats for this species listed in the EPBC Conservation Advice (DotEE 2015):
  - The disturbance footprint and vegetation clearing will be the minimum required to safely install the infrastructure
  - Work sites will be inspected for weeds, and vehicles and equipment that have potentially been in contact with weeds will be cleaned down before entering new work sites to avoid introduction and spread of weeds
  - All relevant personnel will be advised of the location and extent of weed infestations in the vicinity of the work areas and the risks involved in moving from one site or property to another
  - When sourcing maintenance materials, materials such as bedding sand, topsoil, straw bales and sand bags will be brought to site only after it is ascertained that the materials are not contaminated with weeds and plant or animal pathogens. A weed hygiene declaration form will be requested from the supplier where there is possible risk of contamination in products
  - Fire-fighting equipment will be readily available on-site, inspected and serviced in accordance with relevant legislation and standards
  - Disturbance, harassment or shooting of wildlife will be prohibited

- Arrow will manage food, waste and other project activities to prevent or minimise the potential for these to transport or attract pest animals such as feral cats and foxes which may then impact the Squatter Pigeon

### Murray Cod

- No habitat identified as suitable for the Murray Cod will be impacted.

### Yakka Skink

- There is no EPBC Recovery Plan for this species. The EPBC Conservation Advice for this species notes the main ongoing threats as being inappropriate roadside management, removal of wood debris and rock microhabitat features, ripping of rabbit warrens and predation by feral animals (DotEE 2014). The following measures are proposed to address the relevant threats for this species:
  - The disturbance footprint and vegetation clearing will be the minimum required to safely install the infrastructure
  - Retain woody debris, logs and rocks for use in rehabilitation, spreading them over part or all of the corridor or, as a minimum, piled along the edge of the cleared corridor to provide refuge for fauna
  - Fell trees away from existing stands where practicable. Where trees unavoidably fall into a stand, leave trees in situ to emulate natural tree fall and provide habitat for ground-dwelling species, where practicable
  - Arrow will manage food, waste and other project activities to prevent or minimise the potential for these to transport or attract pest animals such as feral cats and foxes which may then impact the Yakka Skink
- The following additional measures from the approved Surat Gas Project EPBC Species Impact and Management Plan (Arrow 2018) will be implemented:
  - Open trenches will be inspected and monitored as per the APIA Code of Environmental Practice and will be checked within two hours of sunrise and trapped fauna released
  - The time a trench is left open will be minimised. Fauna exit points will be incorporated when construction is within 1 km of native vegetation, using appropriate material. Fauna refuges, such as sawdust-filled bags, will be provided regularly through areas of high fauna activity
  - Appropriately trained personnel or a FSC will be used to capture injured wildlife, where possible. If further action is required, consult with a qualified vet to determine appropriate action
  - The FSC will be present during clearing. The FSC will be suitably qualified as per the definition provided in EPBC 2010/5344. The number of FSCs on site at the time of clearing will depend on the number of machines being used at any given time
  - Rehabilitation plans will be developed addressing ground preparation requirements, natural and constructed drainage patterns, soil erodibility, contamination, slope steepness and length, vegetation cover, land use and landowner requirements. Partial

rehabilitation of linear infrastructure will be undertaken to reduce edge effects (including weed invasion)

### Painted Honeyeater

- There is no EPBC Recovery Plan for this species. The EPBC Conservation Advice for this species notes the main ongoing threats as being grazing of habitat by livestock, native macropods and rabbits. Other threats are listed as competition with the aggressive Noisy Miner, predation by invasive species such as the Black Rat, deliberate removal of mistletoe from production forests, pasture improvement, collision with road vehicles and nest predation by other birds (DotEE 2015). The proposed project will not contribute to or exacerbate most of these threats. Arrow will implement the following measures to mitigate impacts associated with habitat clearing and collision with road vehicles:
  - The patch of Brigalow that contains mistletoe and from which an individual of this bird species was observed will not be cleared for this project
  - The disturbance footprint and vegetation clearing will be the minimum required to safely install the infrastructure
  - Construction activities will not extend beyond the work site boundaries
  - Fell trees away from existing stands where practicable. Where trees unavoidably fall into a stand, leave trees in situ to emulate natural tree fall and provide habitat for ground-dwelling species, where practicable
  - Speed limits on Project controlled roads will be developed with due consideration to reduce the potential for vehicle collisions with wildlife at least no greater than 60 km/hr

### Kogan Waxflower

- There is no EPBC Recovery Plan for this species. The following measures are proposed to address the main threats of habitat loss, invasive weeds and inappropriate fire regimes for this species (as per the EPBC Conservation Advice, DotEE 2008):
  - The disturbance footprint and vegetation clearing will be the minimum required to safely install the infrastructure
  - Construction activities will not extend beyond the work site boundaries
  - Work sites will be inspected for weeds, and vehicles and equipment that have potentially been in contact with weeds will be cleaned down before entering new work sites to avoid introduction and spread of weeds
  - All relevant personnel will be advised of the location and extent of weed infestations in the vicinity of the work areas and the risks involved in moving from one site or property to another
  - When sourcing maintenance materials, materials such as bedding sand, topsoil, straw bales and sand bags will be brought to site only after it is ascertained that the materials are not contaminated with weeds and plant or animal pathogens. A weed hygiene declaration form will be requested from the supplier where there is possible risk of contamination in products

- Fire-fighting equipment will be readily available on-site, inspected and serviced in accordance with relevant legislation and standards

### Brigalow

- There is no EPBC Recovery Plan for this community. The following measures are proposed to address the main threats of clearing, invasive weeds and inappropriate fire regimes for this community (as per the EPBC Conservation Advice, DotEE 2013):
  - The disturbance footprint and vegetation clearing will be the minimum required to safely install the infrastructure
  - Construction activities will not extend beyond the work site boundaries
  - Work sites will be inspected for weeds, and vehicles and equipment that have potentially been in contact with weeds will be cleaned down before entering new work sites to avoid introduction and spread of weeds
  - All relevant personnel will be advised of the location and extent of weed infestations in the vicinity of the work areas and the risks involved in moving from one site or property to another
  - When sourcing maintenance materials, materials such as bedding sand, topsoil, straw bales and sand bags will be brought to site only after it is ascertained that the materials are not contaminated with weeds and plant or animal pathogens. A weed hygiene declaration form will be requested from the supplier where there is possible risk of contamination in products
  - Fire-fighting equipment will be readily available on-site, inspected and serviced in accordance with relevant legislation and standards.

## 5.2 Monitoring

Monitoring will be undertaken to determine the success of the mitigation and management measures identified within this off-tenure component of the SGP in accordance with the approved EPBC SIMP for the on-tenure components of the SGP (see Tables 5.2 and 5.3).

Monitoring will be conducted by suitably skilled and qualified persons at representative locations. Annual reviews of monitoring data will be conducted during operations, and post closure, to assess trends and performance. Corrective actions will be undertaken based on the outcomes of incident investigations, audits, monitoring results and advice given by the relevant regulatory authority.

Table 5.2 reproduces the monitoring program that was provided in the EPBC SIMP for the SGP and will also be implemented for this off-tenure component of the project. The table describes the location, methods and proposed timing as well as identifying responsible parties, reporting formats, trigger values for corrective actions to be initiated and describes adaptive management responses and / or how they will be determined.

Note that Geocortex and the Arrow Sharepoint database, referred to in Table 5.1 is a web-based collaborative platform that integrates with Microsoft Office and allows multiple users to enter and view project data.

Table 5.3 is also reproduced from the EPBC SIMP for the SGP and identifies the indicators of success and corrective actions that correlate to mitigation measures identified. These actions will also be implemented for the off-tenure pipelines.



Table 5.2 Monitoring program components for EPBC Act species and communities (reproduced from the EPBC approved SGP SIMP)

Monitoring Activities	Methods / commitments	Locations	Timing	Who	Reporting format	Corrective action trigger values	Adaptive management responses
Review of compliance with approval conditions and SIMP mitigation measure commitments	<p>The coordinates and total area of cleared EPBC Act species and community habitat will be recorded and tracked monthly against approved maximum disturbance limits and used for annual compliance reporting.</p> <p>All confirmed cases of non-compliance (and remedial actions) will be reported on the Arrow website.</p> <p>Monitoring and inspection of avoidance, mitigation and management measures will be implemented to ensure the impacts and residual risks continue to be low throughout the lifetime of the Project.</p>	SGP activity areas	Clearing tracked & monitored monthly. Reporting to Dept annual except if non-compliance occurs – self report as per conditions.	Arrow	Annual Compliance Report	Non - compliances	As determined by Annual Compliance Reports
Pre- clearance surveys	<p>Surveys to identify any additional areas that need to be avoided and quantify areas of EPBC Act species, species habitat or TEC which are unavoidable and will be cleared.</p> <p>As a minimum, these will include:</p> <ul style="list-style-type: none"> <li>vegetation mapping at a scale suitable for site-specific planning.</li> <li>identification of habitats for EVNT species.</li> <li>identification of site-specific</li> </ul>	Proposed vegetation clearing sites	Prior to all vegetation clearing Reported annually	Supervised by a suitably qualified person	Annual Pre - clearance Survey Report provided on the Arrow website	Clearances proposed which would result in the project exceeding the maximum disturbance limit for any EPBC Act species or communities	<p>A more detailed assessment will be undertaken to identify if the EPBC Act species, habitat or community can be avoided or impacts minimised.</p> <p>Information on the findings and potential impacts will be prepared and notification provided to DotEE and Department of Environment and Science (DES).</p>



Monitoring Activities	Methods / commitments	Locations	Timing	Who	Reporting format	Corrective action trigger values	Adaptive management responses
	<p>sensitive areas (e.g. ESAs) that require avoidance or buffers.</p> <p>Quantification will be based on field recording of GPS coordinates of the boundary of the habitat within proposed clearing boundaries. These surveys will also be used to ensure that the limits of the area to be cleared are clearly marked on the ground (i.e. high visibility flagging tape, hazard netting or similar) in accordance with the construction limits shown on construction drawings.</p>					including any residual significant impact to any of these that are not included in Table 1 of the EPBC approval.	Approval for additional unavoidable residual significant impacts to any EPBC Act species or community (including any of these which were not in Table 1 of the EPBC approval) will be sought. Arrow also commits to providing offsets for any such additional residual significant impacts.
	Key Koala trees will be identified and visually inspected prior to clearing to ensure that they are free of Koalas.	Proposed vegetation clearing sites	Prior to vegetation clearing and daily during clearing works	Supervised by a suitably qualified person	Koala presence recorded within Geocortex and the Arrow Sharepoint database. Spotter-catcher daily activity records	Koalas located	Trees containing Koalas retained until the animals have moved on.
	Hollow-bearing tree locations and patches of vegetation with a distinct canopy and a dense cluttered shrub layer will be recorded.	Proposed vegetation clearing areas within habitat for MNES	Prior to vegetation clearing	Supervised by a suitably qualified person	Hollow-bearing trees and preferred habitat patches recorded within Geocortex and the Arrow Sharepoint database	Hollow-bearing tree and preferred habitat patches identified	Spotter-catcher present and search for this species in these areas during clearing.

