ATTACHMENT 6

SURAT GAS PROJECT

Draft Environmental Offsets Strategic Management Plan

arrow energy
go further

Project Director	Barton Napier		
Project Manager	Jessica Reid		
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1. INTRODUCTION

Arrow Energy Pty Ltd (Arrow) is seeking approval to construct, operate and decommission the Surat Gas Project (the project), located approximately 160 km west of Brisbane in Queensland's Surat Basin (see Figure 1.1). The project is an expansion to Arrow's existing operations in the Surat Basin, to cater to the growing demand for gas in the domestic market and the global liquefied natural gas (LNG) export market.

Arrow lodged an application to prepare a voluntary environmental impact statement with the Queensland Government Department of Environment and Resource Management (DERM) on 27 January 2010. An initial advice statement describing the project was submitted with the application. The Chief Executive accepted Arrow's application following consideration of the initial advice statement.

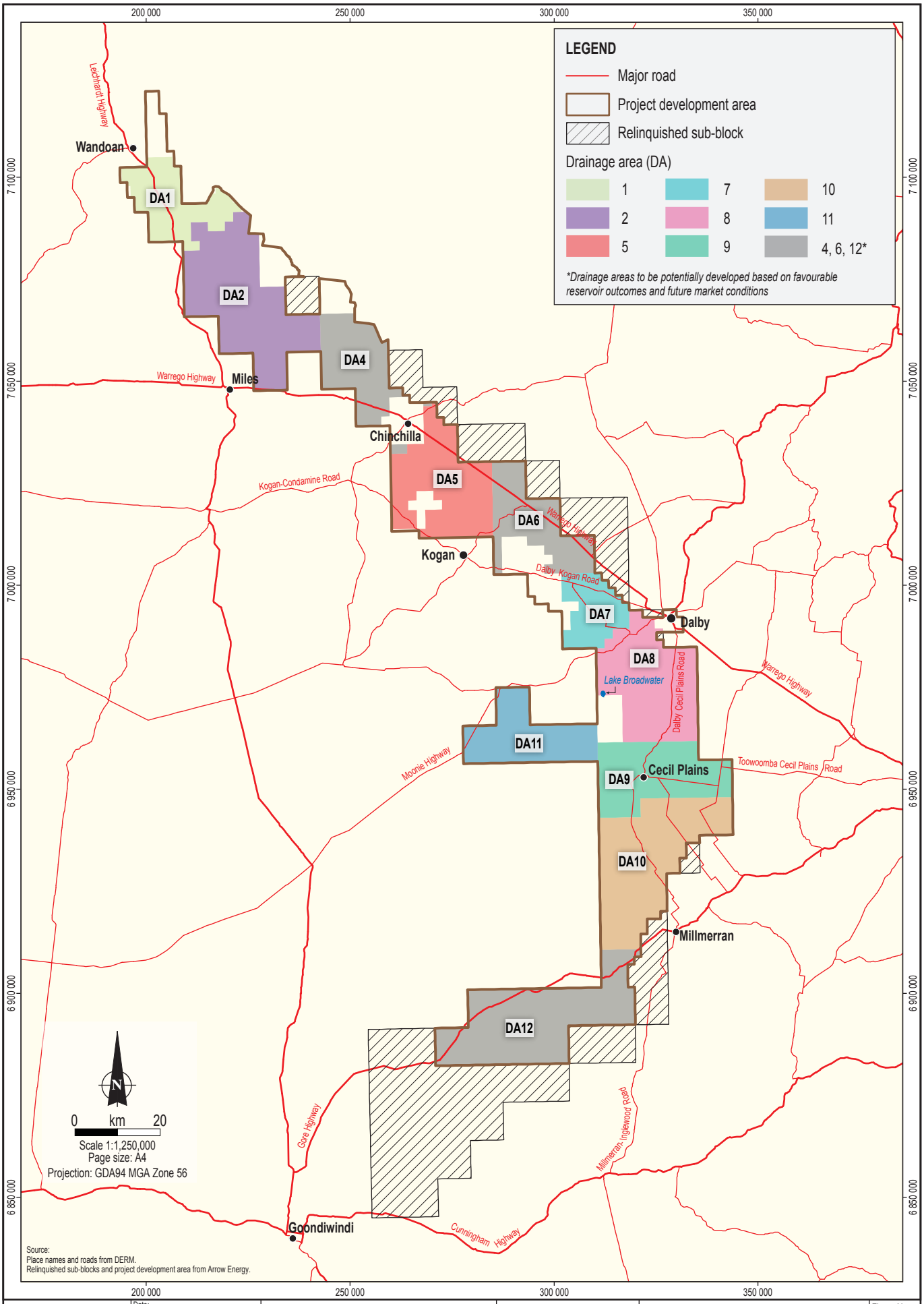
On 2 February 2010, Arrow referred the Surat Gas Project to the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC; previously known as the Department of Environment, Water, Heritage and the Arts) in Referral No. 2010/5344. On 26 March 2010, the Australian Government declared the project a controlled action due to its potential to significantly impact listed threatened species and ecological communities (s. 18 and s. 18A) and listed migratory species (s. 20 and s. 20A).

The Australian Government determined that an environmental impact statement (EIS) was the appropriate level of assessment and that the assessment would be coordinated by EHP under the *Environmental Protection Act 1994* (Qld) (EP Act) in accordance with the bilateral agreement between the Australian and Queensland governments. This allowed Arrow to prepare one document, the Surat Gas Project EIS and Supplementary Report to the Surat Gas Project EIS (SREIS) to address both Australian and Queensland government requirements; however each government still makes an independent decision on approval at the completion of the assessment process.

An EIS has been prepared for the project under Chapter 3 of the EP Act and Chapter 4 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act). Coffey Environments Australia Pty Ltd (Coffey Environments) was engaged by Arrow to prepare the EIS (Coffey Environments, 2012). The EIS will inform a decision on whether the project should proceed and, if so, under what conditions.

The EIS was submitted to the Chief Executive of the DERM in March 2012. The EIS was placed on public exhibition from 16 March 2012 to 14 June 2012. During this period, a state election was held and a new department, the Department of Environment and Heritage Protection (EHP) was formed and took over the assessment manager role performed by DERM. The Chief Executive of EHP received 167 submissions relating to the EIS from government agencies and the public during this time.

Under s. 56 of the EP Act, following the receipt of submissions, the Chief Executive of EHP requested Arrow to prepare a supplementary report that summarised and addressed the comments made in submissions and responded to any additional matters identified by EHP. The SREIS has been prepared for this purpose.



coffey environments	Date: 19.06.2013 MXD: 7040AE_12_GIS054_v1_1 File Name: 7040_12_ATT6_F01.01_GIS_VS	Arrow Energy Surat Gas Project	arrow energy go further	Surat Gas Project Development Area	Figure No: 1.1

Queensland and Australian government policies require the provision of environmental offsets for unavoidable impacts on biodiversity, remnant vegetation, listed species and habitat, and unavoidable significant impacts on matters of national environmental significance. This document sets out Arrow's strategy for providing environmental offsets for the project.

This document (Draft Environmental Offset Strategic Management Plan) presents Arrow's strategy to meet environmental offset obligations for the Surat Gas Project. The aim of this document is to facilitate discussion with EHP and SEWPaC on suitable offsets for unavoidable losses of vegetation and habitat incurred in constructing the project.

The document describes the measures taken to avoid and minimise impacts, the expected disturbance to terrestrial ecology environmental values, and evidence that there are opportunities to offset the estimated losses of remnant vegetation, species and habitat. It details Arrow's preferred approach to the provision of environmental offsets.

2. PROJECT OVERVIEW

Arrow proposes expansion of its coal seam gas operations in the Surat Basin through the Surat Gas Project. The need for the project arises from the growing demand for gas, global demand for energy and the associated expansion of LNG export markets.

2.1 Project Description

The project development area is located approximately 160 km west of Brisbane in Queensland's Surat Basin. Through ongoing exploration activities, Arrow has enhanced its understanding of the gas resource and subsequently, relinquished tenure sub-blocks, where development activities will now not occur. The overall size of the project development area since the EIS was published has reduced from 8,600 km^2 to 6,100 km^2 due to the relinquishment of tenure sub-blocks within Arrow's exploration tenements. The majority of these relinquishments were made in the Goondiwindi development region.

The project development area extends from the township of Wandoan in the north towards Goondiwindi in the south, in an arc through Dalby. Townships within or in close proximity to the project development area include Wandoan, Chinchilla, Kogan, Dalby, Cecil Plains, Millmerran and Miles. Project infrastructure, including coal seam gas production wells and production facilities (including both water treatment and power generation facilities where applicable), will be located throughout the project development area but not in towns. Facilities supporting the petroleum development activities, such as depots, stores and offices, may be located in or adjacent to towns.

The EIS described that around 7,500 wells would be drilled across the project development area. With a smaller project development area, fewer wells will be drilled. It is currently anticipated that over the life of the project (nominal 35 years), about 6,500 production wells will be drilled.

Wells will be drilled from both single-well pads (as described in the EIS) and multi-well pads. The single-well pads will typically be vertical production wells, while the multi-well pads will be comprised of up to 12 wells per pad (most commonly comprising nine wells per pad), approximately 8 m apart. A likely configuration of the multi-well pads will be one central vertical production well, with the remainder of the wells being deviated production wells.

The multi-well pads consolidate a group of wells at one surface location, reducing the total number of well pad sites, reducing the individual pad area required per well, and increasing the distance between any two adjacent well pad sites. Overall, the total disturbance area resulting from well pads will be reduced.

A single well site is approximately 100 m x 100 m (i.e., 1 ha) including an area for sediment and erosion control devices, while a multi-well pad containing up to 12 wells is approximately 200 m x 100 m (i.e., 2 ha) inclusive of allowance for sediment and erosion control. Well sites will be assessed on an individual basis to reduce footprint as far as practicable.

Field development planning has advanced since preparation of the EIS. The overall project development area has been defined by eleven drainage areas, identified simply by sequential numbering. The drainage area numbering has been adopted for the central gas processing facilities (CGPF) that will process the gas reserves in each drainage area. The SREIS discusses the sequence of the project's development in terms of these drainage areas (as opposed to the five development regions that were described in the EIS).

Eight of these drainage areas are initially expected to be developed for the Surat Gas Project (drainage areas 1, 2, 5, 7, 8, 9, 10 and 11). Each drainage basin will incorporate wells, a water gathering network, a gas gathering network and a CGPF. The number of CGPFs has reduced from the 12 described in the EIS to eight. A further three drainage areas may be developed with favourable reservoir outcomes and future market conditions.

Arrow has identified four sites to locate CGPFs, two of which will have water treatment facilities located adjacent to them. The approximate footprint for a CGPF is 350 m x 250 m. The number of water treatment facilities has been reduced from six described in the EIS to two, co-located with the CGPFs in drainage area 2 and drainage area 9. The total footprint at each water treatment facility could be up to 2 km^2 (200 ha), as originally stated in the EIS.

Sites with a water treatment facility located adjacent to a CGPF were referred to as integrated processing facilities in the EIS. These sites are now referred to as a CGPF and co–located water treatment facility.

A further site, Village F, has been identified by Arrow to locate a temporary workers accommodation facility (TWAF).

The exact locations of infrastructure within the four properties acquired and/or leased by Arrow for CGPFs and the TWAF have not been determined. Final siting of infrastructure and the specific orientation and layout of each facility will depend on site-specific land and environmental features, such as remnant vegetation, topography, soil and the proximity of sensitive receptors. Facilities will be designed and constructed to minimise footprint and environmental impact.

Field compression facilities described in the EIS have been retained in the revised project description, as a contingency option. Should field compression facilities be required, the location would be considered in accordance with Arrow's commitment to avoid the construction of major infrastructure on intensively farmed land. Field compression facilities would likely be located between production wells and the CGPFs. The maximum number of field compression facilities (six) and approximate footprint (100 m by 50 m) has not changed from the EIS.

The updated Coal Seam Gas Water and Salt Management Strategy (Attachment 5 to the SREIS) includes provision for coal seam gas water to be discharged from each water treatment facility to a nearby watercourse as required and within prescribed limits. Discharge to watercourses is a management option that addresses the variability of other coal seam gas water management options (i.e., distribution to existing and new water users for beneficial use and injection to a suitable aquifer). Surface water aspects such as watercourse type, morphology, and aquatic ecosystems at the two identified water treatment facility sites will inform the management options that can be adopted at those locations.

Additional infrastructure will also include:

- Low-pressure gas gathering lines to transport gas from the production wells to CGPFs.
- Medium-pressure gas pipelines to transport gas between field compression facilities and CGPFs.
- High-pressure gas pipelines to transport gas from CGPFs to the sales gas pipeline.
- Water gathering lines (located in a common trench with the gas gathering lines) to transport coal seam gas water from production wells to water treatment and storage facilities.

- Gas-powered electricity generation equipment co-located with production facilities, or electricity transmission infrastructure that will transmit electricity from the Queensland electricity grid via third-party substations.

Arrow has established an environmental framework approach to guide the identification of sites for production wells, pipelines and production facilities. The framework will also be used to select sites for associated infrastructure, such as access roads and construction camps. Environmental and social constraints to development identified through the EIS process, coupled with the application of appropriate environmental management controls, will ensure that protection of environmental values (resources) is integrated into project planning. This approach will maximise the opportunity to select appropriate site locations that minimise potential environmental and social impacts.

Arrow intends to pursue opportunities in the selection of equipment (including reverse osmosis units, gas-powered engines, electrical generators and compressors) and the design of facilities that facilitate the cost-effective and efficient scaling of facilities to meet field conditions. This flexibility will enable Arrow to better match infrastructure to coal seam gas production.

3. LEGISLATIVE FRAMEWORK

Chapter 2, Project Approvals Update provides an update to the principal approvals required by Arrow to construct and operate and maintain the project that were detailed in the EIS (Chapter 2 of the EIS, Project Approvals). The legislative framework applicable to offsets is summarised below. Additional legislation and policies relevant to the project are described in Attachment 8, Legislation and Policy Update.

The project must satisfy the environmental offsets policy requirements of the Queensland and Australian governments, as it triggered assessment under both jurisdictions. Offsets delivered in accordance with Queensland Government policy can, where appropriate, satisfy the Australian Government's requirements. This section describes the legislative framework for environmental offsets. Arrow will work to any policy changes that are made by Australian or state government as appropriate.

3.1 Queensland Government Legislation and Policy

The Queensland Government Environmental Offsets Policy, June 2008 (EPA, 2008) sets out the requirements for environmental offsets for activities triggering assessment or the grant of environmental authorities or permits for the following relevant legislation:

- *Environmental Protection Act 1994* (Qld).
- *Vegetation Management Act 1999* (Qld).
- *Nature Conservation Act 1992* (Qld).
- *Fisheries Act 1994* (Qld).
- *Sustainable Planning Act 2009* (Qld).