Monitoring Activities	Methods / commitments	Locations	Timing	Who	Reporting format	Corrective action trigger values	Adaptive management responses
	Trees will be assessed for potential nesting hollows prior to felling.	Proposed vegetation clearing sites	Prior to clearing	Supervised by a suitably qualified person	Nesting hollows recorded within Geocortex and the Arrow Sharepoint database. Spotter-catcher daily activity records.	Nesting hollows identified	Trees will be felled in the presence of a FSC and rolled so that the hollows are facing upwards, allowing fauna to escape.
	Data collection, particularly of EVNT species identified during pre-clearance surveys, during trench checking or in other SGP related activities, will be ongoing until rehabilitation is complete. Pre-clearance surveys will include searches for EVNT species and communities.	Predicted and known EVNT species locations	During pre-clearance surveys and checking of open trenches	Arrow	Recorded within Geocortex and the Arrow Sharepoint database	Clearances proposed which would result in the SGP exceeding the maximum disturbance limit for any EPBC Act species or communities including any residual significant impact to any of these which are not included in Table 1 of the EPBC approval.	A more detailed assessment will be undertaken to identify if the EPBC Act species, habitat or community can be avoided or impacts minimised before the clearing takes place. Information on the findings and potential impacts will be prepared and notification provided to DotEE and DES. Approval for additional unavoidable residual significant impacts to any EPBC Act species or community (including any of these which were not in Table 1 of the EPBC approval) will be sought. Arrow also commits to providing offsets for any such additional residual significant impacts.

Monitoring Activities	Methods / commitments	Locations	Timing	Who	Reporting format	Corrective action trigger values	Adaptive management responses
Monitoring for unauthorised clearing	Audits/checks will be undertaken during and after clearing activities to ensure no unauthorised encroachment has occurred. Buffer zones and the Project footprint will be regularly monitored using satellite imagery.	Vegetation clearing areas	At least daily during clearing and at the completion of clearing	Construction contractor (environmental representative)	The Construction Contractor is required to report any unauthorised clearing to the Arrow Environment Manager within 24hrs of becoming aware.	Unauthorised Clearing	Review of CEMP with Construction Contractor and amendment as required.
Fauna spotter-catcher monitoring	A FSC will be present during clearing. The number of FSCs on site at the time of clearing will depend on the number of machines being used at any given time.	Active vegetation clearing areas	At all times during clearing	Suitably qualified FSCs as per the definition provided in EPBC 2010/5344	All human/wildlife interactions or incidents involving EVNT Act fauna species will be reported to Arrow via the Fauna Incident Notification Form (FIN) within 24 hours, and will be detailed in the FSC report to be provided to Arrow at the completion of habitat clearing activities (or weekly if clearing activities are ongoing). The FSC report will also detail all human/wildlife interactions or	Injury to or mortality of individuals of EPBC Act species.	An investigation into possible root causes would be undertaken as well as a review of relevant mitigation measures and the CEMP and refinement of these where necessary.

Monitoring Activities	Methods / commitments	Locations	Timing	Who	Reporting format	Corrective action trigger values	Adaptive management responses
					incidents with any species irrespective of their conservation status. Interactions are defined as observations of the species on the work site, captures, removals and relocations. Incidents are defined as any injury or death.		
Inspection for fauna entrapment	Trenches will be inspected and monitored as per the APIA Code of Environmental Practice and will be checked within two hours of sunrise and trapped fauna released. Additional inspections will be undertaken after rainfall events.	All open trenches	At least daily whenever trenches are open	Suitably qualified person	Fauna rescue records	Injury to or mortality of individuals of EPBC Act species	Construction of additional fauna exit ramps / ladders; installation of additional trench plugs; increased frequency of inspections.
EPBC fauna presence and frequency monitoring	Data collection, particularly of EVNT species identified during pre-clearance surveys, during trench checking will be ongoing until rehabilitation is complete.	Representative habitat areas in proximity to project disturbed areas or infrastructure	Data collection ongoing/Oppportunistic. Statistical analysis annual	Supervised by a suitably qualified person	Annual EPBC Monitoring Report	Statistically significant reduction in EPBC fauna frequency attributable to the SGP	An investigation into root causes would be undertaken as well as a review of relevant mitigation measures and the CEMP and refinement of these where necessary.



Monitoring Activities	Methods / commitments	Locations	Timing	Who	Reporting format	Corrective action trigger values	Adaptive management responses
Analysis of EPBC Act fauna species mortality records	EVNT fauna mortality (e.g. road kill) record database will be maintained and analysed.	All SGP areas	Incident based throughout the life of the project	Arrow	Recorded within Geocortex and the Arrow Sharepoint database and reported in Annual Compliance Report	Any EVNT fauna mortalities caused by SGP activities	Dependence on the cause of mortality responses could include installation of warning signs or fencing and reduction in speed limits in specific locations.
EPBC Act community condition monitoring	Inspections for EPBC community health will be undertaken in accordance with the Queensland Government Department of Environment and Heritage Protection’s Guide to determining terrestrial habitat quality – A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy (2017).	Representative TEC areas in proximity to project disturbed areas or infrastructure	Annual	Supervised by a suitably qualified person	Annual EPBC Monitoring Report	A whole number fall in average habitat quality score for a TEC	An investigation into root causes would be undertaken within 3 months of a corrective action trigger as well as a review of mitigation measures and CEMP and refinement where necessary.
Weed and pest monitoring	Weed surveys (and targeted weed control measures) will be undertaken within sensitive EVNT habitats (particularly threatened communities such as Brigalow). In accordance with the Pest Management Plan regular inspections for pest flora and evidence of pest fauna will be undertaken within Project disturbed areas. Surveys will also search for any new weed and pest species being introduced to an area.	Representative Project disturbance areas within areas known to contain MNES.	At least quarterly and reported at least annually	Arrow	Annual EPBC Monitoring Report	New weeds recorded. Higher weed cover within disturbed areas relative to adjoining areas.	Additional weed management measures at problem locations. Review of Weed and Pest Management Plan.



Monitoring Activities	Methods / commitments	Locations	Timing	Who	Reporting format	Corrective action trigger values	Adaptive management responses
Rehabilitation monitoring	<p>Pipeline RoWs will be regularly inspected until ground stabilisation and natural revegetation or pasture grasses or crops are established. After decommissioning, rehabilitation areas will be inspected for regrowth similar to the surrounding environment. Regular checks of rehabilitation success will be carried out). A rehabilitation management plan for decommissioning will be developed and implemented which includes inspections and maintenance of rehabilitated areas until rehabilitation sign off criteria are met.</p> <p>Surveys/inspections of the rehabilitated areas will be undertaken to identify whether the general objectives of the rehabilitation strategy are being met, and whether a sustainable and stable landform has been achieved. Surveys/inspections will be conducted by suitably skilled and qualified persons at representative locations. Annual reviews of surveys/inspection data will be conducted during operations, and post closure, to assess trends and performance.</p>	All Project disturbed areas	Post-construction, at least quarterly and reported annually	Supervised by a suitably qualified person	Annual EPBC Monitoring Report	Rehabilitation data trending away from, and prior to, non-achievement of rehabilitation completion criteria	An investigation into root causes would be undertaken within 3 months of the corrective action trigger including a review of the suitability of rehabilitation methods being applied.

Monitoring Activities	Methods / commitments	Locations	Timing	Who	Reporting format	Corrective action trigger values	Adaptive management responses
Offset area monitoring	<p>As per EPBC Approval Conditions for the SGP (EPBC 2010/5344), no Project Phases will commence until an Offset Strategy addressing offset obligations for that Project Phase has been developed by Arrow and approved by the Minister.</p> <p>Each Strategy will set out a program for monitoring and reporting on the effectiveness of the management measures, and identify the performance and completion criteria to be tracked for the offset areas.</p>	Offset areas	During the life of each offset area	Arrow	Offset progress reports which will feed into the Offset Strategies for subsequent Project Phases	These will be identified within each strategy / offset area management plan	These will be identified within each strategy / offset area management plan.