The policy sets out seven principles for achieving economically sustainable outcomes in providing environmental offsets. The principles set out in EPA (2008) are:

- Principle 1: Offsets will not replace or undermine existing environmental standards or regulatory requirements, or be used to allow development in areas otherwise prohibited through legislation or policy
- Principle 2: Environmental impacts must first be avoided, then minimised, before considering the use of offsets for any remaining impact.
- Principle 3: Offsets must achieve an equivalent or better environmental outcome.
- Principle 4: Offsets must provide environmental values as similar as possible to those being lost.
- Principle 5: Offset provision should minimise the time-lag between the impact and delivery of the offset.
- Principle 6: Offsets must provide additional protection to environmental values at risk, or additional management actions to improve environmental values.
- Principle 7: Offsets must be legally secured for the duration of the offset requirement.

This overarching policy is supported by policies that address the specific requirements of the relevant legislation. Specific policies that apply to the provision of offsets for unavoidable losses are detailed below.

Policy for Vegetation Management Offsets (Version 3) 30 September 2011 (DERM, 2011) sets out the specific requirements for offsets to achieve the desired outcomes under the Vegetation Management Act.

Petroleum activities carried out under the *Petroleum and Gas (Production and Safety) Act 2004* are exempt from the requirements of the Vegetation Management Act, as the clearing of vegetation is regulated through environmental authorities issued under the EP Act. Offsets for unavoidable disturbance of vegetation authorised in an environmental authority may be required to satisfy the Queensland Biodiversity Offsets Policy (Version 1) 3 October 2011 (DERM, 2011). Environmental authorities issued for the Surat Gas Project will require offsets in accordance with this policy or any subsequent update or replacement.

The Queensland Biodiversity Offsets Policy sets out the specific requirements for offsets of state significant biodiversity values and provides a framework to prevent net loss of biodiversity in Queensland through the application of project specific biodiversity offsets. State significant biodiversity values are the relevant values defined in various GIS datasets compiled by EHP and site based assessments. This policy is currently under review by the Queensland Government.

State significant biodiversity values are as stated in Appendix 1 of the Queensland Biodiversity Offsets Policy and include remnant regional ecosystems (REs) (endangered and of concern status), high value regrowth vegetation, threshold REs, critically limited REs, essential habitat, essential regrowth habitat, wetlands, watercourses, areas of connectivity, protected species and wetland protection areas.

The adequacy of an environmental offset is determined by application of the ecological equivalence method (DERM, 2011) which requires assessment of the vegetation to be lost and vegetation proposed as the offset. The method evaluates the ecological condition and special features of the project and offset sites to ensure the offset satisfies the objective of ‘no net loss’. Application of the method is set out in Ecological Equivalence Methodology Guideline, Policy for Vegetation Management Offsets, Queensland Biodiversity Offset Policy, Version 1, 3 October 2011 (DERM, 2011).

Regional ecosystem mapping (v6.0) (DERM, 2009a) and regrowth mapping databases (DERM, 2009b) are administered by EHP as preliminary guidance on vegetation mapping within Queensland. For the EIS, these databases were used in conjunction with field survey mapping to inform the location of environmental values and potential constraints. Since the EIS was finalised, EHP has released the following database updates:

- Version 7.0 Regional Ecosystem digital data (EHP, 2012a).
- Mature Regrowth digital data (EHP, 2012b).

The release of Version 7.0 Regional Ecosystem digital data mapping is specifically for use in projects regulated under the EP Act where ‘biodiversity status’ should be applied rather than ‘vegetation management status’ under the Vegetation Management Act.

Prior to the release of EHP’s Mature Regrowth digital data, RE types were not attributed to regrowth vegetation, formerly recognised as ´high value regrowth‘. The revised dataset now attributes RE types and associated biodiversity status using mapping of regrowth vegetation which is based on temporal analysis of aerial photography or satellite imagery identifying regrowth vegetation not cleared since 31 December 1989.

The EP Act was revised in June 2012 and EHP now recognises Mature Regrowth vegetation by RE type in accordance with the updated Mature Regrowth digital data (EHP, 2012b).

3.2 Australian Government Legislation and Policy

Actions that result in a significant residual impact on matters of national environmental significance (MNES), after all practical avoidance and mitigation measures are in place, may be required to offset that impact under the provisions of the EPBC Act. The Environmental Offsets Policy, October 2012 (SEWPaC, 2012) sets out the requirements for offsets.

The Environmental Offsets Policy applies to all new referrals or variations to approval conditions from 2 October 2012. It also applies to projects currently under assessment for which a decision has not yet been made, and therefore will apply to the Surat Gas Project.

Implementation of the policy is guided by the Offsets Assessment Guide (SEWPaC, 2012). It has been developed to give effect to the requirements of the policy, utilising a balance sheet approach to measure impacts and offsets. It places a higher value on offsets that are delivered in advance of the loss occurring and those that produce a conservation gain in the short-term. It incorporates the International Union for the Conservation of Nature (IUCN) figures for annual probability of extinction for IUCN Red List species.

The guiding principles for the provision of offsets in accordance with the Environmental Offsets Policy are (SEWPaC, 2012):

- Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed development.
- Be efficient, effective, transparent, proportionate, scientifically robust and reasonable.
- Be built around direct offsets but may include other compensatory measures.
- Be of a size and scale proportionate to the impacts being offset.
- Be in proportion to the level of statutory protection that applies to the affected species or community.
- Effectively manage the risks of the offset not succeeding but may include other compensatory measures.
- Be additional to what is already required determined by law or planning regulations or agreed under other schemes or programs.
- Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

3.3 Revisions to Species or Habitats Schedules

Since the project was declared a controlled action under the EPBC Act on 26 March 2010, due to its potential to significantly affect listed threatened species and ecological communities (s. 18 and s. 18A) and listed migratory species (s. 20 and s. 20A), revisions have been made to the schedules of a number of species or communities. Under the EPBC Act, the environmental assessment process and conditions on approval can only consider the species listed at the time of the controlled action decision, and the conservation status of the species at that time.

Koala (*Phascolarctos cinereus*)

On 2 May 2012, koala populations in Queensland, New South Wales and the Australian Capital Territory were listed as vulnerable under the EPBC Act. In order to list the Queensland/New South

Wales/Australian Capital Territory koala population separately, the Minister was required to nominate it under Section 517(1) of the EPBC Act as a separate species to other koala populations. This approach was based on advice from the Threatened Species Scientific Committee (TSSC) to SEWPaC (TSSC, SEWPaC 2012).

All new developments within koala habitat in Queensland, New South Wales or the Australian Capital Territory will now need to consider whether the development is likely to have a significant impact upon the koala, using the existing EPBC Act significant impact criteria for vulnerable species. Referral guidelines for the koala have been released as well as outline criteria for assessing 'critical habitat', 'important populations' and significant impacts. The MNES assessment for the Surat Gas Project is not affected by the listing, as it came after the Australian Government Environment Minister decided the project was a controlled action.

The koala does not constitute one of the controlling provisions for the project, and is not discussed further within this attachment. However, potential impacts to the terrestrial faunal values of the species and its potential habitat within the project area are addressed in the EIS (Appendix K, Terrestrial Ecology Impact Assessment) and the SREIS (Appendix 9, Supplementary Terrestrial Ecology Assessment). The project will not trigger an offset requirement for habitat identified as koala habitat, however offset requirements for other species may include koala habitat.

King blue grass (*Dichanthium queenslandicum*)

On 30 January 2013 an amendment was made to the status of king blue grass (*Dichanthium queenslandicum*) under the EPBC Act, upgrading the species to endangered (previously vulnerable). The amendment to the listing for king blue grass came into effect after the project was declared a controlled action. The SREIS considers the species with the status it had at the time the controlled action was decided i.e., as vulnerable. Potential impacts on this species are assessed in accordance with the EPBC significant impact criteria for vulnerable species.

Brigalow scaly-foot (*Paradelma orientalis*)

On 29 April 2013, an amendment was made to delist a number of species listed as threatened under the EPBC Act. Of these species, brigalow scaly-foot (*Paradelma orientalis*) is of relevance to the project as the species was listed in the EPBC referral for the Surat Gas Project, as vulnerable.

Brigalow scaly-foot is now delisted and is not considered threatened under Australian Government legislation. Although no assessment is required under the EPBC Act, the species is retained in the MNES attachment for the SREIS, and its revised status will be addressed when EA applications are made for the project. No offset requirement under the EPBC Act will be triggered for this species.

Wardell's wattle (*Acacia wardellii*)

On 23 May 2013, an amendment was made to delist Wardell's wattle (*Acacia wardellii)* listed as vulnerable under the EPBC Act. Wardell's wattle is now delisted and is not considered threatened under Australian Government legislation. Although no assessment is required under the EPBC Act, the species is retained in the MNES attachment for the SREIS, and its revised status will be addressed when EA applications are made for the project. No offset requirement under the EPBC Act will be triggered for this species.

Australian Painted Snipe (*Rostratula australis*)

On 30 April 2013, an amendment was made to upgrade Australian painted snipe (*Rostratula australis*) previously listed as vulnerable under the EPBC Act to endangered. The amendment to the listing for Australian painted snipe came into effect after the project was declared a controlled

action. The SREIS will consider the species with the status it had at the time the controlled action was decided i.e., as vulnerable. Potential impacts on this species are assessed in accordance with the EPBC significant impact criteria for vulnerable species.

4. BIOREGIONAL CONTEXT

The project development area lies within the Brigalow Belt South bioregion. Generally, the Brigalow Belt South bioregion is characterised by the brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community. Brigalow is a wattle tree with silvery foliage that grows as forests or woodlands on clay soils. Other vegetation types that occur with brigalow include eucalypt and cypress pine forests and woodlands, vine thickets and grasslands.

The Brigalow Belt South bioregion is a major pastoral and agricultural area, with much of the natural vegetation extensively cleared as a result of land development. The resulting landscape is one of isolated patches of remnant, disturbed and regrowth vegetation that vary in size, shape and distribution across the landscape. This is evident in the network of linear vegetation (both remnant and regrowth) along road verges and fence lines and by the few larger stands of vegetation containing relatively intact habitat preserved in areas that either are unsuitable for agriculture or have been protected through alternative use.

The extent of remnant vegetation in the Brigalow Belt bioregions (including both Brigalow Belt South, where the project development area is located, and Brigalow Belt North bioregions) is set out in Table 4.1.

Table 4.1 Extent of remnant vegetation in the Brigalow Belt bioregions

Bioregion	Pre-clearing (Accad *et al*) Extent of Remnant Vegetation (ha)	Remnant Vegetation 2009 (ha)	Remnant Vegetation Remaining
Brigalow Belt bioregions*	36,486,511	15,222,470	42%

* Includes both the Brigalow Belt North and Brigalow Belt South bioregions.

Source: Accad, A; Neldner, V.J; Wilson, B. A; and Niehus, R.E. (2012) Remnant Vegetation in Queensland. Analysis of remnant vegetation 1997-2009, including RE information. (Queensland Department of Science, Information Technology, Innovation and the Arts: Brisbane).

Remnant vegetation comprises approximately 263,202 ha of the bioregion with the balance of 586,178 ha being non-remnant vegetation (70% of the project development area), comprising mostly cleared pastoral and grazing land.

5. ENVIRONMENTAL PROTECTION OBJECTIVES

The environmental protection objectives for terrestrial ecology remain as stated in the EIS Terrestrial Ecology Chapter (Chapter 11), namely:

- To minimise habitat loss and fauna mortality.
- To avoid or minimise adverse effects on and to protect terrestrial ecosystems and associated biodiversity and habitat of state and national conservation significance.
- To avoid or minimise adverse impacts on and to protect ESAs.
- To prevent project activities from introducing or spreading new or existing exotic terrestrial flora or fauna.

Achievement of the environmental protection objectives will reduce assessed residual impacts on ecological values to ‘not significant’ which will reduce Arrow’s potential offset liability.

6. AVOIDANCE, MITIGATION AND MANAGEMENT MEASURES

Proposed avoidance, mitigation and management measures have been presented in the technical studies undertaken for the EIS and SREIS to achieve the identified environmental protection objectives.

The mitigation and management measures set out in the EIS and SREIS are Arrow's commitments to the effective management of the potential environmental and social impacts of the project.

The implementation of the avoidance, mitigation and management measures set out in this section will avoid adverse impacts from project activities, or reduce the severity of their magnitude on species and communities in the project development area. Arrow has developed an 'environmental framework' approach (Chapter 8, Environmental Framework of the EIS) which includes constraints mapping to guide site and route selection to avoid and minimise environmental impacts from its project activities, in the absence of certainty about the precise location of project infrastructure.

Profiles have been developed for all MNES communities and species of relevance to the Surat Gas Project (Attachment 1, Matters of National Environmental Significance, Appendix C) which include an assessment of the significance of impacts of the project on the MNES species and communities across the project development area. A corresponding assessment for *Nature Conservation Act 1992* (Qld) (NC Act) listed species is presented in Appendix K of the EIS, Terrestrial Ecology Impact Assessment, Table 36.

These qualitative assessments have been undertaken to define the sensitivity of habitats, local flora and fauna populations, and to assess the magnitude of impacts on the MNES. The assessments address the likely disturbance to MNES within the project development area based on known ecological attributes including life span and life cycle, resilience to disturbance and the capacity of the population for recovery and rehabilitation.

At this stage, the precise locations of the facilities and infrastructure to be developed in the project development area are not known. The terrestrial ecology assessment therefore has taken a precautionary approach in assessing residual impacts for each species or community on the basis that avoidance may not be possible in many cases, although avoidance is the first preference in site and route selection for habitat for listed species.

Planning of field development will use constraints mapping to ascertain the presence and/or potential presence of listed species and communities. The conceptual layout will be refined as a result of ecological field assessments (preconstruction clearance surveys) undertaken by suitably qualified person(s).

Preconstruction clearance surveys inform any further refinement of the conceptual gas field layout, particularly the location and arrangement of production facilities and routes for medium pressure gas pipelines. The outcome of field surveys informs the detailed design of the gas field and selection of equipment and construction methods that address the environmental constraints. Data collection will be ongoing and the results used to refine areas of known and possible core habitat for threatened species. The environmental management controls (standard operating procedures) applicable to the proposed activities at the selected sites or routes are identified and incorporated in the work plans. An outline of approach for these surveys is presented and discussed in Chapter 11, Terrestrial Ecology.