**Table 5.3 Description of mitigation measures, indicators of success and corrective actions**

Mitigation	Commitment	Indicator of success	Corrective action
<p>Pre-construction clearance surveys / minimise clearing</p>	<ul style="list-style-type: none"> <li>• When the project activities proceed through the detailed planning phase, a field inspection of the specified disturbance footprint (this is specified by a surveyor in the field) will be undertaken by a suitably qualified ecologist and the presence, absence and extent of environmental values will be verified and mapped in the field via GIS. The results of this step will be recorded within Geocortex and the Arrow Sharepoint database.</li> <li>• Where environmental values are confirmed, a ‘framing trade-offs’ session will be held with the project engineers, planners and ecologists to determine if the location of the activities can be modified to avoid and/or reduce the impact to environmental values. In the event that EPBC species or community habitat cannot be avoided, the actual area to be cleared will be surveyed to quantify the impacts. This data will be recorded and cumulative impact areas tracked.</li> <li>• The disturbance footprint and vegetation clearing will be minimised.</li> <li>• The land cleared for construction purposes will be kept to the minimum necessary, especially during the drier months of the year.</li> <li>• Land disturbance will be minimised with the smallest practical area of land being disturbed in the shortest practicable time.</li> <li>• All operations will be planned to ensure minimal damage on any vegetation, cropping or pasture areas outside the limits to be cleared.</li> <li>• Disturbance within the following areas will be avoided where possible:                         <ul style="list-style-type: none"> <li>– Endangered EPBC Act TECs: Brigalow Ecological Community; Coolibah-Black Box Woodlands; Weeping Myall Woodlands).</li> <li>– Core habitat for EVNT species.</li> </ul> </li> <li>• Pre-clearance surveys will be conducted to identify any additional areas that need to be avoided. As a minimum, these will include:                         <ul style="list-style-type: none"> <li>– vegetation mapping at a scale suitable for site-specific planning.</li> <li>– identification of habitats for EVNT species.</li> <li>– identification of site-specific sensitive areas (e.g. ESAs) that require avoidance or buffers.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Preconstruction clearance surveys by a suitably qualified ecologist are conducted at every site of proposed activities in areas mapped as habitat for MNES</li> <li>• There is documented evidence that the management hierarchy described in Section 2 has been implemented at every site of proposed activities in areas mapped as habitat for MNES</li> <li>• Linear infrastructure easements (right-of-way) will be within the limits authorised by the Environmental Authority (EA)</li> <li>• The MNES impact areas are equal to or less than the impact areas shown in Tables 1.2 of this document</li> </ul>	<ul style="list-style-type: none"> <li>• Undertake preconstruction clearance surveys by suitably qualified ecologist</li> <li>• Investigate the cause of non-conformance with the management hierarchy and amend the relevant processes / procedures to avoid future non-conformance</li> <li>• Investigate the cause of non-conformance with EA conditions and amend the relevant processes / procedures to avoid future non-conformance</li> <li>• Notify the Department of the Environment and Energy of impacts beyond those shown in Table 1.2 and make the necessary adjustment in the Offset Strategy / Plan for the subsequent phase</li> </ul>



Mitigation	Commitment	Indicator of success	Corrective action
	<ul style="list-style-type: none"> <li>• Wells, gathering lines and access tracks will be located within previous clearings or non-remnant vegetation if possible.</li> <li>• Infrastructure will be designed to avoid undisturbed tracts of remnant vegetation, where practical. Where collection and gathering infrastructure is to be placed within contiguous vegetation, collection networks will be designed to avoid dissection.</li> <li>• Access track location will avoid the repeated isolation of small parcels of remnant vegetation from more continuous tracts.</li> <li>• Vegetation disturbance will be minimised wherever practical. Corridors for linear infrastructure will be as narrow as practical, particularly when crossing linear corridors of vegetation. Areas cleared for field development will be as small as practical.</li> <li>• Habitat trees will be retained where practicable.</li> <li>• Removal of riparian vegetation will be avoided when directional drilling and reduction of right of ways where practical.</li> <li>• Access tracks and pipelines will deviate around sensitive vegetation where practicable.</li> <li>• Sensitive infrastructure design principles will be applied to avoid watercourse, drainage lines and riparian areas where practicable.</li> <li>• Pre-clearance surveys will be undertaken to determine the likelihood of the species (including weeds) occurring.</li> <li>• Where EVNT species are identified in proposed development areas, consideration will be given to mitigation measures such as translocation and/or propagation of flora species. Progress of any translocation programs will be monitored in accordance with the relevant translocation management plans.</li> <li>• The width of construction RoWs will be minimised within areas of sensitivity to the greatest extent practicable without compromising the safety of workers.</li> <li>• Buffer zones will be adopted for Project activities (with the exception of required creek crossings), in different areas of constraint, as defined by the project's constraints mapping.</li> <li>• Tracks will be restricted in riparian zones and durations of impacts minimised, except in the immediate vicinity of creek crossings.</li> <li>• During the design and construction of waterway crossings, care will be taken to minimise</li> </ul>		



Mitigation	Commitment	Indicator of success	Corrective action
	<p>the footprint of the structure and to avoid unnecessary disturbance to stream beds and banks.</p> <ul style="list-style-type: none"> <li>• Where practical the width of the easement will also be narrowed at these points, further reducing impacts on stream banks, beds and riparian zones by restricting the area of waterway that would be disturbed.</li> <li>• Gathering line and access road creek crossings will be kept to a minimum where possible.</li> <li>• Watercourse crossings will be minimised, where practicable, during route selection. Where required, crossing locations will be selected to avoid or minimise disturbance to aquatic flora, waterholes, watercourse junctions and watercourses with steep banks.</li> <li>• Watercourse crossings will be designed to enable passage of flows resulting from a 1 in 100 year average recurrence interval flood event, as a minimum.</li> <li>• Gathering lines and tracks will be designed to avoid watercourses, drainage lines and riparian areas (particularly permanent watercourses or perennial aquatic habitat), where practicable.</li> <li>• Pipeline RoWs widths will be designed to be narrower at watercourse crossings, where practicable.</li> </ul>		
<p>Construction activities as per plan (no-go areas)</p>	<ul style="list-style-type: none"> <li>• Delineation of disturbance boundary limits of works will be clearly established prior to commencement of clearing and soil stripping.</li> <li>• Disturbance exclusion zones (or management buffers) will be established and managed during construction and operations to effectively protect ESAs as defined by the project’s constraints mapping.</li> <li>• Trees will be felled away from existing vegetation not identified for removal where practicable.</li> <li>• Damage to trees (e.g. through scraping of tree trunk or breaking of limbs by equipment) not identified for removal will be avoided where practicable.</li> <li>• Avoidance boundaries will be clearly delineated prior to clearing.</li> <li>• Audits/checks will be undertaken during and after clearing activities to ensure no unauthorised encroachment has occurred.</li> <li>• Construction activities in sensitive areas will be supervised to ensure appropriate methods (e.g., narrowing of RoW) are being implemented, where required.</li> </ul>	<ul style="list-style-type: none"> <li>• There is documented evidence that the management hierarchy described in Section 2 has been implemented at every site of proposed activities in areas of MNES</li> <li>• Fauna spotter catcher will be on site during clearing of any MNES</li> <li>• As constructed impact areas (i.e. the actual area in which clearing of any MNES has occurred) are accurately documented</li> <li>• The MNES impact areas are equal to or less than the impact</li> </ul>	<ul style="list-style-type: none"> <li>• Investigate the cause of non-conformance with the management hierarchy and amend the relevant processes / procedures to avoid future non-conformance</li> <li>• Ensure fauna spotter catcher is on site during clearing of any MNES</li> <li>• Ensure site works / clearing boundaries are accurately marked in the field</li> <li>• Early and clear communication of the</li> </ul>



Mitigation	Commitment	Indicator of success	Corrective action
	<ul style="list-style-type: none"> <li>• Construction that will potentially affect waterways will occur during dry months (periods of low rainfall and low flow) where possible. The use of machinery and vehicles on stream beds and banks will be avoided wherever possible.</li> <li>• Trenching will be perpendicular to the creek where the gathering line crosses waterways.</li> <li>• Where possible trenching within or in the vicinity of watercourses will occur during the drier months of the year, which will reduce the potential for water quality decline as a result of sediment mobilisation.</li> <li>• Buffer zones and the Project footprint will be regularly monitored using satellite imagery.</li> <li>• Watercourse crossings will be constructed in a manner that minimises sediment release to watercourses, stream bed scouring, obstruction of water flows and disturbance of stream banks and riparian vegetation (i.e., the crossing location will be at a point of low velocity, and straight sections will be targeted, with the pipeline or road orientated as near to perpendicular to water flow as practicable).</li> <li>• Transport of equipment across watercourses will be avoided unless an appropriate crossing that minimises disturbance to the watercourse bed and banks and to riparian vegetation is available.</li> <li>• Construction and maintenance activities will be planned to minimise movement of plant and equipment between properties or areas with weed infestations.</li> </ul>	<ul style="list-style-type: none"> <li>• areas shown in Tables 1.2 of this document</li> <li>• Significant disturbance to watercourses will occur when there is no or low flow</li> <li>• High risk weeds are managed as per Arrow’s Weed Management Procedure (ORG-ARW-HSM-PRO-00139)</li> </ul>	<ul style="list-style-type: none"> <li>• tracking of actual versus authorised MNES impact areas and relocate future infrastructure to avoid MNES if actual impact is expected to exceed authorised impact</li> <li>• Revise plans of significant disturbance to watercourses to occur when there is no or low flow or improve erosion and sediment controls when such works occur during conditions of water flow</li> <li>• Reinforce the requirement to follow Arrow’s Weed Management Procedure</li> </ul>
Clear Communication	<ul style="list-style-type: none"> <li>• Harassment of wildlife and the unauthorised collection of flora or fauna will be prohibited, unless directed by a suitably qualified and experienced person.</li> </ul>	<ul style="list-style-type: none"> <li>• Records of preconstruction ‘tool box’ sessions / advices provided to construction crews demonstrating compliance</li> </ul>	<ul style="list-style-type: none"> <li>• Investigate the cause of non-conformance and amend the relevant processes / procedures to avoid future non-conformance or apply appropriate measures if deemed a significant breach of conduct rules</li> </ul>
Protection of topsoils	<ul style="list-style-type: none"> <li>• Soil will be stripped according to designated profile depths, subject to further field investigations during stripping.</li> <li>• Where practicable, stripped material will be placed directly onto area to be rehabilitated</li> </ul>	<ul style="list-style-type: none"> <li>• Erosion and Sediment Control Plans (inclusive of topsoil management specifications) in place and implemented prior to</li> </ul>	<ul style="list-style-type: none"> <li>• Development and implementation of Plans</li> </ul>



Mitigation	Commitment	Indicator of success	Corrective action
	<p>and spread immediately (if rehabilitation sequences and weather conditions permit) to avoid the requirement for stockpiling.</p> <ul style="list-style-type: none"> <li>• Soils will be separated into windrows for later collection or re-spreading to minimise compression effects of heavy equipment.</li> <li>• Soil transported by dump trucks may be placed directly into storage. Soil transported by scrapers will be pushed to form stockpiles by other equipment (e.g. dozer) to avoid tracking over previously laid soil to minimise compaction.</li> <li>• Surface of soil stockpiles will be left in as coarsely structured a condition as possible to promote infiltration and minimise erosion until vegetation is established or suitable erosion controls have been applied, and to prevent anaerobic zones from forming.</li> <li>• Pipeline construction will be conducted in a manner that limits the duration of exposure of soils. Stripped and salvaged soil will be re-used within a short period of time (i.e. 28 days) in areas where rehabilitation immediately follows the installation of pipelines.</li> <li>• Erosion and Sediment Control Plans will be developed and maintained in accordance with the International Erosion Control Association (IECA) (2008) Best Practice Erosion and Sediment Control guidelines. All proposed erosion and sediment control measures will be implemented in advance of, or in conjunction with clearing activities to ensure any downstream impacts are avoided and/or minimised.</li> <li>• Topsoil will be stripped, salvaged and stockpiled separately from subsoils.</li> <li>• Appropriate sediment and erosion control structures will be installed and maintained at work sites.</li> <li>• Best practice erosion and sediment control measures will be implement during decommissioning works in accordance with the requirements of the IECA (2008) Best Practice Erosion and Sediment Control manual.</li> </ul>	<p>all clearing activities.</p>	
<p>Open trench management</p>	<ul style="list-style-type: none"> <li>• Trenches will be inspected and monitored as per the APIA Code of Environmental Practice and will be checked within two hours of sunrise and trapped fauna released. Additional inspections will be undertaken following rainfall events.</li> <li>• The time a trench is left open will be minimised. Fauna exit points will be incorporated when construction is within 1 km of native vegetation, using appropriate material. Fauna refuges, such as sawdust-filled bags, will be provided regularly through areas of high fauna activity.</li> <li>• Harm to fauna from entrapment during construction and operation of dams will be</li> </ul>	<ul style="list-style-type: none"> <li>• Site records / photographs demonstrating compliance</li> </ul>	<ul style="list-style-type: none"> <li>• Investigate the cause of non-conformance and amend the relevant processes / procedures to avoid future non-conformance</li> </ul>



Mitigation	Commitment	Indicator of success	Corrective action
	<p>prevented.</p> <ul style="list-style-type: none"> <li>As soon as practical following pipe laying, the trench will be backfilled with excavated material, compacted and topsoil replaced and erosion controls implemented.</li> </ul>		
Fauna spotter catcher	<ul style="list-style-type: none"> <li>Suitably qualified fauna spotter-catcher (FSC) or ecologist will capture injured wildlife, where possible. Injured wildlife resultant from land clearing will be taken to a qualified veterinary surgeon or carer where practical (B153). The FSC will be at the site on the day of clearing. The FSC will be suitably qualified as per the definition provided in EPBC 2010/5344. The number of FSCs on site at the time of clearing will depend on the number of machines being used at any given time.</li> <li>Trees will be assessed for potential nesting hollows prior to felling. If hollows are identified, trees will be felled in the presence of a qualified FSC and rolled so that the hollows are facing upwards, allowing fauna to escape.</li> <li>Key Koala trees will be identified and visually inspect prior to clearing to ensure that they are free of Koalas. If Koalas are located, the tree will be retained until the animals have moved on, typically overnight.</li> <li>Checks for identified EPBC Act fauna species breeding places will be undertaken immediately prior to commencing vegetation clearing.</li> <li>Potential breeding places will be clearly marked in the field with spray paint, coloured flagging tape (unless not permitted by land owners, e.g. some cattle properties), or by other suitable methods.</li> </ul>	<ul style="list-style-type: none"> <li>Review of spotter/catcher records / notes demonstrates compliance</li> <li>Potential breeding places are clearly marked in the field</li> </ul>	<ul style="list-style-type: none"> <li>Reinforce the requirement to follow Arrow's Fauna Spotter/Catcher Work Instruction document (ORG-ARW-AND-WOI-00001)</li> <li>Investigate the cause of non-conformance and amend the relevant processes / procedures to avoid future non-conformance</li> </ul>
Appropriate rehabilitation	<ul style="list-style-type: none"> <li>The cleared areas and stockpiles will be progressively rehabilitated through revegetation and/or mulching.</li> <li>Areas will be cleared progressively and rehabilitation implemented as soon as practicable following construction and decommissioning activities.</li> <li>Rehabilitation timeframes will be compliant with applicable Environmental Authority conditions and consider any landholder requirements/expectations.</li> <li>Rehabilitation plans will be developed addressing ground preparation requirements, natural and constructed drainage patterns, soil erodibility, contamination, slope steepness and length, vegetation cover, land use and landowner requirements. Partial rehabilitation of gathering lines and other linear infrastructure will be undertaken to reduce edge effects (including weed invasion) and maintain movement rates.</li> </ul>	<ul style="list-style-type: none"> <li>Inspection of site during and after installation of infrastructure demonstrates compliance</li> <li>That the area has been returned to pre-disturbed condition (or better) as agreed with the landholder and as required by DES in order to grant progressive rehabilitation certification and EA surrender.</li> <li>Progressive rehabilitation</li> </ul>	<ul style="list-style-type: none"> <li>Early and clear communication with the construction crew if inspections are not demonstrating compliance</li> <li>Continued remediation and rehabilitation of the disturbed areas until the progressive rehabilitation certification is granted</li> </ul>



Mitigation	Commitment	Indicator of success	Corrective action
	<ul style="list-style-type: none"> <li>• Rehabilitation of available areas will be undertaken that is consistent with pre-clearance habitats, to increase the rate of recovery.</li> <li>• Woody debris, logs and rocks will be retained for use in rehabilitation. Where practical, these will be piled along the edge of the cleared corridor. Where possible these features will be spread over all or part of the corridor to provide refugia for crossing fauna. Systematic removal of surface debris will be avoided and cleared timber will never be burnt.</li> <li>• Data collection, particularly of EVNT species identified during pre-clearance surveys, during trench checking or in other Project related activities, will be ongoing until rehabilitation is complete.</li> <li>• Site planning, preparation and management requirements will be implemented in accordance with a decommissioning and rehabilitation plan.</li> <li>• After decommissioning, rehabilitation areas will be inspected for regrowth similar to the surrounding environment.</li> <li>• Regular monitoring of rehabilitation success will be carried out.</li> <li>• During rehabilitation works, care will be taken when moving stockpiled logs and vegetation to avoid fauna mortality.</li> <li>• Excavations, particularly pipeline trenches and drilling sumps, will be backfilled and rehabilitated. Backfilling will be conducted in a manner that will promote successful rehabilitation, including capping of exposed subsoil with topsoil and replacement of the land surface to preconstruction levels to reduce trench subsidence and concentration of flow. Soils will be mounded where required to allow for settling. However, in laser-levelled paddocks, this may not be practicable, and backfilling will be carried out in consultation with the landowner.</li> <li>• A rehabilitation management plan for decommissioning will be developed and implemented which includes monitoring and maintenance of rehabilitated areas until rehabilitation sign off criteria are met.</li> <li>• Monitoring of the rehabilitated areas will be undertaken to identify whether the general objectives of the rehabilitation strategy are being met, and whether a sustainable and stable landform has been achieved. Monitoring will be conducted by suitably skilled and qualified persons at representative locations. Annual reviews of monitoring data will be conducted during operations, and post closure, to assess trends and performance.</li> </ul>	<p>certification is granted by the Department of Environment and Science (DES) when requested.</p> <ul style="list-style-type: none"> <li>• The EA surrender application including the Final Rehabilitation Report and landholder signoff is granted by the DES.</li> </ul>	<ul style="list-style-type: none"> <li>• Continued remediation and rehabilitation of the disturbed areas until the EA surrender application is granted</li> </ul>



Mitigation	Commitment	Indicator of success	Corrective action
	<ul style="list-style-type: none"> <li>• A final rehabilitation report and a decommissioning plan, including a contaminated land assessment where required, landowner commitments and agreements, and rehabilitation status, will be prepared and submitted to the appropriate authorities for approval where required.</li> <li>• The area disturbed within the pipeline corridor during the laying of the pipelines will be progressively rehabilitated as soon as practicable after completion of the pipeline installation. Fences, roads and tracks and other existing infrastructure impacted during construction of the pipeline will be repaired and/or replaced as required.</li> <li>• At decommissioning, a suitable vegetation cover will be re-established to enable natural vegetation progression and minimal weed invasion.</li> <li>• Final ground conditions will be rehabilitated to a state that is conducive to support further natural regeneration at project closure.</li> </ul>		
Reduce light spill	<ul style="list-style-type: none"> <li>• Lighting will be designed in a manner that limits disruption on landscape character, views and visual amenity and lighting will be directed into the infrastructure siting rather than dispersed into native vegetation when sites are adjacent to intact habitat.</li> </ul>	<ul style="list-style-type: none"> <li>• No lighting directed towards intact MNES habitat</li> </ul>	<ul style="list-style-type: none"> <li>• Lighting redirected or shielded away from intact habitat</li> </ul>
Reduce project traffic speed	<ul style="list-style-type: none"> <li>• Speed limits on Project controlled roads will be developed with due consideration to reduce the potential for vehicle collisions with wildlife.</li> </ul>	<ul style="list-style-type: none"> <li>• Review reports generated from Arrow's In-Vehicle Monitoring System (IVMS)</li> </ul>	<ul style="list-style-type: none"> <li>• Clear communication and warning for any IVMS breaches</li> </ul>
Weed control	<ul style="list-style-type: none"> <li>• A detailed pest management plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. This plan will include requirements for machinery washdown procedures to be followed during all clearing activities.</li> <li>• Weed monitoring and targeted weed control measures will be undertaken within sensitive EVNT habitats (particularly threatened communities such as Brigalow and native grasslands). Weed control methods within EVNT habitats will be selected on the basis of minimising the risk of adverse impacts on EVNT species or communities.</li> <li>• In accordance with the Pest Management Plan regular inspections for pest flora and evidence of pest fauna will be undertaken within Project disturbed areas.</li> <li>• Washdown facilities will be designed to ensure that runoff is contained on site and does not transfer weed seeds, spores or infected soils to adjacent areas.</li> <li>• When sourcing maintenance materials, materials such as bedding sand, topsoil, straw bales and sand bags will be brought to site only after it is ascertained that the materials are not contaminated with weeds and plant or animal pathogens. A weed hygiene</li> </ul>	<ul style="list-style-type: none"> <li>• Inspection of site after installation of infrastructure demonstrates compliance</li> <li>• High risk weeds are managed as per Arrow's Weed Management Procedure (ORG-ARW-HSM-PRO-00139)</li> </ul>	<ul style="list-style-type: none"> <li>• Reinforce the requirement to follow Arrow's Vehicle and Machinery Hygiene Procedure (ORG-ARW-HSM-PRO-00138) and Weed Management Procedure</li> </ul>