Infrastructure design and site selection that seeks to avoid core habitat known will be prioritised. Areas classed as 'core habitat known' are to be avoided if practicable, and will not require survey work on this basis. If clearing is planned in areas of core habitat known or possible, survey work appropriate to the species or community in question, will be conducted before any project activities are undertaken.

Project activities will not cause significant impacts if disturbance of threatened ecological communities/REs and habitat for listed threatened species is avoided. The residual impact on some species remains high where avoidance may not be possible and other management and mitigation measures are implemented instead.

Two threatened EPBC Act listed ecological communities have been identified for avoidance: 'Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland' and 'White box-yellow box- Blakely's red gum grassy woodland and derived native grassland'.

Site assessment and ecological survey methods appropriate for each listed threatened species, their habitat and listed threatened ecological communities will be applied, and a record will be kept of these surveys and results submitted to the Australian Government on request.

Site management measures will be developed and approved prior to construction, which will include additional site specific measures to the commitments outlined in the EIS and SREIS as required. Should an area hold more than one listed species, the site specific management measures will include measures appropriate to the species present.

6.1 Avoidance

Arrow undertakes a desktop site selection process as a matter of standard procedure. Once a potential site is identified, detailed, field-based ecological assessment is carried out to identify and avoid sensitive locations known to be of value to listed flora and fauna species. Construction activities (such as clearing) will be routinely observed by a spotter-catcher to check that the activity is being conducted within the approved area and according to agreed methods.

Arrow will avoid, where practicable, listed threatened ecological communities and the habitat of listed flora, fauna and migratory species, as follows:

- Wondul Range National Park and Lake Broadwater Conservation Park (Category A ESAs).
- Chinchilla Sands Local Fossil Fauna Site.
- 'Critically endangered' EPBC Act communities within the project development area (REs 11.3.21, 11.3.24, and 11.8.2a), including three natural grassland road reserves (Dalby Kogan, Dalby St George and Dalby Cecil Plains). [C217]

Arrow will aim to avoid the following terrestrial ecology values:

- Additional national- and state-listed communities: Brigalow (REs 11.3.1, 11.4.3, 11.4.10, 11.9.5, 11.9.6), Semi-evergreen vine thickets (REs 11.9.4a, 11.8.3), Weeping Myall Woodlands, and Coolibah – Blackbox Woodlands (RE 11.3.3).
- Category B ESAs.
- Category C ESAs, including Gurulmundi State Forest, Binkey State Forest and Barakula State Forest.

- Wyaga-Kindon Ooline populations.
- Stock routes and state or bioregional wildlife corridors.
- Essential and core habitat (supporting listed wildlife species).
- State forests and resources reserves.
- State-listed 'of concern' regional ecosystems. [C218]

In addition, Arrow will manage potential impacts to Category A, B and C ESAs through implementation of buffers in accordance with legislative requirements at the time. [C227]

Additional Commitment Derived from SREIS Studies

The following additional commitments were developed as a result of the technical studies undertaken for the SREIS:

- Design infrastructure to avoid disturbance of state significant vegetation and other high value ecological corridors, where practicable. [C557]
- Demarcate in order to restrict access to any ground-truthed populations of *Microcarpaea agonis* identified adjacent to work sites. [C559]

With these additional measures and EIS commitments in place, a significant impact upon a number of protected matters will be avoided; these are outlined in Table 6.1.

Table 6.1 Listed communities or species for which significant impacts on core habitat are avoided

Group	Scientific Name	Common Name	EPBC Act Status	NC Act Status	Key Avoidance Measure
Threatened ecological community	–	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically endangered	–	Community will be mapped and avoided
Threatened ecological community	–	White box-yellow box- Blakely's red gum grassy woodland and derived native grassland	Critically endangered	–	Community will be mapped and avoided
MNES flora species	*Microcarpaea agonis*	An unnamed member of the Scrophulariaceae family	Endangered	Endangered	Demarcate in order to restrict access to any ground truthed populations of *Microcarpaea agonis* identified adjacent to work sites. [C559]

Arrow will aim to avoid listed species and communities where practical in undertaking project activities, although this may not always be possible. Some species have high to major residual impacts as the assessment assumes that populations will be present within the project development area and that the species cannot be avoided (therefore the significance of impacts would be high). The characteristics of the species of high or extremely high sensitivity, that retain

high to major residual impacts, are summarised below. This information will assist Arrow to implement preconstruction clearance surveys that will establish the presence and status of these species within the project development area, and develop site specific management plans where necessary.

- ***Anomalopus mackayi.*** The species mainly occurs in native grasslands. Arrow will aim to avoid areas of core habitat.
- ***Anthochaera phrygia.*** The habitat for this species consists of dry eucalypt woodland and open forest, woodland, and rural and urban areas with mature eucalypts. There are no known breeding populations within the project development area. If populations are discovered Arrow will aim to avoid these areas.
- ***Delma torquata.*** This species has been found as a small number of individuals approximately 12 km west of Wondul Range National Park. The bulk of records occur outside the project development area. The species is often found in very small, restricted populations. Preconstruction clearance surveys will aim to identify the location of this species in development areas so core habitat can, where possible, be avoided.
- ***Tympanocryptis cf. tetraporophora.*** Native grasslands are listed as essential habitat for species, but it is also regularly recorded in sorghum crops adjacent to native grassland verges. Arrow will determine the presence of this species through preconstruction clearance surveys and will aim to avoid any identified areas of core habitat.
- ***Macrozamia machinii.*** This species is mainly located in the Wondul Range which Arrow intends to avoid. Arrow will aim to avoid any other locations where this species is found to occur.
- ***Calytrix gurulmundensis.*** This species was found outside the project development area and just along the border of the area. Arrow will determine the presence of this species through preclearance surveys and will aim to avoid any identified areas of core habitat.
- ***Prostanthera*** **sp. (Dunmore).** Arrow will identify the presence of this species through preconstruction clearance surveys, aim to avoid any identified areas of core habitat and use appropriate buffers to protect identified populations of the species.
- ***Cadellia pentastylis*****.** Arrow will identify the presence of this species through preconstruction clearance surveys, aim to avoid any identified areas of core habitat and use appropriate buffers to protect identified populations of the species.
- ***Denhamia parvifolia.*** Arrow will identify the presence of this species through preconstruction clearance surveys, aim to avoid any identified areas of core habitat and use appropriate buffers to protect identified populations of the species.

Where avoidance is not possible, Arrow will minimise the area of habitat or number of species affected by reducing the right of way and workspace requirements and through micro-siting or realignment of facilities and infrastructure.

6.2 General Mitigation and Management Measures

The following mitigation and management measures presented in the EIS were developed to address the potential impacts of the project on terrestrial ecology, including listed communities, flora, fauna and migratory species.

- Design gathering lines and tracks to avoid watercourses, drainage lines and riparian areas (particularly permanent watercourses or perennial aquatic habitat), where practicable. [C191]
- Manage potential impacts on Lake Broadwater Conservation Park (Category A ESA) through implementation of relevant buffers in accordance with legislative requirements at the time of development in this region. [C156]
- Arrow will implement a buffer zone from the high bank of all watercourses to prevent development or clearance occurring within the buffer (other than construction of watercourse crossings for roads and pipelines, discharge infrastructure and associated stream monitoring equipment). Determine the buffer zone distance in accordance with the legislative requirements at the time of development or through preconstruction clearance surveys. [C157]
- Develop an erosion and sediment control plan and install and maintain appropriate site-specific controls, established on the basis of the sensitivity of the surrounding environment. [C034]
- Conduct preconstruction clearance surveys and include as a minimum:
  - Vegetation mapping at a scale suitable for site specific planning.
  - Identification of core habitats and listed species
  - Identification of site-specific sensitive areas that require avoidance or buffer areas. [C232]
- Conduct preconstruction clearance surveys to identify any additional areas that may need to be avoided. [C220]
- Mark site boundaries clearly for site-specific sensitive areas that require avoidance. [C228]
- Develop management procedure, inclusive of buffers where required, for threatened communities and species as and when project activities are identified as likely to have an impact on these values. [C224]
- Develop site specific monitoring programs for threatened species and communities based on the identified risk to the conservation or maintenance of a viable population. [C303]
- Where avoidance is not possible, and significant residual impacts remain to threatened species and communities, implement an offset strategy approved by a relevant government agency and comply with reporting conditions of an offset plan. [C219]
- Clear areas progressively and implement rehabilitation as soon as practicable following construction and decommissioning activities. [C015]
- Design facilities to ensure natural surface water flows are not impounded, e.g., by installing culverts on roads and stormwater diversion ditches around production facilities. [C221]
- Develop fire plans for production facilities. [C223]
- Demarcate buffers and inform workers and machinery operators of buffer locations when working within the vicinity of national- and state-listed species, communities and areas identified for avoidance. [C230]
- Consider the preconstruction clearance survey baseline characterisation when rehabilitating project sites. [C244]
- Implement site planning, preparation and management requirements in accordance with a developed and approved decommissioning and rehabilitation plan. [C245]

- Decommission the pipeline corridors in a manner that minimises potential impacts on the environment. [C246]
- Identify areas for rehabilitation. [C247]
- Prioritise areas for rehabilitation based on the preconstruction clearance survey baseline characteristics. [C248]
- Advise, through procedures and plans, on requirements for rehabilitation in identified areas that are no longer in use. [C250]
- Carry out routine monitoring of rehabilitated sites. [C478]
- Reinstate self-supporting drainage lines. [C251]
- Inspect rehabilitation areas after decommissioning for regrowth similar to the surrounding environment. [C252]
- Minimise the disturbance footprint and vegetation clearing. [C020]
- Confine project traffic to designated roads and access tracks, where practicable. [C033]
- Erect fauna-exclusion fences around project dams. [C243]
- Dispose of food scraps in large skips or bins that prevent animal access. Empty these storage devices regularly in a manner that does not involve disposal to onsite trenches or waste dumps. [C258]
- Select plant species for the purposes of rehabilitation that are specific to the original ecosystem and of local provenance, wherever practicable. [C253]
- Identify declared weeds during the preconstruction clearance survey. [C193]
- Develop a declared weed and pest management plan in accordance with the Petroleum Industry - Pest Spread (including coal seam methane gas) minimising pest spread advisory guidelines (Biosecurity Queensland, 2008), or relevant legislation at the time. Undertake species-specific management for identified key weed species at risk of spread through project activities (mesquite, parthenium, African love grass and lippia). Increase weed control efforts in areas particularly sensitive to invasion. The pest management plan should include, as a minimum, training, management of pest spread, management of pest infestations, requirements for crossing and working around pest fences and monitoring the effectiveness of control measures. [C188]
- Design washdown facilities to ensure that runoff is contained on site and does not transfer weed seeds, spores or infected soils to adjacent areas. Treat or dispose of washdown solids in a registered landfill. [C187]
- When siting production facilities, avoid wetlands and consider the following:
  - Stream processes that may result in channel migration (either over time or as a result of project activities) and areas that are highly susceptible to erosion (i.e., dispersive soils).
  - Downstream values of nearby watercourses or wetlands.
  - Minimising changes to natural drainage lines and flow paths.
  - Flooding regimes and areas subject to inundation. [C151]

- Do not wash down vehicles in watercourses. [C180]
- Install and maintain appropriate sediment and erosion control structures at work sites. [C261]
- Where used for dust suppression on roads or for construction and operations activities, coal seam gas water quality will be in accordance with the relevant permits and/or consents. [C176]
- Prohibit disturbance or harassment of wildlife and the unauthorised collection of flora and forest products. [C256]
- Apply appropriate international, Australian and industry standards and codes of practice for the handling of hazardous materials (such as chemicals, fuels and lubricants). [C035]
- Apply appropriate international, Australian and industry standards and codes of practice for the design and installation of infrastructure associated with the storage of hazardous materials (such as chemicals, fuels and lubricants). [C048]
- Discharge water from project activities at a rate and location that will not cause or exacerbate erosion. Install erosion protection measures, including energy dissipation structures, at discharge outlets. [C066]
- Inspect erosion and sediment control measures following significant rainfall events and carry out repairs and/or maintain as required to retain the effectiveness of the measures. [C505]
- Carry out corrective actions immediately upon the identification of any contamination of soil or groundwater that has occurred as a result of project activities. [C038]
- Advise all relevant personnel of the location and extent of weed infestations in the vicinity of work areas and the risks involved in moving from one site or property to another. [C179]
- When sourcing maintenance materials, check materials such as bedding sand, topsoil and sand bags for weeds and plant materials or animal pathogens. Request a weed hygiene declaration form from the supplier where there is possible risk of contamination in products or materials. [C190]
- Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites. [C099]
- Train field personnel to identify key pest species and to maintain constant vigilance of weeds and pest fauna species throughout the project life to ensure early detection and intervention. [C259]
- Avoid transport of equipment across watercourses unless an appropriate crossing that minimises disturbance to the watercourse bed and banks and to riparian vegetation, is available. [C194]
- Locate self-contained portable toilet facilities at designated work sites at appropriate distances from watercourses, where they are accessible to all operations and maintenance personnel. Regularly maintain the facilities and dispose of sewage and greywater from toilet facilities via a chemical treatment system, or transport to a municipal sewage treatment plant using a licensed contractor. [C182]

No additional mitigation and management measures were proposed in technical studies completed for the SREIS.

6.3 Mitigation and Management Measures for Ecological Communities

In addition to the general measures identified above, further mitigation and management measures (expressed as commitments) were developed to protect significant ecological communities and respond to potential impacts identified on listed ecological communities. These include:

- Construct production wells, gathering lines and access tracks within cleared areas, where practicable, with the aim of avoiding remnant vegetation and high-value regrowth. [C240]
- Reduce the width of construction ROWs within areas of sensitivity to the greatest extent practicable without compromising the safety of workers. [C231]
- Inform relevant workers, including contract plant and machinery operators of the location of significant remnant vegetation and buffers and use qualified personnel to guide clearing activities. [C229]

No additional mitigation and management measures were proposed in technical studies completed for the SREIS.

6.4 Mitigation and Management Measures for Flora Species

In addition to the general measures identified above, further mitigation and management measures (expressed as commitments) developed to protect significant flora species and respond to potential impacts identified on listed flora species were presented in the EIS. They are:

- Translocate or propagate significant species where it is deemed necessary for use during rehabilitation or in offsets, in accordance with relevant legislation. [C239]
- 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. [C242]

The following additional commitments were developed as a result of technical studies undertaken for the SREIS.