Mitigation	Commitment	Indicator of success	Corrective action
	<p>declaration form will be requested from the supplier where there is possible risk of contamination in products.</p> <ul style="list-style-type: none"> <li>All relevant personnel will be made aware of the location and extent of weed infestations in the vicinity of the work area and the risks involved in moving from one site or property to another.</li> <li>A declared weed and pest management plan will be developed in accordance with the Petroleum Industry – Pest Spread Minimisation Advisory Guide (Biosecurity Queensland, 2008). Species-specific management will be undertaken for identified key weed species at risk of spread through Project activities. Weed control efforts will be increased in areas particularly sensitive to invasion. The pest management plan will include, as a minimum, training, management of pest spread, management of pest infestations and monitoring effectiveness of control measures.</li> </ul>		
Grazing	<ul style="list-style-type: none"> <li>Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites.</li> </ul>	<ul style="list-style-type: none"> <li>Livestock absent from infrastructure sites</li> </ul>	<ul style="list-style-type: none"> <li>Reinstate integrity of exclusion fencing</li> </ul>
Documentation	<ul style="list-style-type: none"> <li>A Water Management Plan, Erosion and Sediment Control Plan, and Waste Management Plan will be designed to avoid or minimise the potential impacts of Project.</li> <li>Corrective actions will be undertaken in accordance with the outcomes of incident investigations, audits, monitoring results or advice given by the relevant regulatory authority.</li> <li>Arrow will develop emergency response plans in consultation with emergency services organisations that includes a list of required equipment, training and other resources, and foreseeable emergency and crisis situations (including escapes, blowouts, gas fire, bushfire, critical equipment failure, trapped or missing people, flooding, cyclones, power failure, security incidents and threats, and transport incidents). The plans will include safe evacuation procedures, communication protocols (internal and to emergency services, including the Petroleum and Gas Inspectorate), accounting for personnel and visitors, roles and responsibilities, and requirements for training.</li> <li>Any residual impacts to EPBC Act species and communities will be offset. A detailed SGP Phase 1 Offset Strategy and additional offset strategies for the subsequent phases will be developed and implemented to add value rather than just compensating for impact.</li> </ul>	<ul style="list-style-type: none"> <li>Water Management Plan, Erosion and Sediment Control Plan, and Waste Management Plan in place for the Project and Offset Strategy in place for relevant phase of the Project</li> </ul>	<ul style="list-style-type: none"> <li>Develop and implement required plans</li> <li>Investigate the cause of non-conformance and amend the relevant processes / procedures to avoid future non-conformance</li> </ul>



Mitigation	Commitment	Indicator of success	Corrective action
Hazardous materials management	<ul style="list-style-type: none"> <li>• Appropriate international, Australian and industry standards and codes of practice will be applied for the handling and storage of hazardous materials, such as chemicals, fuels and lubricants.</li> <li>• Appropriate spill response equipment including containment and recovery equipment will be available onsite.</li> <li>• Staff will be trained on appropriate handling, storage and containment practices for chemical, fuels and other potential chemicals as relevant.</li> </ul>	<ul style="list-style-type: none"> <li>• Records of training provided to construction crews demonstrating compliance</li> </ul>	<ul style="list-style-type: none"> <li>• Undertake and record evidence of such training</li> <li>• Investigate the cause of non-conformance and amend the relevant processes / procedures to avoid future non-conformance</li> </ul>
Bushfire	<ul style="list-style-type: none"> <li>• Fire management plans will be developed for production facilities.</li> <li>• Radiation exclusion zones around flares will be designed according to API standard.</li> <li>• Enclosed spaces where flammable gas may accumulate will be minimised.</li> <li>• Fire-fighting equipment will be installed, inspected and serviced in accordance with risk assessments and relevant legislation and standards.</li> <li>• Gathering lines will be buried at a minimum depth of 600 mm. Where gathering lines are present above the ground (at wellheads and at vents or drains), a clear area will be maintained. The size of the cleared area will be determined on a site-by-site basis with consideration of the site-specific risk of bushfire.</li> <li>• Fire-safety equipment will be commissioned in the early phase of the construction period.</li> <li>• All buildings and production facilities will be fitted with smoke or fire alarms.</li> <li>• Fire and gas detection systems will be installed to shutdown compressors.</li> <li>• Protocols will be developed for the control of operational activities during extreme fire danger periods, e.g., flaring or shutdowns.</li> <li>• Regular patrols and inspections of pipeline easements will be conducted, including status of signposting subsidence and of fire breaks.</li> <li>• Vegetation surrounding production facilities and wellheads will be maintained in a manner that limits the amount of combustible material in the area. The size of the cleared area will be determined on a site-by-site basis with consideration of the site-specific risk of bushfire.</li> </ul>	<ul style="list-style-type: none"> <li>• Fire management plans in place and implemented prior for all production facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Development and implementation of required plans</li> <li>• Investigate the cause of non-conformance and amend the relevant processes / procedures to avoid future non-conformance</li> </ul>



Mitigation	Commitment	Indicator of success	Corrective action
	<ul style="list-style-type: none"> <li>• Access tracks to well sites will be kept clear of dry grass and combustible material wherever practicable and where there is a higher risk of bushfire (to minimise the risk of dry grass being ignited by hot components of vehicles accessing the sites).</li> <li>• Project vehicles will not be driven or parked off-track in situations that are a high risk of igniting a grass fire.</li> <li>• Daily operations will be managed with consideration of the fire danger current at that time.</li> </ul>		

## 6. Rehabilitation Requirements

Each of the separate pipeline projects will be subject to rehabilitation requirements set out in the Petroleum Pipeline License (PPL) Environmental Authority (EA) as administered by the Queensland Department of Environment and Science. One of the proposed pipelines has already achieved approval of the associated EA and this is provided in Appendix D to show the type of conditions placed on pipeline projects in Queensland.

The PPL EA requirements and rehabilitation goals for the project are as follows:

- All significantly disturbed land caused by the carrying out of the petroleum activities will be rehabilitated to meet the following final acceptance criteria (i.e. rehabilitation goals):
  - any contaminated land (e.g. contaminated soils) is remediated and rehabilitated
  - rehabilitation will be undertaken in a manner such that any actual or potential acid sulphate soils on the area of significant disturbance are treated to prevent or minimise environmental harm in accordance with the *Instructions for the treatment and management of acid sulfate soils (2001)*
  - for land that is not being cultivated by the landholder:
    - groundcover, that is not a declared pest species will be established and self-sustaining
    - vegetation of similar species richness and species diversity to pre-selected analogue sites will be established and self-sustaining
    - for land that is to be cultivated by the landholder, either left fallow or cover crop is revegetated, depending on discussions with the landholder.
- The ROW for the bed, banks and approaches to watercourses will be minimised as far as practicable and existing access tracks will be utilised wherever possible
- Monitoring of performance indicators will be carried out on rehabilitation activities until final acceptance criteria have been met for the rehabilitated area
- Monitoring will include factors such as:
  - survival of plants
  - species richness and composition and community structure (including landform, ground cover, ground debris, fauna present)
  - reinstatement of ground profile, leaf litter, woody debris and rocks
  - effectiveness of weed control and on-going need for weed management
  - comparison of rehabilitated vegetation communities against analogue sites established outside the project area.
- Annual reporting is also a requirement of the EA via a document termed the 'Annual Return'. The annual return will report on:
  - significant disturbance that occurred during the period
  - rehabilitation that has been undertaken
  - the results of all monitoring undertaken.

- A detailed decommissioning and rehabilitation plan will be developed and implemented in accordance with AS2885 in consultation with landholders and the regulator at the time of abandonment. The abandoned pipeline easement will be returned to the surrounding vegetation prevalent at that time and in compliance with final rehabilitation requirements of the relevant Environmental Authority or as negotiated with the landholder.

Beyond the State Government rehabilitation requirements, the EPBC approved Species Impact Management Plan for the SGP includes rehabilitation commitments and these have been included in Table 5.3 above (see mitigation termed ‘Appropriate rehabilitation’, ‘Pre-construction clearance surveys / minimise clearing’ and ‘Construction activities as per plan (no-go areas)’). These commitments will also be implemented for the off-tenure component of the project including watercourses.

## 7. Environmental Offsets

The assessment of potential impacts against the EPBC Significant Impact Guidelines provided in Section 4 has determined that residual significant impacts may only occur on the Koala and the Threatened Ecological Community of Brigalow. The areas of impact provided are maximum total impact areas to be subject to offsets (recognising that these areas may be reduced further during the micro-siting that occurs as part of our pre-clearance surveys).

As required by the Department of the Environment and Energy (DotEE) information request for Preliminary Documentation, Appendix E provides a draft Offset Management Strategy which addresses these two MNES.

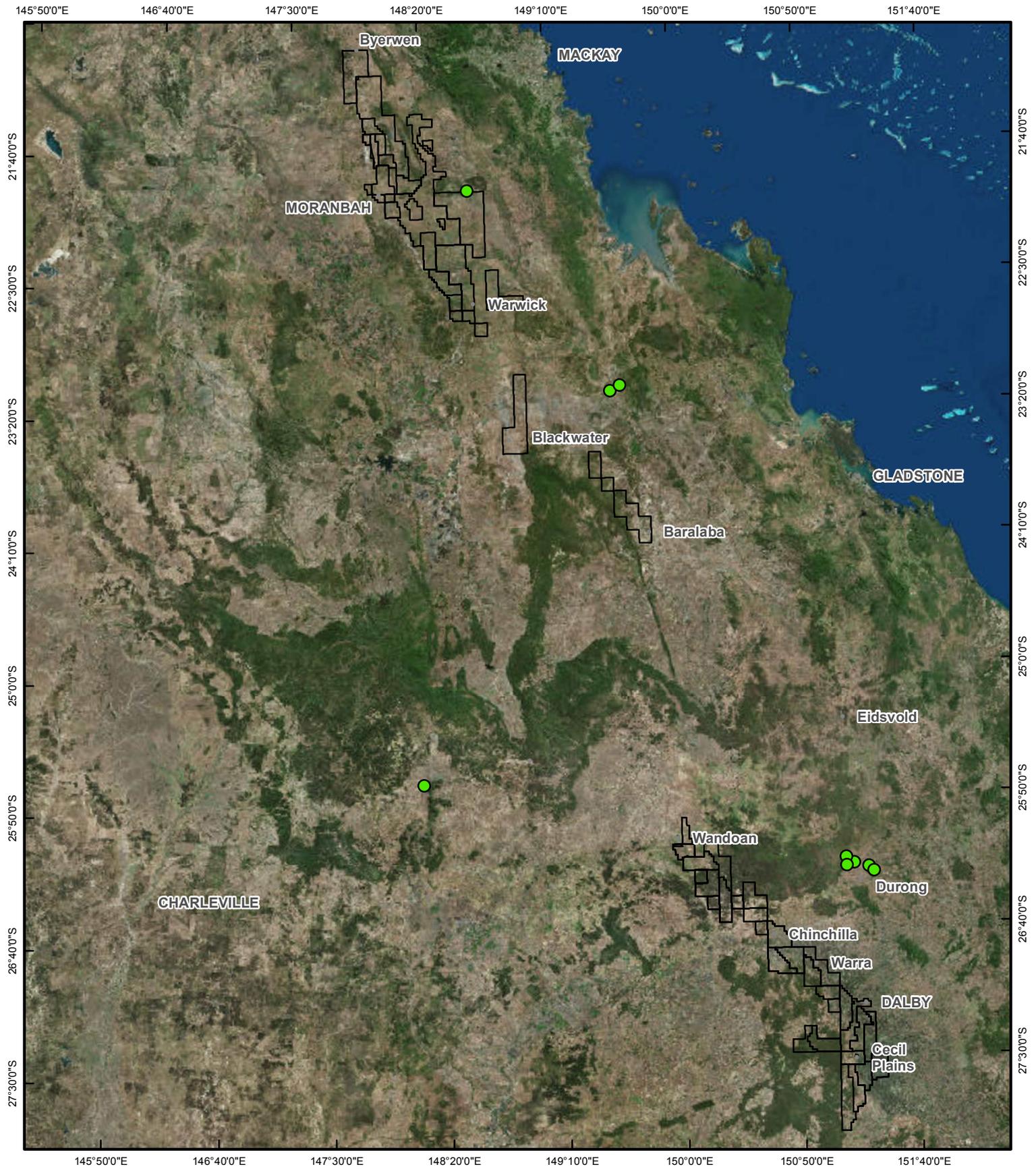
Of particular relevance to offsets and this Preliminary Documentation:

- Arrow has been working with DotEE on two biodiversity plans for the greater SGP development and to date (see Arrow website for the previously approved EPBC plans <https://www.arrowenergy.com.au/environment/environmental-management-plans-and-reports>):
  - Received approval of the SGP Species Impact Management Plan (SIMP) in December 2018 (this plan includes the Koala and Brigalow TEC)
  - Received approval for the SGP Stage 1 Offset Strategy in July 2019 (this Strategy includes the Koala and Brigalow TEC).
- Arrow has also worked with DotEE and received approval on 15 October 2018 of a Species Impact Management Plan and Stage 1 Offset Strategy that includes the Koala and Brigalow TEC (amongst other MNES) for our operations in the Bowen Basin.
- Arrow’s preferred option to legally secure offsets for the SGP (including the off-tenure component the subject of this Preliminary Documentation) is via direct land-based offsets using voluntary declarations with landholders. In particular, we have been investigating offset properties since 2015 and to date:
  - We have screened over 60 properties
  - This property list was refined through a ranking process that considered the ability of the property to provide for multiple MNES offset requirements, strong connectivity in the

landscape, a combination of remnant and regrowth vegetation, condition of vegetation, land use and property ownership

- Twenty-two (22) of the properties were identified for further investigation and landholder engagement
- From 2017 to the present, Arrow have been in commercial in confidence discussions with offset brokers; have narrowed the suitable properties to eight (8); and are confident that sufficient property(ies) are available to secure project offsets (for the greater SGP and this off-tenure component). Appendix E provides some discussion on how these offset properties provide suitable values and connectivity with other relevant habitat and biodiversity corridors for these MNES.
- Figure 7.1 shows the location of the currently short-listed offset properties in relation to Arrow tenure (as commercial discussions/agreements with these properties are yet to be transacted, the exact property location remains in confidence)
- Draft Offset calculators have been included for these two MNES in Appendix E and these will be refined with the Department. The ‘start quality’ habitat score of the offset properties within these calculators is currently based on Arrow’s objectives for identifying suitable offset properties and the Department’s guidance on the requirement to achieve a conservation gain (see Section 5 of Appendix E for details). In other words, we are actively seeking offset areas with a lower start quality score so we can improve the value of these areas for the particular MNES. Also, Arrow is confident that we can secure offset properties with Koala habitat at a start quality of 6. However, remaining patches of Brigalow in Queensland are typically degraded and have poor connectivity and therefore a start quality score of 4 is more appropriate (but provides a greater opportunity to improve this habitat). Once an agreement has been reached with the property owners, Arrow will field verify the start quality habitat score using the same methodology employed to identify the habitat score for the impacted areas of MNES as described in Section 3 of this document).
- The draft Offset calculators provided in Appendix E show:
  - Koala: a total impact area of 65 ha at a quality of 7; which as per the EPBC calculator provides 45.5 ha quantum of impact; the proposed offset area at a start quality of 6 giving a proposed offset area of 170 ha
  - Brigalow TEC: a total impact area of 2 ha at a quality of 3; which as per the EPBC calculator provides 0.6 ha quantum of impact; the proposed offset area at a start quality of 4 giving a proposed offset area of 3 ha
- Arrow has completed a risk assessment to the successful implementation of the SGP Offset Strategy/ies and this is included as Table 7.1.

Responsible parties for the management and monitoring of secured offset properties will be determined and documented in the Offset Area Management Plan (OAMP). An OAMP will be signed by the relevant landholder/s and secured on the Title of the property via a legally binding mechanism. The OAMP will be prepared to fulfil the requirements of the EPBC Act Environmental Offsets Policy. Examples of the management measures that will be included in the OAMP to ensure that the habitat quality gains in the offset calculations will be achieved are as follows:



	Potential offset properties		Arrow Tenure
	Populated Places		

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Issued To: M Ryan  
Author: tstringer

**Disclaimer:** While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no warranty is given that the information contained on this map is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it.

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**Source:**  
Arrow Energy Limited, Geosciences Australia  
Dept Envir. and Resource Mgmt.



Coordinate System: GDA 1994 MGA Zone 56

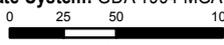


Figure 7.1 - Approximate location of offset properties being investigated relevant to Arrow tenure



Date: 10/07/2018

- Performance targets and completion criteria will be established and documented in the OAMP. This will include matters such as:
  - site context, condition and species stocking rate
  - control of pest animals and domestic dogs
  - percentage cover targets for environmental weeds
  - targets for the composition, structure and quality of remnant and regrowth vegetation
  - provision, retention and enhancement of fauna habitat features such as Koala feed trees
  - Management of human access, disturbance and waste at the site
- Allowable uses or development of the site will be included to ensure any future proposals do not conflict with the objectives of the offset site
- Annual monitoring will be undertaken for compliance with the OAMP
- Ecological surveys will be undertaken as per the OAMP and will measure progress to attaining the agreed completion criteria for the offset.

**Table 7.1 Risks to the successful implementation of the SGP EPBC Offset Strategy**

Risk description	Existing controls	Risk Rating	Trigger that will be monitored	Contingency measure
Arrow does not implement the Offset Strategy	<ul style="list-style-type: none"> <li>Arrow Energy provides DotEE with the commitment to implement the Offset Strategy</li> </ul>	Low	Annual report, including accurate records substantiating impacts to MNES and demonstrating compliance with this Strategy, will be made available on Arrow’s website within 3 months of every 12 month anniversary of project commencement	Arrow will notify the DotEE of the non-compliance and either rectify within 3 months or seek an alternative arrangement with DotEE
Insufficient resources are assigned to implementing the Strategy	<ul style="list-style-type: none"> <li>Arrow Energy is committed to implementing our Health Safety and Environment Policy, which specifically states, ‘Arrow will fully support the implementation of this Policy by providing sufficient resources, systems and training to effectively manage HSE risks.’</li> <li>Arrow has a dedicated Environment Team that is sufficiently resourced to implement this Strategy</li> </ul>	Low	Compliant Annual report as per above	Assign sufficient resources to implement this Strategy and deliver a compliant Annual report or rectify as per above
Arrow is unable to legally secure the required offset property(ies)	<ul style="list-style-type: none"> <li>As noted above, Arrow is well advanced in the search for suitable offset properties</li> <li>Arrow has already commissioned an offset broker that has available and suitable properties for the bulk of the required SGP offsets</li> </ul>	Low	The request for Voluntary Declaration (VDec) will be submitted to the Queensland Government at least 6 months before an agreement is required	If the VDec is not submitted 4 months before the date that the agreement is required, Arrow will pursue other options (e.g. purchase the required offset property(ies))
Impacting MNES areas greater than those predicted in this Strategy because of a failure to accurately identify the Stage 1 MNES impact areas	<ul style="list-style-type: none"> <li>Arrow has undertaken seasonal surveys with suitably qualified ecologists to further refine the EIS and Queensland Government habitat mapping throughout the Stage 1 disturbance areas</li> <li>Arrow has adopted a precautionary approach in the application of habitat mapping rules for EPBC listed species</li> </ul>	Low	Any clearing of MNES core habitat outside of the limits approved in this Strategy	DotEE will be notified of any clearing outside of the limits approved in this Strategy within 10 business days and offsets will be provided for all impacts on MNES