- Record the location of any newly identified populations of Machin's macrozamia (*Macrozamia machinii*) and confidentially notify relevant authorities. [C563]
- Develop a site specific management plan to reduce changes to wetland habitat hydrology, including water quality, in areas of ground-truthed populations of *Microcarpaea agonis* adjacent to work sites. [C558]
- Salvage seed from threatened flora species unavoidably disturbed for use in rehabilitation as propagation material or natural regeneration. [C541]

6.5 Mitigation and Management Measures for Fauna Species

In addition to the general measures identified above, further mitigation and management measures (expressed as commitments) were developed to protect significant fauna species and respond to potential impacts identified on listed fauna species. These include:

- Design dams to have an egress (escape point) for wildlife. [C214]

- 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 crossing fauna. [C238]
- Review site-specific management plans before moving stockpiled logs and vegetation to avoid reduce potential for fauna mortality. [C473]
- Use appropriately trained personnel or a spotter-catcher to capture injured wildlife, where possible. If further action is required, consult with a qualified vet to determine appropriate action. [C237]
- Minimise the time a trench is left open. Construct exit points when construction is within 1 km of native vegetation, using appropriate material. Provide fauna refuges, such as sawdust-filled bags, regularly through areas of high fauna activity. [C233]
- Inspect and manage open trenches in accordance with the following:
  - Inspect trenches for the presence of fauna daily (preferably in the morning), as well as immediately prior to closing a trench.
  - Have appropriately trained personnel remove any fauna from a trench to minimise stress to the animal and to avoid personal injury.
  - Record details of trapped fauna for inclusion in the EHP Wildnet database. [C500]
- 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. [C241]
- Retain habitat trees, where practicable. [C234]
- Implement noise control techniques in accordance with the project's noise and vibration commitments and standard industry noise suppression techniques. [C254]
- Assess trees prior to felling for potential nesting hollows. If identified, 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. [C235]
- Reduce light spill resulting from project activities to reduce disturbance to nocturnal fauna. [C255]
- Implement speed limits on project-controlled roads to reduce the potential for vehicle collisions with wildlife. [C260]
- Obtain all relevant permits required under the *Fisheries Act 1994* (Qld), including permits for construction of waterway barriers or disturbance of fish habitat. [C192]
- Construct watercourse crossings in a manner that reduces sediment release to watercourses, stream bed scouring (e.g., the crossing location will be at low-velocity, straight sections, with the pipeline or road orientated as near to perpendicular to water flow as practicable), obstruction of water flows and disturbance of stream banks and riparian vegetation. Avoid, where practicable, the use of rock gabions, as they are unsuited to watercourses of the region. [C164]
- Design flumes used to construct watercourse crossings to a suitable size to maintain flows and enable fish passage. Protect the bed of the watercourse from scouring at the site of the downstream discharge of any flumes or pipes. [C196]

- If diversion of watercourse flows using pumps is required, screen the pump intakes with mesh to protect aquatic life. [C198]

No additional mitigation and management measures were proposed in technical studies completed for the SREIS.

6.6 Mitigation and Management Measures for Migratory Species

In addition to the general measures identified above and fauna specific measures, a further management measure was developed to protect significant migratory species and respond to potential impacts identified on listed migratory species. The management measure expressed as a commitment is:

Avoid construction activities in waterbodies frequented by migratory species. [C225]

The following additional management measure expressed as a commitment was developed as a result of technical studies undertaken for the SREIS:

Ensure Arrow's overhead distribution powerlines are visible when construction is planned in proximity to waterbodies frequented by an important population of listed migratory bird species. [C562]

6.7 Significance of Residual Impacts on Protected Matters

Implementation of the mitigation and management measures detailed in Sections 6.1 to 6.6 will reduce the impact on a number of protected matters to 'not significant'. The terrestrial ecology assessment has taken a precautionary approach in assessing residual impacts for each species or community on the basis that avoidance may not be possible in all cases, although avoidance is the first preference in site and route selection for habitat for listed species.

Therefore the assessed significance of potential impacts presented in Section 8 is likely to be reduced in many cases.

7. STATE SIGNIFICANT BIODIVERSITY VALUES SUMMARY

Table 7.1 presents a summary of state significant biodiversity values listed in Appendix 1 of the Queensland Biodiversity Offsets Policy, and the relevance of the values to the Surat Gas Project.

Table 7.1 State significant biodiversity values listed under the Queensland Biodiversity Offsets Policy 2011

State Significant Biodiversity Value	Description (as per Appendix 1 of the Queensland Biodiversity Offsets Policy)	Applicability to Surat Gas Project
Regional Ecosystems		
Remnant endangered regional ecosystems	Regional ecosystems which: • are listed in schedule 1 of the Vegetation Management Regulation 2000. • is shown as remnant vegetation on a map. • fits the description for the regional ecosystem contained in the Regional Ecosystem Description Database.	Remnant endangered REs within the project development area are summarised in Table 8.1, and an estimate of the availability of these REs as suitable areas for offset sites (following the Queensland Biodiversity Offsets Policy) is presented in Table 9.1.
Remnant endangered grassland regional ecosystems	Regional ecosystems which: • are listed in Appendix 4 of the Queensland Biodiversity Offsets Policy. • are remnant vegetation. • fit the description for the regional ecosystem contained in the Regional Ecosystem Description Database.	Remnant endangered grassland REs (as defined in Appendix 4 of the Queensland Biodiversity Offsets Policy) within the project development area consist of RE 11.3.21 and RE 11.3.24. The extent of these REs within the project development area is presented in Table 8.1, and an estimate of the availability of these REs as suitable areas for offset sites (following the Queensland Biodiversity Offsets Policy) is presented in Table 9.1.
Remnant of concern regional ecosystems	Regional ecosystems which: • are listed in schedule 2 of the Vegetation Management Regulation 2000. • are remnant vegetation. • fit the description for the regional ecosystem contained in the Regional Ecosystem Description Database.	Remnant of concern REs within the project development area are summarised in Table 8.1, and an estimate of the availability of these REs as suitable areas for offset sites (following the Queensland Biodiversity Offsets Policy) is presented in Table 9.1.
Remnant of concern grassland regional ecosystems	Regional ecosystems which: • are listed in Appendix 4 of the Queensland Biodiversity Offsets Policy • are remnant vegetation. • fit the description for the regional ecosystem contained in the Regional Ecosystem Description Database.	There are no remnant of concern grassland REs (as defined in Appendix 4 of the Queensland Biodiversity Offsets Policy) mapped as occurring within the project development area.

Table 7.1 State significant biodiversity values listed under the Queensland Biodiversity Offsets Policy 2011 (cont'd)

State Significant Biodiversity Value	Description (as per Appendix 1 of the Queensland Biodiversity Offsets Policy)	Applicability to Surat Gas Project
Regional Ecosystems (cont'd)		
High value regrowth vegetation containing endangered regional ecosystems	High value regrowth vegetation which: • contains an endangered pre-clear regional ecosystem. • the pre-clear regional ecosystem is listed in schedule 1 of the Vegetation Management Regulation 2000. • fits the description for the pre-clear regional ecosystem contained in the Regional Ecosystem Description Database.	EHP now recognises Mature Regrowth vegetation by regional ecosystem type in accordance with the updated Mature Regrowth digital data (EHP, 2012a) as discussed in Section 3. Consequently areas of high value regrowth vegetation are included in Tables 8.1 and 9.1, as discussed under remnant vegetation above.
High value regrowth vegetation containing of concern regional ecosystems	High value regrowth vegetation which: • contains an of concern pre-clear regional ecosystem. • the pre-clear regional ecosystem is listed in schedule 2 of the Vegetation Management Regulation 2000. • fits the description for the pre-clear regional ecosystem contained in the Regional Ecosystem Description Database.	
Threshold regional ecosystems	Regional ecosystems which: • are listed in Appendix 6 of this Policy. • are remnant vegetation. • fit the description for the regional ecosystem contained in the Regional Ecosystem Description Database.	There are no threshold REs (as defined in Appendix 6 of the Queensland Biodiversity Offsets Policy) mapped as occurring within the project development area.
Critically limited regional ecosystems	Regional ecosystems which: • are listed in Appendix 5 of this Policy. • are remnant vegetation. • fit the description for the regional ecosystem contained in the Regional Ecosystem Description Database.	Two critically limited REs (as defined in Appendix 5 of the Queensland Biodiversity Offsets Policy) are mapped as occurring within the project development area – RE 11.3.24 and RE 11.9.6. These REs are included in Tables 8.1 and 9.1, as discussed under remnant vegetation above.

Table 7.1 State significant biodiversity values listed under the Queensland Biodiversity Offsets Policy 2011 (cont'd)

State Significant Biodiversity Value	Description (as per Appendix 1 of the Queensland Biodiversity Offsets Policy)	Applicability to Surat Gas Project
Essential Habitat		
Essential habitat	For protected wildlife, means an area of vegetation shown on the regional ecosystem map or remnant map as remnant vegetation: • that has at least three essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or • in which the protected wildlife, at any stage of its life cycle, is located.	Essential habitat for NC Act listed species as regulated under the Vegetation Management Act was considered within the EIS and SREIS assessments. Essential habitat may be drawn from a number of data sources, both verified and non-verified, is not regularly updated and does not account for all previously recorded occurrences of a species. Essential habitat is therefore considered secondary to the classification of core habitat known in the project development area (as discussed in Appendix 9, Supplementary Terrestrial Ecology Assessment, Appendix A2). Essential habitat as recognised by EHP, is generally captured within those areas mapped as core habitat known for a particular species. Areas of core habitat known for listed species (both EPBC Act and NC Act) are presented within Table 8.2.
Essential regrowth habitat	For protected wildlife, means an area of vegetation shown on the regrowth vegetation. map as high value regrowth vegetation: • that has at least three essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or • in which the protected wildlife, at any stage of its life cycle, is located.	
Wetlands		
Wetland (Vegetation Management Act 1999)	The area of land that supports plants or is associated with plants that are adapted to and dependent on living in wet conditions for at least part of their life cycle, and that is: (a) a regional ecosystem listed in a Table titled 'Wetland regional ecosystems' of the relevant Regional Vegetation Management Code for the area; or (b) the area on the ground represented as a swamp, lake, marsh, waterhole, wetland, billabong, pool, spring or like represented on the most recent, finest scale: i. Geoscience Australia topographic map or data that shows swamps, lakes, marshes, waterholes, wetlands, billabongs, pools, springs or like, or	Table 14 of the Regional Vegetation Management Code for Brigalow Belt and New England Tablelands Bioregions includes RE 11.3.27 as a wetland regional ecosystem, which is present within the project development area. This RE is included in Tables 8.1 and 9.1 as discussed under remnant vegetation above. Arrow has committed to the avoidance of wetlands when siting facilities (C151 of the EIS).

Table 7.1 State significant biodiversity values listed under the Queensland Biodiversity Offsets Policy 2011 (cont'd)

State Significant Biodiversity Value	Description (as per Appendix 1 of the Queensland Biodiversity Offsets Policy)	Applicability to Surat Gas Project
Wetlands (cont'd)		
Wetland (Vegetation Management Act 1999) (cont'd)	ii. topographic data that represents swamps, lakes, marshes, waterholes, wetlands, billabongs, pools, springs or like—which is publicly available from the Department of Environment and Resource Management; or iii. listed as an 'active' spring in the Queensland Springs Database, (Queensland Wetland Data Springs).	
Significant wetland (Vegetation Management Act 1999)	(a) In the Baffle, Barron, Black, Boyne, Burdekin, Calliope, Daintree, Don, Fitzroy, Haughton, Herbert, Johnstone, Mossman, Russell-Mulgrave, Murray, O'Connell, Pioneer, Plane, Proserpine, Ross, Shoalwater, Styx, Tully and Waterpark catchments, the area of land that supports plants or is associated with plants that are adapted to and dependent on living in wet conditions for at least part of their life cycle and that is: i. shown as a Great Barrier Reef Wetland on the Vegetation Management Wetland Map; or (b) In all other catchments, the area of land that supports plants or is associated with plants that are adapted to and dependent on living in wet conditions for at least part of their life cycle and that is: i. a regional ecosystem listed in a Table titled 'Wetland regional ecosystems' in the relevant Regional Vegetation Management Code for the area and the area on the ground represented as a swamp, lake, marsh, waterhole, wetland, billabong, pool, spring or like, on the most recent 1:250 000 Geoscience Australia topographic map of the area; or ii. a Ramsar wetland.	Table 14 of the Regional Vegetation Management Code for Brigalow Belt and New England Tablelands Bioregions includes RE 11.3.27 as a wetland regional ecosystem, which is present within the project development area. This RE is included in Tables 8.1 and 9.1 as discussed under remnant vegetation above. There are no Ramsar wetlands in the project development area. Arrow has committed to the avoidance of wetlands when siting facilities (C151 of the EIS).

Table 7.1 State significant biodiversity values listed under the Queensland Biodiversity Offsets Policy 2011 (cont'd)

State Significant Biodiversity Value	Description (as per Appendix 1 of the Queensland Biodiversity Offsets Policy)	Applicability to Surat Gas Project
Watercourses		
Watercourses	1. The area of land between the high banks of a natural channel—whether artificially improved or not—in which water flows permanently or intermittently, and that is represented as: (a) a creek, stream, river or watercourse at a scale of 1:100,000 on the Vegetation Management Remnant Watercourse Map; or (b) a creek, stream, river or watercourse at a scale of 1:250,000 on the Vegetation Management Remnant Watercourse Map where there is no 1:100,000 map available; and 2. The remnant vegetation within the specified distance from the high banks of the watercourse identified in the relevant Regional Vegetation Management Code for the region in which the impact is occurring.	Arrow has committed to minimising crossings of watercourses where practicable (C152 of the EIS) and implementing appropriate buffer distances from the high bank of all watercourses in accordance with legislative requirements at the time (C157 of the EIS). At this stage, precise locations of infrastructure and routes for linear infrastructure are not known, therefore offset requirements cannot be estimated.
Connectivity		
Connectivity	Areas which consist of remnant or high value regrowth where the proposed impact area: • contains State significant biodiversity values; or • is within 500 meters of a State significant biodiversity value; and • forms an important link or stepping stone in the landscape; or • forms part of a patch which is five ha or greater; and • will compromise the function of State significant biodiversity values.	A preliminary assessment of the availability of affected regional ecosystems and threatened species habitat in the Brigalow Belt South bioregion has been undertaken using GIS analysis of regional ecosystem, regrowth mapping and threatened species habitat. The analysis involved the sequential application of filters to identify suitable patches/tracts of affected regional ecosystems, and hence potentially viable offsets, which includes tract size and connectivity to other areas of remnant vegetation. Important bioregional corridors are discussed in Chapter 11, Section 11.4.6. At this stage, precise locations of infrastructure and routes for linear infrastructure are not known, therefore offset requirements cannot be estimated.

Table 7.1 State significant biodiversity values listed under the Queensland Biodiversity Offsets Policy 2011 (cont'd)

State Significant Biodiversity Value	Description (as per Appendix 1 of the Queensland Biodiversity Offsets Policy)	Applicability to Surat Gas Project
Protected Animals		
Protected Animals	Endangered, vulnerable, near threatened and special least concern animals under the Nature Conservation Act 1992.	Areas of core habitat known within the project development area for listed species (both EPBC Act and NC Act) are presented within Table 8.2. At this stage, precise locations of infrastructure and routes for linear infrastructure are not known, therefore offset requirements cannot be estimated.
Legally Secured Offset Area Under State Legislation		
Legally Secured Offset Area Under State Legislation	Only applicable to mining, petroleum and gas activities under the Environmental Protection Act 1994. An offset area approved by the administering authority associated with a legislative or policy requirement for the provision of an offset.	The precise requirements for offset sites (including exclusion of legally secured offset areas under state legislation, and other requirements in the Queensland Biodiversity Offset Policy offset rules) will be refined at the site selection phase of Arrow's offset proposal, prior to construction.
B2 Nature Conservation Act 1992		
Protected Plants	Extinct in the wild, endangered, vulnerable or near threatened protected plants under the Nature Conservation Act 1992.	Areas of core habitat known within the project development area for listed species (both EPBC Act and NC Act) are presented within Table 8.2. At this stage, precise locations of infrastructure and routes for linear infrastructure are not known, therefore offset requirements cannot be estimated.
B3 State Planning Policy xx/11 Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments		
Wetland Protection Areas	Means an area shown as a wetland protection area on the Map of Referrable Wetlands, and as defined in Annex 3 of SPP 2.11.	There are no Great Barrier Reef catchments within the project development area with the exception of the Dawson catchment which covers a small part of the northern portion of the project development area. There are no wetland protection areas within this part of the project development area.

8. POTENTIAL AREA OF DISTURBANCE

The area of disturbance is defined as the footprint of the proposed facilities and infrastructure plus a buffer that accounts for constructability issues. The buffer width varies and is dependent on the activity, type of equipment and estimated working space requirements.

Since publication of the EIS, Arrow has developed a conceptual field layout for the drainage areas comprising the initial development i.e., drainage areas 1, 2, 5, 7, 8, 9, 10 and 11. The conceptual field layout comprises an advanced concept layout where field development planning has progressed and a generic grid layout in all other areas. With the exception of the proposed production facility sites, the footprints detailed in Chapter 3, Project Description and nominal constructability buffers were applied to the conceptual field layout to define the project area for the purposes of estimating the area of disturbance.

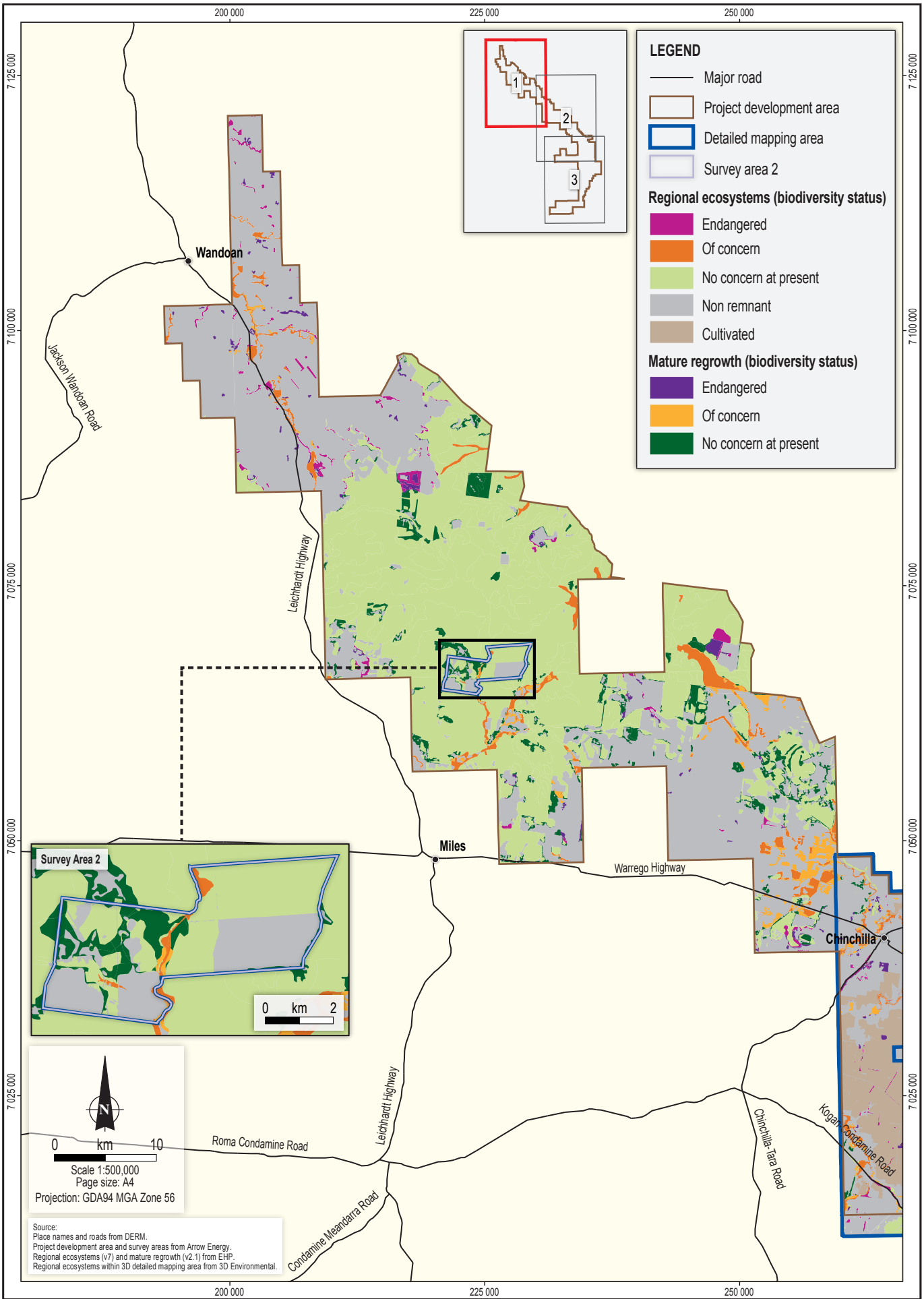
Based on the findings of the terrestrial ecology surveys undertaken for the SREIS, the least constrained parcel of each of the four properties on which CGPFs will be located was adopted for the purposes of estimating the area of disturbance. In all cases, the parcels were substantially larger than the approximately 10 ha required for a CGPF and approximately 220 ha required for a CGPF and co-located water treatment facility. The entire property on which the identified TWAF is to be located was included in the area of disturbance. The estimated area of disturbance is therefore a conservative estimate of the potential area of disturbance.

The potential area of disturbance was determined by intersecting the project area, as described above, with the following datasets using the project GIS:

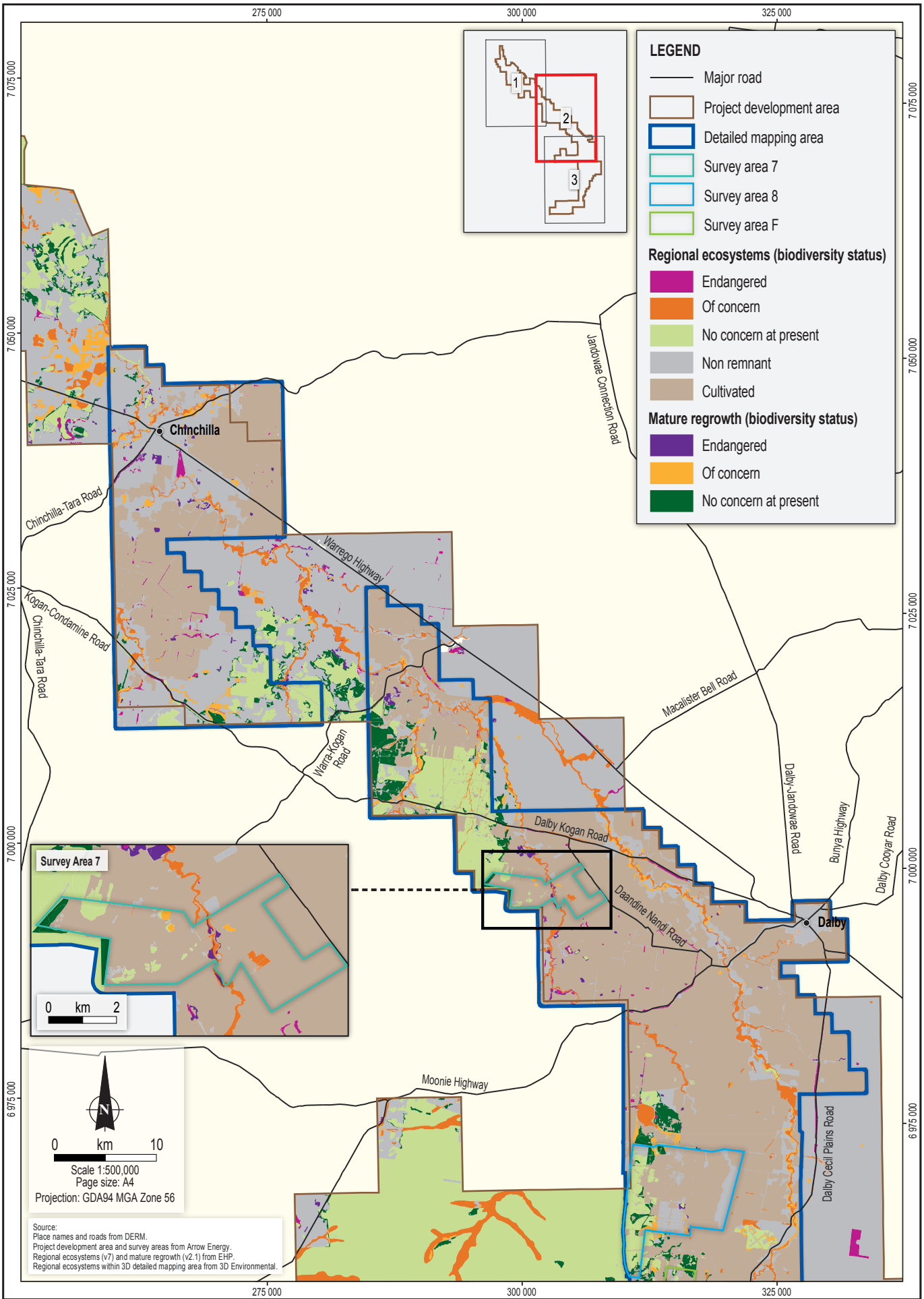
- Version 7.0 Regional Ecosystem digital data (EHP, 2012d).
- EHP's Mature Regrowth digital data (EHP, 2012a).
- Detailed mapping area (3D Environmental technical study - SREIS data).

The analysis provided estimates of the area of disturbance affected regional ecosystems, mature regrowth and core habitat possible for listed threatened species. The results of the analysis include REs where they are part of a heterogenous RE polygon, therefore refinement will be required to assess the proportion of RE type within heterogenous polygons to ascertain which is the dominant RE. Figures 8.1a to c show the potential area of disturbance of REs in the project development area, as determined by application of the current version of the conceptual field layout.

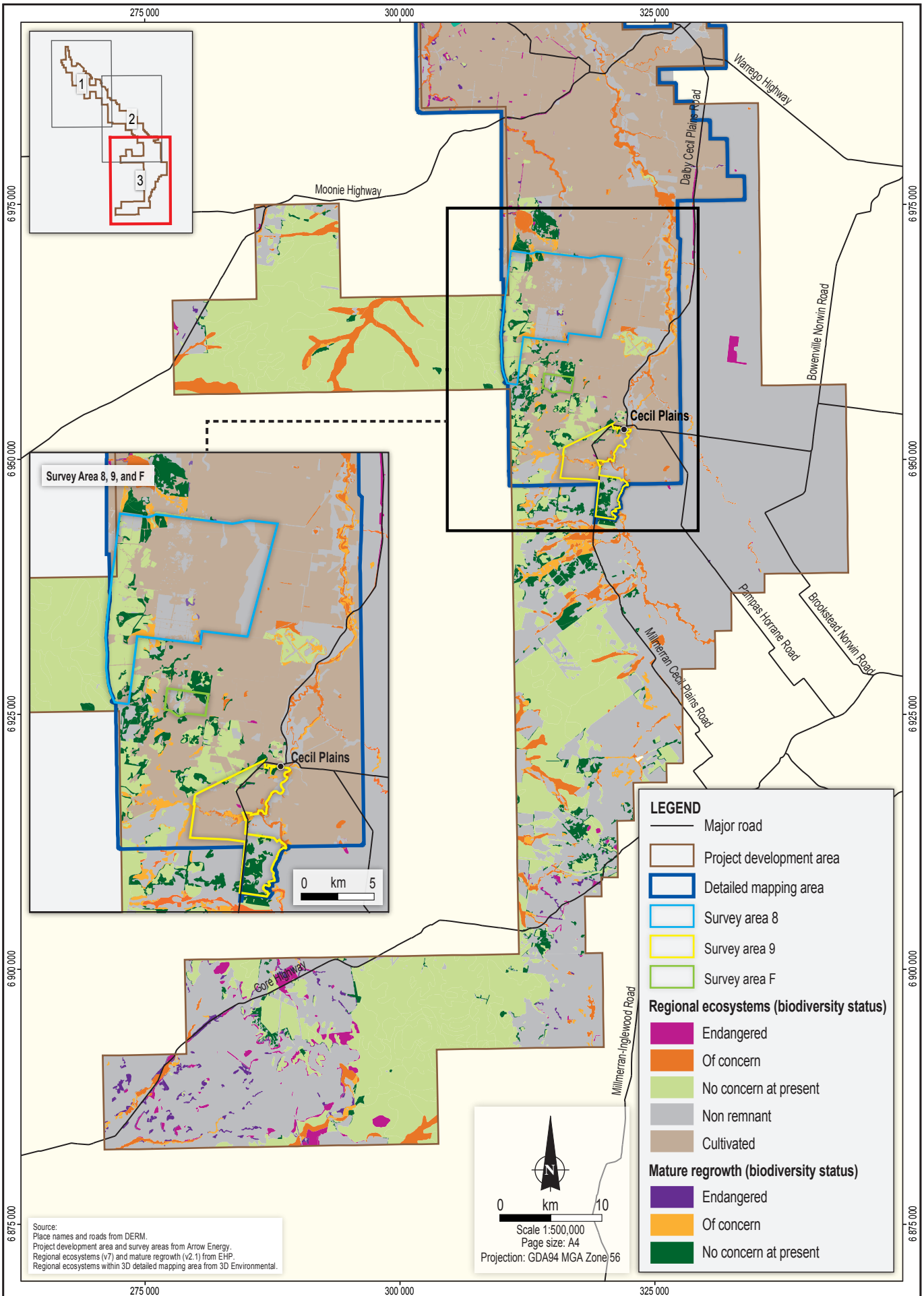
The Queensland Biodiversity Offsets Policy (DERM, 2011) requires offsets for impacts to endangered and of concern REs, essential habitat, high value regrowth containing endangered and of concern REs, essential habitat, threshold and critically limited REs, threatened species (endangered, vulnerable and near threatened), waterways and wetlands. The estimated area of each RE within the Brigalow Belt South bioregion, in the project development area and potentially disturbed by project activities is detailed in Table 8.1, along with the method for calculating the offset required including any applicable multiplier. The Environmental Offsets Policy (SEWPaC, 2012) requires offsets for significant residual impacts to MNES. For the Surat Gas Project, this includes listed threatened species and ecological communities and listed migratory species. As the precise locations for infrastructure are not yet known to confirm the findings of the significance assessments undertaken for the EIS and SREIS, a precautionary approach has been taken and potential area of disturbance of habitat for all of the listed species estimated.