Risk description	Existing controls	Risk Rating	Trigger that will be monitored	Contingency measure
Impacting MNES areas greater than those predicted in this Strategy because of a relocation of SGP infrastructure	<ul style="list-style-type: none"> <li>The current field development layout and alignment of off-tenure pipelines has avoided and minimised impacts to MNES in consideration of other competing constraints</li> <li>It is possible however that infrastructure will be relocated as part of the detailed engineering design process</li> </ul>	Medium	Any clearing of MNES core habitat outside of the limits approved in this Strategy	DotEE will be notified of any clearing outside of the limits approved in this Strategy within 10 business days and offsets will be provided for all impacts on MNES
Failure to accurately track impacts to MNES	<ul style="list-style-type: none"> <li>The coordinates and total area of cleared MNES habitats and communities will be recorded by GPS in the field and tracked monthly against approved maximum disturbance limits</li> <li>The monthly tracking of impacts to MNES will be provided in the annual compliance reporting to DotEE</li> <li>The Environment Team will audit the reported clearing areas against the predicted clearing areas annually</li> </ul>	Low	Post-clearing GPS records of impacts to MNES are greater than predicted impacts	DotEE will be notified of any clearing outside of the limits approved in this Strategy within 10 business days, offsets will be provided for all impacts on MNES and Arrow will engage a third party audit of predicted / actual clearing
Failure to detect impacts to other MNES not addressed in this Strategy	<ul style="list-style-type: none"> <li>Arrow has completed desktop and seasonal field surveys within the impact area to identify all MNES that may potentially occur in these areas</li> <li>This information has been included on our GIS mapping layers that are interrogated when assessing the implications of any new disturbance</li> <li>Pre-clearance surveys are conducted by suitably qualified ecologists prior to any new disturbance in vegetated areas and bio-condition assessments will be undertaken in areas requiring clearing of MNES</li> </ul>	Low	Post-clearing GPS records of impacts to MNES will be reviewed to detect any clearing of MNES not addressed in this Strategy	The process and measures described in Section 6 of this Preliminary Documentation will be implemented
The offsets do not address the principles of the EPBC Offset Policy	<ul style="list-style-type: none"> <li>Arrow has engaged external parties experienced in delivering EPBC offsets to the satisfaction of DotEE</li> </ul>	Low	A compliant Annual report	Arrow will notify the DotEE of the non-compliance and either rectify within 3 months or seek an alternative arrangement with DotEE

## 8. Ecologically Sustainable Development (ESD)

In recognition of the importance of sustainable development, in June 1990, the Australian Government released the document *Ecologically Sustainable Development: A Commonwealth Discussion Paper* which introduced the term 'ecologically sustainable development' and aimed to institute a process of discussion on what Australians needed to do to embrace ESD. From this, the Australian Government developed a *National Strategy for Ecologically Sustainable Development* (NSED), which was adopted by all levels of Australian Government in 1992. The NSED defines ESD as:

*Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.*

The core objectives of the NSED are to:

- Enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations
- Provide for equity within and between generations
- Protect biological diversity and maintain essential processes and life support systems.

The principles of ESD include five key concepts:

1. Long-term and short-term economic, environmental, social and equitable considerations: this requires the effective integration of environmental considerations and resources in decision making.
2. The precautionary principle: environmental assessment involves predicting what the environmental outcomes of a development are likely to be. The precautionary principle reinforces the need to take risk and uncertainty into account.
3. Inter-generational equity: Inter-generational equity is the concept that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
4. Conservation of biological diversity and ecological integrity: Biological diversity, or biodiversity, is considered to be the number, relative abundance and genetic diversity of organisms from all habitats and includes diversity within species and between species, as well as diversity of ecosystems.
5. Improved valuation, pricing and incentive mechanisms: this principle of ESD requires that environmental factors be included in the valuation of assets and services. This principle reflects the idea that if the real value of natural resources is incorporated into the cost of using those resources, it is more likely that those resources will be used in a sustainable manner, adequately managed and not wasted.

Arrow Energy demonstrates its commitment to the principles of ESD through our Sustainable Development Policy and Framework (see Appendix F). These documents emphasise Arrow's objectives to:

- Establish a sustainable development culture that reflects our corporate values, expectations, commitments and obligations
- Integrate sustainable development with all aspects of the business to ensure that sustainability is a fundamental consideration in achieving the business objectives
- Develop appropriate in-house controls to properly control risk to a standard that is acceptable to Arrow and its stakeholders
- Monitor the effectiveness and efficiency of the framework and ensure continuous improvement.

Additionally, the Health, Safety and Environment (HSE) Standards Compendium (Arrow Energy 2018) articulate Arrow's commitment to environmental responsibility and sustainable development. This collection of standards for HSE promote a mutually beneficial relationship between Arrow, the environment, the communities in which we operate and the people indigenous to these communities. Key elements of relevance to the principles of ESD are:

- HSE Policy: states that Arrow will fully support the implementation of the Policy by:
  - Minimising the environmental impact of our operations
  - Efficiently and responsibly using energy and natural resources to provide our products and services
  - Implementing the principles of sustainable development
- Biodiversity Standard: states that Arrow will:
  - Ensure the protection of biodiversity (flora, fauna and natural habitats) in the areas in which Arrow operates in recognition of the value of healthy and functioning terrestrial and aquatic natural systems
  - Ensure that risk assessments are conducted to identify and assess biodiversity impacts and that controls are implemented to reduce biodiversity risks to as low as reasonably practicable
  - Controls for biodiversity impact management documented in land access conditions for the worksite shall be complied with
  - Personnel involved in disturbing natural systems shall receive awareness training and all personnel involved in managing biodiversity shall be trained and competent to do so.
- Land Management Standard: states that Arrow will:
  - Ensure land disturbance is managed to avoid or minimise environmental impacts and where land is impacted by Arrow activities it is returned to an agreed condition
  - Landholder requirements for land management, as documented in land access conditions, shall be complied with
  - When operating on agricultural land, activities shall be managed to maintain the viability of existing and future agricultural operations
- Greenhouse Gas Standard: states that Arrow will:
  - Implement processes to ensure compliance with relevant greenhouse gas legislation and associated regulatory requirements
  - Ensure that the appropriate risk assessments are conducted, that controls are implemented to manage greenhouse gas emissions both in the design phase and during operations, and that risks are reduced to as low as reasonably practicable

- Ensure that contractors understand their contractual obligations with respect to emissions and energy reporting. Unless agreed otherwise, contractors are responsible for determining and meeting greenhouse gas regulatory reporting obligations associated with activities performed for Arrow
- Develop and maintain systems that measure, report and forecast greenhouse gas emissions
- Establish and maintain governance in relation to greenhouse gas emissions management that clearly allocates responsibilities and ensures that all relevant interests are represented.

Specific to the proposed SGP pipelines project, the design, planning and assessment processes associated with the project have been carried out applying the principles of ESD through:

- Adoption of the above mentioned HSE standards
- An iterative process of impact and risk assessment at various stages in the project design to assist the decision-making process regarding infrastructure location
- Including within the proposed action all of the off-tenure pipelines required to support the ~27 year SGP development so that the short and long-term economic, environmental and social considerations were examined.
- Adopting the precautionary principle when developing the mapping of habitat for MNES in that all relevant regional ecosystems for each species have been included as possible habitat
- Intergenerational equity has been included through the assessment of the construction, operation, rehabilitation and decommissioning stages for the ~27 year project. Furthermore, the offset strategy to address residual impacts promotes a management approach that will lead to long-term gains for the relevant MNES (e.g. biodiversity offsets spanning at least 20 years)
- Optimisation of the balance between economic benefits and environmental impacts by selecting pipeline alignments that reduce disturbance and fragmentation of MNES habitat, sometimes at the expense of additional pipeline length and therefore additional cost. This approach has:
  - Reduced considerably impacts to habitat considered critical to survival of a species, avoided any stronghold populations of MNES species and thus assisted the maintenance of biological diversity and ecological integrity
  - Demonstrated Arrow's understanding of the economic value of significant environmental matters.
- Extensive and ongoing consultation with regulatory and community stakeholders.

## 9. Environmental record of the person proposing to take the action

Arrow approaches its environmental responsibilities with the same discipline, strategy and accountability that drive every part of our business. For all our activities, we aim to reduce environmental impacts, conserve and recycle resources, reduce waste and pollution and improve processes to help protect the natural environment. Since our inception we have prioritised environmental activities thanks to our team's dedication and the rigid implementation of our Health, Safety and Environment Management System (HSEMS).

At its core, the HSEMS requires compliance with laws and regulations. Beyond compliance with legislation, we support programs that improve our understanding of environmental impacts while developing effective control measures.

No proceedings under a Commonwealth or State law for the protection of the environment or the conservation and sustainable use of natural resources have been taken against Arrow Energy Pty Ltd.

Arrow's Health, Safety and Environment Policy is provided as Appendix G.

Arrow's planning framework with regards to environmental protection is outlined in Section 8, and is demonstrated through our Sustainable Development Framework, and Health, Safety and Environment (HSE) Standards Compendium. Furthermore, the process undertaken to avoid, minimise, mitigate and offset impacts to MNES is discussed in Section 7.

## 10. Social and Economic Matters

### 10.1 Social matters

Public consultation on the SGP project, including the off-tenure pipeline component of the SGP, has been and will continue to be extensive. During the SGP EIS process, consultation was held with (refer Chapter 6 of the SGP EIS for full details):

- 12 government departments
- three local governments
- four government-owned corporations
- all registered property owners within the entire development area
- all leaseholders of properties within the entire development area that made themselves known through participation in consultation activities
- the communities of Dalby, Cecil Plains, Chinchilla, Goondiwindi, Miles, Millmerran and Wandoan
- six indigenous groups
- 11 local industry and business associations
- eight agricultural associations
- 18 environmental groups / associations
- 12 community / interest groups
- 29 schools
- Print (7), radio (5) and television (2) media.

Following the SGP EIS, consultation with many of the above listed groups has continued, with particular attention provided to the relevant government agencies, landowners, leaseholders, indigenous groups and the communities of Wandoan, Miles, Chinchilla, Dalby and Cecil Plains.