coffey environments	Date: 19.06.2013 MXD: 7040AE_12_GIS068_v1_2 File Name: 7040_12_ATT6_F08.01a_GIS_VS	Arrow Energy Surat Gas Project	arrow energy go further	Regional ecosystems (biodiversity status and regrowth mapping) (northern project development area), Map 1 of 3	Figure No: 8.1a



coffey environments	Date: 19.06.2013 MXD: 7040AE_12_GIS069_v1_2 File Name: 7040_12_ATT6_F08.01b_GIS_VS	Arrow Energy Surat Gas Project	arrow energy go further	Regional ecosystems (biodiversity status and regrowth mapping) (central project development area), Map 2 of 3	Figure No: 8.1b



coffey environments	Date: 19.06.2013 MXD: 7040AE_12_GIS070_v1_2 File Name: 7040_12_ATT6_F08.01c_GIS_VS	Arrow Energy Surat Gas Project	arrow energy go further	Regional ecosystems (biodiversity status and regrowth mapping) (southern project development area), Map 3 of 3	Figure No: 8.1c

The Queensland Biodiversity Offsets Policy and Environmental Offsets Policy require ‘no net loss’ of vegetation and habitat and promote ‘net gain’ to protect ecological resources and enhance ecosystem function. The Queensland Biodiversity Offsets Policy, Ecological Equivalence Method (DERM, 2011) and EPBC Act Offsets Assessment Guide (SEWPaC, 2012) for EPBC Act listed species or communities will determine the offset required for the estimated potential area of disturbance of species, species habitat and ecological communities where a significant residual impact is identified in subsequent preconstruction clearance surveys. For the purposes of this document, a nominal ‘like-for-like’ offset requirement has been assumed. Where available, multipliers for individual plants specified in the policies have been adopted.

The potential area of disturbance to habitat for EPBC Act and NC Act listed species based on application of the current version of the conceptual field layout is detailed in Table 8.2, along the area of habitat in the project development area and in the bioregion. It is noted that the potential area of disturbance of habitat for a particular species may also include habitat for other listed species. Therefore, the area of disturbance that informs any offset requirement will likely be less than the total area of disturbance for the species listed in Table 8.2.

The potential area of disturbance of REs, species habitat and species presented in Tables 8.1 and 8.2 is the estimated project area which is defined by the current conceptual field layout.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of extremely high sensitivity associated with EPBC Act listed threatened ecological community									
11.3.21	*Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils.	E	E	CE	51,721	608	19	Ecological equivalence method Nominal 'like-for-like'	Habitat for *Cymbonotus maidenii*, king blue grass, finger panic grass, hawkweed, austral toadflax, five-clawed worm-skink, darling downs earless dragon, squatter pigeon, *Cyperus clarus, Ptilotus extenuatus* and *Solanum papaverifolium.*
11.3.24	*Themeda avenacea* grassland on alluvial plains. Basalt-derived soils.	E	E	CE	104	101	1.7	Ecological equivalence method Nominal 'like-for-like'	Habitat for *Cymbonotus maidenii*, finger panic grass, austral cornflower, austral toadflax, five-clawed worm-skink, darling downs earless dragon, *Cyperus clarus* and *Solanum papaverifolium.*
11.8.2a	*Eucalyptus tereticornis* and *E. melliodora* occurring on low hills.	LC	NCAP	CE	35,812	383	0	Ecological equivalence method Nominal 'like-for-like'	Habitat for small-leaved denhamia, squatter pigeon, regent honeyeater and black-chinned honeyeater.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area (cont'd)

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of high sensitivity associated with EPBC Act listed threatened ecological community									
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains.	E	E	E	80,610	289	9.7	Ecological equivalence method Nominal 'like-for-like'	Habitat for Queensland white gum, king blue grass, Belson's panic, xerothamnella, collared delma, brigalow scaly-foot, Blake's spikerush, *Solanum stenopterum*, pale imperial hairstreak, golden-tailed gecko, grey snake, glossy black-cockatoo and painted honeyeater.
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	OC	OC	E	281,071	210	8.0	Ecological equivalence method Nominal 'like-for-like'	Habitat for lobed blue grass, king blue grass, five clawed worm-skink, yakka skink, squatter pigeon, *Cyperus clarus,* Blake's spikerush, *Fimbristylis vagans* and turquoise parrot.
11.4.3	*Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains.	E	E	E	75,622	1,254	24.5	Ecological equivalence method Nominal 'like-for-like'	Habitat for small-leaved denhamia, king blue grass, Belson's panic, xerothamnella, collared delma, brigalow scaly-foot, Blake's spikerush, pale imperial hairstreak, golden-tailed gecko, grey snake, glossy black-cockatoo, black-chinned honeyeater and painted honeyeater.
11.4.3a						37	0	Ecological equivalence method Nominal 'like-for-like'	Habitat for brigalow scaly-foot, grey snake, glossy black-cockatoo, black-chinned honeyeater and painted honeyeater.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area (cont'd)

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of high sensitivity associated with EPBC Act listed threatened ecological community (cont'd)									
11.4.10	*Eucalyptus populnea* or *E. pilligaensis, Acacia harpophylla, Casuarina cristata* open forest to woodland on margins of Cainozoic clay plains.	E	E	E	6,461	105	0	Ecological equivalence method Nominal 'like-for-like'	Habitat for Belson's panic, brigalow scaly-foot, glossy black-cockatoo, black-chinned honeyeater and painted honeyeater.
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.	E	E	E	165,917	4,998	29.6	Ecological equivalence method Nominal 'like-for-like'	Habitat for ooline, small-leaved denhamia, Belson's panic, xerothamnella, collared delma, brigalow scaly-foot, *Rutidosis lanata,* pale imperial hairstreak, rough-collared frog, golden-tailed gecko, grey snake, glossy black-cockatoo and painted honeyeater.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area (cont'd)

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of high sensitivity associated with EPBC Act listed threatened ecological community (cont'd)									
11.9.6	*Acacia melvillei* ± *A. harpophylla* open forest on fine-grained sedimentary rocks.	E	E	E	345	157	18.6	Ecological equivalence method Nominal 'like-for-like'	Habitat for xerothamella, brigalow scaly-foot, Dunmall's snake, pale imperial hairstreak, rough-collared frog, golden-tailed gecko and grey snake.
11.9.4a	Semi-evergreen vine thicket or *Acacia harpophylla* with a semi-evergreen vine thicket understorey on fine-grained sedimentary rocks.	E	E	E	33,533	35	0	Ecological equivalence method Nominal 'like-for-like'	Habitat for small-leaved denhamia, brigalow scaly-foot, Dunmall's snake and grey goshawk.
Regional ecosystems of extremely high sensitivity									
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains.	OC	E	–	35,847	233	23.0	Ecological equivalence method Nominal 'like-for-like'	Habitat for Belson's panic, brigalow scaly-foot, Dunmall's snake, squatter pigeon, *Rutidosis lanata*, *Solanum stenopterum*, golden-tailed gecko, grey snake, glossy black-cockatoo , turquoise parrot and painted honeyeater.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area (cont'd)

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of extremely high sensitivity (cont'd)									
11.9.10	*Acacia harpophylla, Eucalyptus populnea* open forest on fine-grained sedimentary rocks.	OC	E	–	33,533	133	9.5	Ecological equivalence method Nominal 'like-for-like'	Habitat for Belson's panic, brigalow scaly-foot, squatter pigeon, pale imperial hairstreak, golden-tailed gecko, grey snake, glossy black-cockatoo , turquoise parrot, black-chinned honeeyater and painted honeyeater.
11.4.12	*Eucalyptus populnea* woodland on Cainozoic clay plains.	E	E	–	7,340	515	9.0	Ecological equivalence method Nominal 'like-for-like'	Habitat for Queensland white gum, brigalow scaly foot, squatter pigeon, golden-tailed gecko, glossy black-cockatoo, turquoise parrot and black-chinned honeyeater.
Regional ecosystems of moderate sensitivity									
11.3.2	*Eucalyptus populnea* woodland on alluvial plains.	OC	OC	–	443,768	6,420	259.3	Ecological equivalence method Nominal 'like-for-like'	Habitat for *Cymbonotus maidenii*, ooline, lobed blue grass, king blue grass, finger panic grass, Belson's panic, hawkweed, Cobar greenhood orchid, austral cornflower, austral toadflax, collared delma, five clawed worm-skink, yakka skink, Darling Downs earless dragon, squatter pigeon, *Cyperus clarus*, Blake's spikerush, *Fimbristylis vagans, Ptilotus extenuatus, Rutidosis lanata, Solanum stenopterum, Solanum papaverifolium,* grey snake and Turquoise parrot.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area (cont'd)

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of moderate sensitivity (cont'd)									
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains.	OC	OC	–	183,695	4,254	86.4	Ecological equivalence method Nominal 'like-for-like'	Habitat for ooline, lobed blue grass, *Microcarpea agonis,* squatter pigeon, brigalow scaly-foot, regent honeyeater, Blake's spikerush, *Fimbristylis vagans, Rutidosis lanata,* golden-tailed gecko, grey snake, black-necked stork, square-tailed kite, turquoise parrot and black-chinned honeyeater.
11.3.25 11.3.25g	*Eucalyptus tereticornis or Eucalyptus camaldulensis woodland fringing drainage lines.*	LC	OC	–	51,3711	7,014	217.3	Ecological equivalence method Nominal 'like-for-like'	No EVNT fauna or flora taxa are likely to be associated with this RE.
11.3.27a, b, c, d	*Freshwater wetlands.*	LC	OC	–	49,086	682	1.2	Ecological equivalence method Nominal 'like-for-like'	Habitat for Microcarpea agonis, brigalow scaly-foot, Dunmall's snake, Australian painted snipe, regent honeyeater, Cyperus clarus, Blake's spikerush, Fimbristylis vagans, grey snake, cotton pygmy goose, grey goshawk, black-necked stork, turquoise parrot and black-chinned honeyeater.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area (cont'd)

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of moderate sensitivity (cont'd)									
11.9.7	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks.	OC	OC	_	108,857	781	3.0	Ecological equivalence method Nominal 'like-for-like'	Habitat for brigalow scaly-foot, Dunmall's snake, *Rutidosis lanata,* rough-collared frog, golden-tailed gecko, turquoise parrot and black-chinned honeyeater.
Regional ecosystems of low sensitivity									
11.3.14	*Eucalyptus* spp., *Angophora* spp., *Callitris* spp. woodland on alluvial plains.	LC	NCAP	_	80,277	6,554	98.3	Offsets not required under Queensland legislation for not of concern REs	Habitat for Kogan waxflower, yakka skink, squatter pigeon, regent honeyeater, golden-tailed gecko, turquoise parrot and black-chinned honeyeater.
11.3.18	*Eucalyptus populnea, Callitris glaucophylla, Allocasuarina luehmannii* shrubby woodland on alluvium.	LC	NCAP	_	79,674	2,098	40.3	Offsets not required under Queensland legislation for not of concern REs	Habitat for *Microcarpea agonis,* Cobar greenhood orchid, brigalow scaly-foot, squatter pigeon, bulloak jewel butterfly, golden-tailed gecko, turquoise parrot and black-chinned honeyeater.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area (cont'd)

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of low sensitivity (cont'd)									
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains.	LC	NCAP	_	43,061	101	3.6	Offsets not required under Queensland legislation for not of concern REs	Habitat for brigalow scaly-foot, squatter pigeon, regent honeyeater, turquoise parrot and black-chinned honeyeater.
11.5.1, 11.5.1a	*Eucalyptus crebra, Callitris glaucophylla, Angophora leiocarpa, Allocasuarina luehmannii woodland on Cainozoic sand plains/remnant surfaces.*	LC	NCAP	_	477,161	52,129	2415	Offsets not required under Queensland legislation for not of concern REs	Habitat for curly-barked wattle, Hando's wattle, Wardell's wattle, Gurulmundi fringe myrtle, Kogan waxflower, Tara wattle, Queensland blue gum, Machin's macrozamia, Prostanthera sp, lobed blue grass, Belson's panic, Cobar greenhood orchid, brigalow scaly-foot, squatter pigeon, Waaje wattle, Acacia tenuinervis, Bailey's cypress, Cryptandra ciliata, Calotis glabrescens, Plunkett mallee, bulloak jewel butterfly, golden-tailed gecko, rough-collared frog, turquoise parrot, glossy black-cockatoo, grey snake and black-chinned honeyeater.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area (cont'd)

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of low sensitivity (cont'd)									
11.5.20	*Eucalyptus moluccana* and/or *E. microcarpa/E. pilligaensis*[§] ± *E. crebra* woodland on Cainozoic sand plains.	LC	NCAP	–	151,772	11,248	827.0	Offsets not required under Queensland legislation for not of concern REs	Habitat for Queensland white gum, brigalow scaly-foot, squatter pigeon, regent honeyeater, rough-collared frog, golden-tailed gecko, grey snake, black-chinned honeyeater.
11.5.21	*Corymbia bloxsomei* ± *Callitris glaucophylla* ± *Eucalyptus crebra* ± *Angophora leiocarpa* woodland on Cainozoic sand plains/remnant surfaces.	LC	NCAP	–	71,764	8,721	439.0	Offsets not required under Queensland legislation for not of concern REs	Habitat for Cobar greenhood orchid, brigalow scaly-foot, Waaje wattle, *Cryptandra ciliata*, Plunkett mallee, bulloak jewel butterfly, golden-tailed gecko, black-chinned honeyeater.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area (cont'd)

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of low sensitivity (cont'd)									
11.5.4	*Eucalyptus crebra, Callitris glaucophylla, C. endlicheri, E. chloroclada, Angophora leiocarpa* on Cainozoic sand plains/remnant surfaces. Deep sands.	LC	NCAP	_	108,556	18,154	576.5	Offsets not required under Queensland legislation for not of concern REs	Habitat for Machin's macrozamia, Tara wattle, Prostanthera sp, lobed blue grass, Cobar greenhood orchid, brigalow scaly-foot, squatter pigeon, Dunmall's snake, Waaje wattle, *Calotis glabrescens,* Plunkett mallee, bulloak jewel butterfly, golden-tailed gecko, grey snake, rough-collared frog, black-chinned honeyeater, glossy black-cockatoo.
11.7.2	*Acacia spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone.*	LC	NCAP	_	366,646	2,274	647.0	Offsets not required under Queensland legislation for not of concern REs	Habitat for Gurulmundi fringe myrtle, brigalow scaly-foot, collared delma, Plunkett mallee, Micromyrtus carinata and golden-tailed gecko.
11.7.4, 11.7.4c	*Eucalyptus decorticans and/or Eucalyptus spp., Corymbia spp., Acacia spp., Lysicarpus angustifolius on Cainozoic lateritic duricrust.*	LC	NCAP	_	222,810	39,811	1,663.4	Offsets not required under Queensland legislation for not of concern REs	Habitat for brigalow-scaly foot, squatter pigeon, golden-tailed gecko and black-chinned honeyeater.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area (cont'd)

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of low sensitivity (cont'd)									
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks.	LC	NCAP	_	62,871	10,405	1,030.5	Offsets not required under Queensland legislation for not of concern REs	Habitat for curly-barked wattle, Hando's wattle, Wardell's wattle, Gurulmundi fringe myrtle, Kogan waxflower, Machin's macrozamia, Tara wattle, Queensland blue gum, Prostanthera sp, brigalow scaly-foot, Waaje wattle, *Acacia tenuinervis,* sandstone prickle bush, Forster's wiregrass, Bailey's cypress, *Cryptandra ciliata*, Plunkett mallee, *Micromyrtus carinata* and *Pomaderris coomingalensis.*
11.7.6	*Corymbia citriodora* or *Eucalyptus crebra* woodland on Cainozoic lateritic duricrust.	LC	NCAP	_	337,345	2,389	82.0	Offsets not required under Queensland legislation for not of concern REs	Habitat for curly-barked wattle, Hando's wattle, Wardell's wattle, Gurulmundi fringe myrtle, Kogan waxflower, Tara wattle, Queensland blue gum, brigalow scaly-foot, Waaje wattle, *Acacia tenuinervis,* sandstone prickle bush, Bailey's cypress, *Cryptandra ciliata*, Plunkett mallee, golden-tailed gecko, turquoise parrot and black-chinned honeyeater.

Table 8.1 Potential area of disturbance of regional ecosystems in project development area (cont'd)

RE Number	Regional Ecosystem	Conservation Status			Extent of RE within Bioregion (ha)	Area of RE Within Project Development Area (ha)	Area of RE Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement	Beneficial Value
		VM Class	Biodiversity Status	EPBC Act					
Regional ecosystems of low sensitivity (cont'd)									
11.7.7	*Eucalyptus fibrosa* subsp. *nubila* ± *Corymbia* spp. ± Eucalyptus spp. on Cainozoic lateritic duricrust.	LC	NCAP	_	170,919	17,717	1,128.6	Offsets not required under Queensland legislation for not of concern REs	Habitat for curly-barked wattle, Hando's wattle, Wardell's wattle, Gurulmundi fringe myrtle, Kogan waxflower, Tara wattle, Queensland blue gum, collared delma, brigalow scaly-foot, squatter pigeon, yakka skink, Waaje wattle, *Cryptandra ciliata*, Plunkett mallee, golden-tailed gecko, turquoise parrot and black-chinned honeyeater.
11.9.9, 11.9.9a	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks.	LC	NCAP	_	122,045	5,780	10.3	Offsets not required under Queensland legislation for not of concern REs	Habitat for brigalow scaly-foot, squatter pigeon, regent honeyeater, bulloak jewel butterfly, rough-collared frog, golden-tailed gecko, turquoise parrot, glossy black-cockatoo and black-chinned honeyeater.
11.10.1/ 11.10.1d	*Corymbia citriodora* open forest on coarse-grained sedimentary rocks.	LC	NCAP	_	879,089	533	106.9	Offsets not required under Queensland legislation for not of concern REs	Habitat for Gurulmundi fringe myrtle, Machin's macrozamia, brigalow scaly-foot, collared delma, squatter pigeon, bulloak jewel butterfly, golden-tailed gecko, glossy black-cockatoo and black-chinned honeyeater.

Conservation Status – CE = Critically Endangered, E = Endangered, V = Vulnerable, OC = Of Concern LC = Least Concern, NCAP = No Concern at Present - = Not Listed

Table 8.2 Potential area of disturbance of species habitat in project development area

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Significance of Impacts (EIS and SREIS)	Area of Core Habitat Known Within Project Development Area (ha)	Area of Core Habitat Known Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement
Threatened Ecological Communities (EPBC Act)							
–	Brigalow (*Acacia harpophylla* dominant and co-dominant)	E	–	Moderate	7,387.0	106.4	EPBC Act Offsets assessment guide Nominal 'like-for-like'
–	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	E	–	Moderate	35.0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
–	Weeping Myall Woodlands	E	–	Moderate	<1.0	0.8	EPBC Act Offsets assessment guide Nominal 'like-for-like'
–	Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions	E	–	Low	206.0	8.1	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Threatened Fauna Species (EPBC Act)							
Geophaps scripta scripta	Squatter pigeon	V	V	Moderate	18,277.0	471.1	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Nyctophilus corbeni	South-eastern long-eared bat	V	V	Moderate	15,418.0	520.1	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Maccullochella peelii peelii	Murray cod	V	V	Moderate	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Paradelma orientalis	Brigalow scaly-foot	V	V	Low	14,147.0	68.9	EPBC Act Offsets assessment guide Nominal 'like-for-like'

Table 8.2 Potential area of disturbance of species habitat in project development area (cont'd)

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Significance of Impacts (EIS and SREIS)	Area of Core Habitat Known Within Project Development Area (ha)	Area of Core Habitat Known Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement
Threatened Fauna Species (EPBC Act) cont'd							
Rostratula australis	Australian painted snipe	V	V	Moderate	530.0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Anthochaera phrygia	Regent Honeyeater	E	E	High	545.0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Furina dunmalli	Dunmall's snake	V	V	Low	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Egernia rugosa	Yakka skink	V	V	Moderate	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Rheodytes leucops	Fitzroy River turtle	V	V	Moderate	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Anomalopus mackayi	Five-clawed worm skink	V	E	Major	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Tympanocryptis cf. tetraporophora	Darling Downs earless dragon	E	E	High	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Delma torquata	Collared delma	V	V	Major	456.0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Threatened Flora Species (EPBC Act)							
Digitaria porrecta	Finger panic grass	E	NT	Moderate	13,691.0	14.0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Bothriochloa biloba	Lobed blue grass	V	-	Moderate	1,841.0	5.2	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Thesium australe	Austral toadflax	V	V	Moderate	77.0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'

Table 8.2 Potential area of disturbance of species habitat in project development area (cont'd)

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Significance of Impacts (EIS and SREIS)	Area of Core Habitat Known Within Project Development Area (ha)	Area of Core Habitat Known Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement
Threatened Flora Species (EPBC Act) cont'd							
Homopholis belsonii	Belson's panic	V	E	Moderate	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Pterostylis cobarensis	Cobar greenhood orchid	V	-	Moderate	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Acacia curranii	Curly-bark wattle	V	V	Moderate	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Acacia handonis	Hando's wattle, Percy Grant wattle	V	V	Moderate	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Acacia lauta	Tara wattle	V	V	Low	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Philotheca sporadica	Kogan wax flower	V	V	Moderate	2,003.0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Xerothamnella herbacea	Xerothamnella	E	E	Moderate	55	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Picris evae	Hawkweed	V	V	Low	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Rhaponticum australe	Austral cornflower	V	V	Low	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Acacia wardellii	Wardell's wattle	V	V	Moderate	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Eucalyptus virens	Shiny-leaved ironbark	V	V	Moderate	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'

Table 8.2 Potential area of disturbance of species habitat in project development area (cont'd)

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Significance of Impacts (EIS and SREIS)	Area of Core Habitat Known Within Project Development Area (ha)	Area of Core Habitat Known Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement
Threatened Flora Species (EPBC Act)							
Dichanthium queenslandicum	King blue grass	V	V	Moderate	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Macrozamia machinii	Machin's macrozamia	V	V	Major	1,534.0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Calytrix gurulmundensis	Gurulmundi fringe-myrtle	V	V	High	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Prostanthera sp. (Dunmore)	An unnamed mint-bush	V	V	High	1,312.0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Cadellia pentastylis	Ooline	V	V	High	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Denhamia parvifolia	Small-leaved denhamia	V	V	High	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Eucalyptus argophloia	Queensland white-gum	V	V	Low	0	0	EPBC Act Offsets assessment guide Nominal 'like-for-like'
Threatened Fauna Species (NC Act)							
Jalmenus eubulus	Pale imperial hairstreak	–	V	Moderate	130.8	1.9	Ecological equivalence method Nominal 'like-for-like'
Cyclorana verrucosa	Rough collared frog	–	NT	Low	5,020.8	320.4	Ecological equivalence method Nominal 'like-for-like'
Strophurus taenicauda	Golden-tailed gecko	–	NT	Low	32,919.2	1,193.3	Ecological equivalence method Nominal 'like-for-like'
Hemiaspis damelii	Grey snake	–	E	Low	982.7	35.0	Ecological equivalence method Nominal 'like-for-like'

Table 8.2 Potential area of disturbance of species habitat in project development area (cont'd)

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Significance of Impacts (EIS and SREIS)	Area of Core Habitat Known Within Project Development Area (ha)	Area of Core Habitat Known Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement
Threatened Fauna Species (NC Act) cont'd							
Lophoictinia isura	Square-tailed kite	–	NT	Low	13,194.2	314.6	Ecological equivalence method Nominal 'like-for-like'
Calyptorhynchus lathami	Glossy black-cockatoo	–	V	Low	16,683.2	251.3	Ecological equivalence method Nominal 'like-for-like'
Melithreptus gularis	Black-chinned honeyeater	–	NT	Low	3,553.8	271.0	Ecological equivalence method Nominal 'like-for-like'
Chalinolobus picatus	Little pied bat	–	NT	Low	29,943.4	936.7	Ecological equivalence method Nominal 'like-for-like'
Hypochrysops piceatus	Bulloak jewel	–	E	Major	0	0	Ecological equivalence method Nominal 'like-for-like'
Acanthophis antarcticus	Common death adder	–	NT	Moderate	0	0	Ecological equivalence method Nominal 'like-for-like'
Accipiter novaehollandiae	Grey goshawk	–	NT	Low	0	0	Ecological equivalence method Nominal 'like-for-like'
Nettapus coromandelianus	Cotton pygmy-goose	_	NT	Low	203.5	0	Ecological equivalence method Nominal 'like-for-like'
Stictonetta naevosa	Freckled duck	_	NT	Low	299.3	0	Ecological equivalence method Nominal 'like-for-like'
Ephippiorhynchus asiaticus	Black-necked stork	_	NT	Low	421.4	0	Ecological equivalence method Nominal 'like-for-like'
Grantiella picata	Painted honeyeater	_	NT	Moderate	164.8	0	Ecological equivalence method Nominal 'like-for-like'

Table 8.2 Potential area of disturbance of species habitat in project development area (cont'd)

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Significance of Impacts (EIS and SREIS)	Area of Core Habitat Known Within Project Development Area (ha)	Area of Core Habitat Known Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement
Threatened Fauna Species (NC Act) cont'd							
Neophema pulchella	Turquoise parrot	_	NT	Low	28.3	0	Ecological equivalence method Nominal 'like-for-like'
Threatened Flora Species (NC Act)							
Cymbonotus maidenii	–	_	E	Low	73	2.0	Offset liability will be established as plants identified in preconstruction clearance surveys 1:5 [1]
Acacia barakulensis	Waaje wattle	_	V	Low	11,853.1	309.6	Offset liability will be established as plants identified in preconstruction clearance surveys 1:3.5 [1]
Acacia tenuinervis	–	_	NT	Low	12,245.3	309.6	Offset liability will be established as plants identified in preconstruction clearance surveys 0 [1]
Callitris baileyi	_	_	NT	Moderate	13,912.6	348.8	Offset liability will be established as plants identified in preconstruction clearance surveys 0 [1]
Cryptandra ciliata	_	_	NT	Low	12,863.5	337.9	Offset liability will be established as plants identified in preconstruction clearance surveys 0 [1]

Table 8.2 Potential area of disturbance of species habitat in project development area (cont'd)

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Significance of Impacts (EIS and SREIS)	Area of Core Habitat Known Within Project Development Area (ha)	Area of Core Habitat Known Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement
Threatened Flora Species (NC Act) cont'd							
Eucalyptus curtisii	Plunkett mallee	–	NT	Low	2,048.7	39.3	Offset liability will be established as plants identified in preconstruction clearance surveys 0 [1]
Solanum papaverifolium	–	–	E	Moderate	62.9	6.1	Offset liability will be established as plants identified in preconstruction clearance surveys 1:5 [1]
Solanum stenopterum	–	–	V	Moderate	50.4	0.4	Offset liability will be established as plants identified in preconstruction clearance surveys 1:3.5 [1]
Apatophyllum teretifolium	Sandstone prickle bush	–	V	Low	0	0	Offset liability will be established as plants identified in preconstruction clearance surveys 1:3.5 [1]
Aristida forsteri	Forster's wiregrass	–	NT	Major	0	0	Offset liability will be established as plants identified in preconstruction clearance surveys 0 [1]
Calotis glabrescens	–	–	NT	Low	0	0	Offset liability will be established as plants identified in preconstruction clearance surveys 0 [1]

Table 8.2 Potential area of disturbance of species habitat in project development area (cont'd)

Scientific Name	Common Name	EPBC Act Status	NC Act Status	Significance of Impacts (EIS and SREIS)	Area of Core Habitat Known Within Project Development Area (ha)	Area of Core Habitat Known Within Conceptual Field Layout (ha)	Offset Assessment Method and Nominal Requirement
Threatened Flora Species (NC Act)							
Cyperus clarus	_	_	V	Moderate	0	0	Offset liability will be established as plants identified in preconstruction clearance surveys 1:3.5 [1]
Elocharis blakeana	Blake's spikerush	_	NT	Low	293.8	0	Offset liability will be established as plants identified in preconstruction clearance surveys 0 [1]
Fimbristylis vagans	_	_	NT	Low	0.2	0	Offset liability will be established as plants identified in preconstruction clearance surveys 0 [1]
Micromyrtus carinata	_	_	E	High	0	0	Offset liability will be established as plants identified in preconstruction clearance surveys 1:5 [1]
Ptilotis extenuatus	_	_	NT	Moderate	0	0	Offset liability will be established as plants identified in preconstruction clearance surveys 0 [1]
Rutidosus lanata	_	_	E	Moderate	0	0	Offset liability will be established as plants identified in preconstruction clearance surveys 1:5 [1]

EPBC Act Status – E = Endangered, V = Vulnerable, - = Not Listed

NC Act Status - E = Endangered, V = Vulnerable, NT = Near Threatened - = Not Listed

[1] Note offset multiplier given for NCA Act flora species based on individual plant specimens, as per Queensland Biodiversity Offset Policy guidance, not an area of habitat in ha. Note that offset requirement for near threatened NCA flora species is zero, based on letter from the Director General to the Australian Petroleum Production and Exploration Association Ltd (APPEA) dated 4 December 2012 (EHP pers comm, 2012). Offsets for near threatened plans listed under the NCA are not required where it can be demonstrated that clearing of the species is avoided to the greatest extent possible, and clearing is limited to a number such that the impact on the plant (including consideration of cumulative impacts) will not likely result in the species satisfying the criteria for declaration as a 'vulnerable' species under the NCA.