The following outlines the recent consultation and future consultation on both on-tenure and off-tenure activities:

- **Project announcement:** on 1 December 2017 Arrow Energy and the Shell-operated QCLNG joint venture announced a Gas Sales Agreement (GSA) to commercialise the majority of Arrow's gas reserves in the Surat Basin. The collaboration between the parties will see the use of existing QGC-operated infrastructure such as gas compression, processing and transmission infrastructure as well as water transport and treatment facilities. Utilising the existing upstream infrastructure will reduce impacts to landholders and to communities.
- **Government:** Arrow meets with the Queensland Government Department of Environment and Science (DES) on a monthly basis and the Department of Natural Resources, Mines and Energy (DNRME) on a fortnightly basis to provide project updates. These meetings have commenced and will continue throughout the life of the SGP and off-tenure infrastructure, noting the frequency of the DNRME meetings are likely to move to monthly now that 14 of the required 16 new Petroleum Leases (PLs) required to support the SGP have been granted. Arrow also holds regular engagements with the Post Approvals Section of the Australian Government Department of the Environment and Energy with regards to the biodiversity and water plans required for the SGP. We also engage closely with relevant local government authorities and elected officials.
- **Public notification:** the activities that are the subject of this action will require Environmental Authorities (EAs) to support tenure applications (i.e. Petroleum Pipeline Licenses (PPLs)) for each of the specific pipeline RoWs. On each occasion, it is a Queensland Government requirement that the EA and PPL applications are publicly notified in the relevant local newspaper/s. This provides the public with an opportunity to review the applications and raise questions to both the Department of Environment and Science (regarding the EA application) and the Department of Natural Resources, Mines and Energy (regarding the PPL application). Arrow then provides written responses to any questions raised and these are considered by the Departments in their assessment of the applications. At the time of writing, the EA and PPL applications for the first pipeline to be constructed (the David pipeline), has been publicly notified and no responses were received. Both the EA and the PPL have now been granted (see Appendix D).
- **Indigenous stakeholders:** The Western Downs Unclaimed Area Native Title Group comprise the relevant Traditional Owners for the SGP and off-tenure pipelines. Arrow has an existing Indigenous Land Use Agreement (ILUA) (registered 19/09/2013) and associated scheduled Cultural Heritage Protocol (commenced 12/12/2012) with this group. As per the ILUA and Cultural Heritage Protocols, Arrow meets with the group's Cultural Heritage Committee on a regular basis and engages their field crews to undertake cultural heritage assessment/surveys in areas of proposed disturbance (i.e. as part of the pre-clearance surveys).

**Community engagements:** Project briefing sessions and opportunities for community groups to raise questions and discuss the SGP development will continue throughout the project. The communities of particular relevance to the activities that are the subject of this proposed action are Miles, Kogan and Dalby. The most common questions that were raised at the sessions were:

- Arrow's coexistence and managing impacts to Intensively Farmed Land (IFL)
- Arrow's approach to environmental impacts and management
- Groundwater impacts and management including substitution of allocation

- Project phasing (development timelines)
- Area Wide Planning and land access processes (see next two dot points).

**Table 10.1 lists the community engagement sessions that has occurred to date for the SGP**

Location	Date
Dalby, Chinchilla, Cecil Plains, Miles	Sept 2019
Dalby, Chinchilla, Cecil Plains, Miles	Sept 2018
Dalby, Chinchilla, Cecil Plains, Miles, Wandoan	Dec 2017
Dalby, Chinchilla, Cecil Plains, Miles, Wandoan	July 2016
Dalby, Chinchilla, Cecil Plains, Miles, Wandoan	November 2013
Chinchilla (drop in session)	April 2013
Chinchilla (drop in session)	March 2013
Dalby, Chinchilla, Cecil Plains, Goondiwindi, Miles, Millmerran, Wandoan	May 2012
Millmerran	April 2012
Dalby, Chinchilla, Cecil Plains, Goondiwindi, Miles, Millmerran	October 2011
Dalby, Chinchilla, Cecil Plains, Goondiwindi, Miles, Millmerran, Wandoan (information sessions and water workshops)	May 2011
Dalby, Chinchilla, Cecil Plains, Goondiwindi, Miles, Millmerran, Wandoan	November 2010
Dalby, Chinchilla, Cecil Plains, Goondiwindi, Miles, Wandoan	June 2010

- **Area Wide Planning:** this is a program Arrow Energy has developed to incorporate landholder's knowledge into its field development and infrastructure plans. Landholders and Arrow work together to identify locations for infrastructure, such as well pads, pipelines and access tracks. Planning occurs one-on-one with landholders and, where appropriate, in local area meetings. This process commenced in early 2018, is ongoing and will continue throughout the SGP as the project development footprint expands.
- **Conduct and Compensation Agreements (CCAs):** following Area Wide Planning, specific landholder, and where relevant leaseholder, agreements are formalised in CCAs. As per the *Petroleum and Gas (Production and Safety) Act 2004* these agreements or similar landholder consent must be reached prior to any construction activities occurring on the landholder's property. This process has commenced and will continue throughout the SGP as the project development footprint expands.

## 10.2 Economic matters

Arrow's proposed Surat Gas Project (SGP) will commercialise the majority of Arrow's Surat gas. It is underpinned by a 27-year gas sales agreement with the Shell-operated QCLNG joint venture, signed in December 2017. This deal will enable Arrow to use existing QGC-operated infrastructure (gas compression, processing and transmission) to accelerate project development. The proposed off-tenure pipelines are required for Arrow to link with QGC facilities.

The SGP was the subject of an extensive Environmental Impact Statement (EIS), which received approval from the Federal Government on 20 December 2013 and by the Queensland Government on 25 October 2013.

While the EIS assessed the social and economic impacts (among other impacts) of a broader Surat project; the current proposed development footprint falls within what was assessed in Arrow's Surat Gas Project EIS, with fewer major impacts. The ability to deliver gas and water to QGC-operated major infrastructure serves to reduce Arrow's potential environmental impacts, although it requires the addition of off-tenure pipelines.

Management of social and economic project impacts have been identified through the Social Impact Management Plan (SIMP) which was completed as part of the EIS. The off-tenure pipelines fall within the communities of interest assessed through the EIS and addressed through the SIMP. As a result, the economic and social impacts are well documented with management methods well-defined.

### Project cost and benefits

The capital expenditure of the Surat Gas Project (inclusive of off-tenure pipelines) is estimated at \$10 billion. Benefits arising from the Surat Gas Project include increases in industry output, Gross Regional Product (GRP), employment and incomes in the Darling Downs and Queensland over the project life through both direct and indirect benefits. This data was developed through economic modelling.

### Socio-economic impacts

#### *Socio-demographic profile*

The off-tenure pipelines fall within the Western Downs Local Government Area (LGA). The estimated resident population of the Western Downs LGA was 34,467 in June 2018, an increase of 1535 persons or 4.45% from the level recorded in June 2012 (32,932) (source ABS 3218.0 Regional Population Growth, Australia, 2017-18).

According to the Queensland Government population projections (2018 edition) the population is expected to continue to grow in the Western Downs LGA over the coming years with an estimated population of 39,797 in 2041.

The economy of the Western Downs has grown 13% from 2016 to 2017 to a level of approximately \$3.3 billion. The previous peak was \$3.2b in 2014 followed by a -8.1% dip (\$2.94b) in 2015 which plateaued at \$2.95b in 2016. The smoothed economic growth rate for Western Downs has remained consistent at 6% per annum, higher than the rate for Queensland over the same period (2.5%).

With regard to industry, the largest contribution within the LGA was made by the mining industry, with approximately \$806 million, or 26.9% in 2016-17 (22.3% in 2013) of the total gross regional product.

### *Employment opportunities*

Arrow's SGP is expected to create around 1,000 jobs (800 in construction and 200 ongoing). Employment opportunities available through the off-tenure pipeline will fall within this estimate; with jobs predominately available through the construction phase.

### *Design and construction phase impacts*

The pipeline route is designed in collaboration with the landholder to minimise impacts on the property, its land use and the landholder's day-to-day activities.

Pipeline construction is typically intensive, but for short periods of time. Construction activities typically occur during daylight hours only.

### *Operational phase impacts*

During the operation phase the pipeline is not expected to have major impacts on rural lots or land uses such as grazing. Some vegetation will be able to grow over the pipeline easement.

Any disturbed land from construction of the project will be rehabilitated as quickly as possible and returned as close as possible to its previous productivity. Existing land uses are expected to be able to continue over the pipeline easement.

### **Managing socio-economic impacts**

Arrow takes a proactive approach to enhancing communities, rather than just the management of potential adverse social or economic impacts. The SIMP supports Arrow's ongoing management of the potential impacts of the project. Arrow's principles on social responsibility include:

- Community Wellbeing - Arrow is committed to protecting and promoting the social and environmental values of communities in which we live and work
- Community Investment – Arrow acknowledges that long term success is closely linked to the social wellbeing of communities
- Community Engagement – Arrow is committed to keeping the community informed about existing and proposed coal seam gas activities
- Indigenous Relations – managing relationships with Aboriginal communities holding traditional connections or historical links to operational areas
- Local Business Development – Arrow strives to use local suppliers who adhere to our OH&S, Cultural Heritage, Native Title and Environment policies
- Local Recruitment – supporting recruitment from the local area, with operational staff based predominately in the region
- Health and Safety – Arrow employees are continually striving for zero harm in the workplace
- Education and Training – Arrow strives to develop the knowledge and skills base of staff through the delivery of a variety of training and development programs.

To support delivery of the SIMP, Arrow has a number of partnership programs designed to build capacity within its areas of operation, within the focus areas of health and safety, education and the

environment. Amongst a broader program of partnerships, sponsorships, research programs and Indigenous Land Use Agreements, Arrow's flagship partnerships include:

- Heart of Australia mobile regional cardiac and allied health specialist services
- LifeFlight medical evacuation (a joint partnership with CSG-LNG operators)
- Brisbane Broncos (including the Brisbane Broncos National Rugby League Women's team and Beyond the Broncos Girls Academy).

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