Where an offset for protected plants is required, EHP will also accept evidence that the proponent has entered into a binding agreement with an established entity (such as a natural resource management, landcare or similar body) to propagate, manage and/or protect an area five times the size of the area being cleared to satisfy those requirements (EHP pers comm, 2012).

9. PRELIMINARY ASSESSMENT OF AVAILABILITY OF AFFECTED ECOLOGICAL COMMUNITIES AND HABITAT

A preliminary assessment of the availability of affected REs and threatened species habitat in the Brigalow Belt South bioregion has been undertaken using GIS analysis of REs, regrowth mapping and threatened species habitat. The analysis involved the sequential application of filters to identify suitable patches/tracts of affected REs, and hence potentially viable offsets.

The filters applied to REs, regrowth mapping and threatened habitat species are:

- Identification of the area of each affected RE available in the Brigalow Belt South bioregion.
- Removal of patches/tracts that are not considered viable – i.e., patches less than 5 ha.
- Removal of patches/tracts contained in urban and rural residential subdivisions.
- Removal of patches/tracts falling within mining leases (MLs not MDLs) and petroleum facility licences (PFL).
- Classification of patches/tracts according to land tenure:
  - Freehold.
  - Conservation reserve, state forest, forest reserve and national park.
  - Other tenures including leasehold.

Table 9.1 lists the area of each RE potentially required to be offset in relation to the area potentially available for offset i.e., the result of the application of the filters above to RE availability within the bioregion (as detailed in Table 8.1). Note the final column excludes areas of remnant vegetation consistent with the Queensland Biodiversity Offset Policy. This column reflects areas of regrowth vegetation associated with the particular RE type.

The Queensland Biodiversity Offset Policy presents a series of offset rules detailing what requirements there are for offset sites, which includes a requirement that the offset must not be an area of high value regrowth (meeting certain criteria). The area of regrowth vegetation available was not able to be further assessed to establish whether the vegetation meets these criteria.

The precise requirements for offset sites (including exclusion of areas of high value regrowth or remnant vegetation, and other requirements in the Queensland Biodiversity Offset Policy offset rules) will be refined at the site selection phase of Arrow's offset proposal, prior to construction. REs with a potential area of disturbance of zero are retained at this stage, due to the conceptual nature of the field development layout. In addition, these REs may provide potential offset sites for listed species associated with these REs as detailed in Table 8.2, so the availability of these REs within the bioregion is of value.

Table 9.1 Preliminary estimate of availability of affected ecological communities and habitat (regional ecosystems) in Brigalow Belt South bioregion

RE Number	Regional Ecosystem	Potential Area of Disturbance based on Conceptual Field Layout (ha)	Estimate of Availability of Regional Ecosystem in Bioregion (ha)	Estimate of Availability of Regional Ecosystem in Bioregion excluding Remnant Vegetation (ha)
Regional ecosystems of extremely high sensitivity associated with EPBC Act listed threatened ecological community				
11.3.21	*Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils.	19	24,337.5	1,963.3
11.3.24	*Themeda avenacea* grassland on alluvial plains. Basalt-derived soils.	1.7	134.3	34.0
11.8.2a	*Eucalyptus tereticornis* and *E. melliodora* occurring on low hills.	0	11,255.6	2,022.4
Regional ecosystems of high sensitivity associated with EPBC Act listed threatened ecological community				
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains.	9.7	53,967.5	23,578.9
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	8.0	140,084.8	30,128.7
11.4.3	*Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains.	24.5	77350.7	32,990.9
11.4.3a		0	499.2	81.4
11.4.10	*Eucalyptus populnea* or *E. pilligaensis, Acacia harpophylla, Casuarina cristata* open forest to woodland on margins of Cainozoic clay plains.	0	5,944.2	3,000.6
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.	29.6	67,725.9	34,057.5
11.9.6	*Acacia melvillei* ± *A. harpophylla* open forest on fine-grained sedimentary rocks.	18.6	339.4	95.7

Table 9.1 Preliminary estimate of availability of affected ecological communities and habitat (regional ecosystems) in Brigalow Belt South bioregion (cont'd)

RE Number	Regional Ecosystem	Potential Area of Disturbance (ha)	Estimated Availability of Regional Ecosystem in Bioregion (ha)	Estimate of Availability of Regional Ecosystem in Bioregion excluding Remnant Vegetation (ha)
Regional ecosystems of high sensitivity associated with EPBC Act listed threatened ecological community (cont'd)				
11.9.4a	Semi-evergreen vine thicket or *Acacia harpophylla* with a semi-evergreen vine thicket understorey on fine-grained sedimentary rocks.	0	19,494.0	8,018.2
Regional ecosystems of extremely high sensitivity				
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains.	23.0	32,989.4	12,026.3
11.9.10	*Acacia harpophylla, Eucalyptus populnea* open forest on fine-grained sedimentary rocks.	9.5	25,806.1	7,817.7
11.4.12	*Eucalyptus populnea* woodland on Cainozoic clay plains.	9.0	6,735.0	2,866.6
Regional ecosystems of moderate sensitivity				
11.3.2	*Eucalyptus populnea* woodland on alluvial plains.	259.3	194,830.4	52,235.5
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains.	86.4	133,789.3	47,037.2
11.3.25/ 11.3.25g	*Eucalyptus tereticornis* or *Eucalyptus camaldulensis* woodland fringing drainage lines.	217.3	203,313.7	29,460.4
11.3.27a, b, c, d	Freshwater wetlands.	1.2	8,154.2	658.6
11.9.7	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks.	3.0	21,492.8	10,121.2

Table 9.1 Preliminary estimate of availability of affected ecological communities and habitat (regional ecosystems) in Brigalow Belt South bioregion (cont'd)

RE Number	Regional Ecosystem	Potential Area of Disturbance (ha)	Estimated Availability of Regional Ecosystem in Bioregion (ha)	Estimate of Availability of Regional Ecosystem in Bioregion excluding Remnant Vegetation (ha)
Regional ecosystems of low sensitivity				
11.3.14	Eucalyptus spp., Angophora spp., Callitris spp. woodland on alluvial plains.	0	25,832.7	3,671.0
11.3.18	*Eucalyptus populnea, Callitris glaucophylla, Allocasuarina luehmannii* shrubby woodland on alluvium.	0	10,693.7	3,230.3
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains.	0	26,965.3	7,916.9
11.5.1, 11.5.1a	*Eucalyptus crebra, Callitris glaucophylla, Angophora leiocarpa, Allocasuarina luehmannii* woodland on Cainozoic sand plains/remnant surfaces.	0	205,963.5	45,532.7
11.5.20	*Eucalyptus moluccana* and/or *E. microcarpa/E. pilligaensis*[§] ± *E. crebra* woodland on Cainozoic sand plains.	0	47,565.3	9,040.6
11.5.21	*Corymbia bloxsomei* ± *Callitris glaucophylla* ± *Eucalyptus crebra* ± *Angophora leiocarpa* woodland on Cainozoic sand plains/remnant surfaces.	0	10,853.7	728.8
11.5.4	*Eucalyptus crebra, Callitris glaucophylla, C. endlicheri, E. chloroclada, Angophora leiocarpa* on Cainozoic sand plains/remnant surfaces. Deep sands.	0	28,356.1	4,931.3

Table 9.1 Preliminary estimate of availability of affected ecological communities and habitat (regional ecosystems) in Brigalow Belt South bioregion (cont'd)

RE Number	Regional Ecosystem	Potential Area of Disturbance (ha)	Estimated Availability of Regional Ecosystem in Bioregion (ha)	Estimate of Availability of Regional Ecosystem in Bioregion excluding Remnant Vegetation (ha)
Regional ecosystems of low sensitivity				
11.7.2	*Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	0	177,359.0	12,984.3
11.7.4, 11.7.4c	*Eucalyptus decorticans* and/or Eucalyptus spp., Corymbia spp., Acacia spp., *Lysicarpus angustifolius* on Cainozoic lateritic duricrust.	0	132,450.6	15,890.0
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks.	0	26,013.0	2,380.6
11.7.6	*Corymbia citriodora* or *Eucalyptus crebra* woodland on Cainozoic lateritic duricrust.	0	120,916.8	13,149.2
11.7.7	*Eucalyptus fibrosa* subsp. *nubila* ± Corymbia spp. ± *Eucalyptus* spp. on Cainozoic lateritic duricrust.	0	70,167.8	4,578.4
11.9.9, 11.9.9a	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks.	0	53,041.5	11,114.6
11.10.1/ 11.10.1d	*Corymbia citriodora* open forest on coarse-grained sedimentary rocks.	0	145,257.4	11,767.2

The preliminary assessment of the availability of regional ecosystems indicates that there are sufficient vegetation resources in which to identify potential offset sites.

10. APPROACH TO PROVISION OF OFFSETS

The strategy that will guide the identification and delivery of offsets for unavoidable losses of listed vegetation communities and species (and their habitat) is explained in this section, along with Arrow's preferred approach to providing offsets.

10.1 Environmental Offset Strategy

Arrow has developed a draft Environmental Offsets Strategic Management Plan (this document) that sets out its approach to the delivery of offsets. The objectives of the plan are to:

- Identify the government framework and policies that must be addressed.
- Identify the key guiding principles to guide offset planning, implementing and management.
- Identify the types of plans to be developed to enable projects to proceed.
- Support projects to proceed by providing a coordinated method to address offset management.
- Reduce implementation costs and improve environmental outcomes by exploring innovative solutions.
- Determine the preferred methods to implement offsets.
- Identify actions to support offset management.

The principles for environmental offsets defined by Arrow are:

- Offsets will meet the requirements of current government policy.
- Offsets will only be used once the hierarchy to minimise impact (avoid, minimise, mitigate) has been followed.
- Offsets will contribute to managing and protecting biodiversity.
- Offset will be implemented strategically and economically.

Arrow has proposed a suite of management plans designed to reflect the phases of identification and development of an environmental offset. The proposed management plans are:

The **Draft Environmental Offset Strategic Management Plan**, which sets out the high-level assessment of impacts on biodiversity values, the estimated area of disturbance and an estimate of the availability of potentially affected vegetation communities and habitat for potential offsets. This attachment fulfils that requirement.

The **Environmental Offset Operational Management Plan**, which identifies the appropriate methods to offset impacts.

The **Project Environmental Offset Management Plan**, which details the proposed offset, how it will be delivered and managed over the life of the offset, nominally until remnant status has been achieved.

Queensland and Australian government policies provide for a range of options for offsets including direct and indirect offsets, and funding arrangements for research and management of ecosystems established through brokerage or banking services. These options have informed Arrow's preferred hierarchy for the delivery of offsets.

10.2 Proposed Approach to Provision of Offsets

The proposed approach to the provision of offsets for unavoidable losses set out below attempts to reconcile the inherent inaccuracy in estimating the area of disturbance upfront and the need to set limits on the extent of the ecological communities and species that might be disturbed by the project activities to ensure the proposed development does not have a significant impact of terrestrial ecological values.

The incremental nature of coal seam gas development and vast geographic areas over which it occurs makes determination of accurate estimates of losses, and consequential estimates of offset liability, very difficult. Coal seam gas development is an evolving development in which planning and design are continually being revised to incorporate exploration and pilot well program results, advances in technology, legislative changes, and learnings by the proponent and coal seam gas industry.

Arrow developed the environmental framework to address the uncertainty embodied in the nature of coal seam gas development. The framework includes a planning tool (constraints mapping) to guide site and route selection, the key objective of which is avoidance of sensitive environmental values. A requirement for an upfront offset for estimated disturbance of identified environmental values is counter-intuitive in the context of the framework, as it does not incentivise the avoidance of the identified environmental values promoted by the framework.

A staged approach to the provision of offsets that accounts for actual losses would be a more appropriate way to manage unavoidable losses and to incentivise avoidance to protect the identified environmental values.

Estimated Area of Disturbance

Inherent inaccuracy in RE mapping and the preliminary nature of the conceptual field development plan used to estimate the area of disturbance presented in the SREIS necessitates review of the preliminary estimates (in consultation with EHP and SEWPaC) to agree an area of disturbance that reduces the potential for significant impacts to the communities and species.

The agreed estimate of the area of disturbance will be adopted as the upper limit of disturbance authorised under Queensland and Australian government conditions of approval for the project. It will inform the quantum of offsets potentially required for the project.

Demonstration of Avoidance

Where unavoidable disturbance has occurred or is likely to occur based on detailed field development plans and preconstruction clearance surveys, Arrow will track the actual losses of threatened communities and habitat for threatened species and review the offset obligations against the estimated area of disturbance. This staged process will also be used to demonstrate Arrow's avoidance of loss of threatened communities and habitat for threatened species on an annual basis.

Provision of Offsets (unavoidable disturbance)

The provision of offsets will be presented in the form of two plans required under Arrow's draft Environmental Offset Strategy:

- **Environmental Offset Operational Management Plan**, which identifies the appropriate methods to offset impacts. Arrow's preferred hierarchy for the provision of offsets is shown in Figure 10.1.

- **Project Environmental Offset Management Plan**, which details the proposed offset, how it will be delivered and managed over the life of the offset, nominally until remnant status has been achieved.

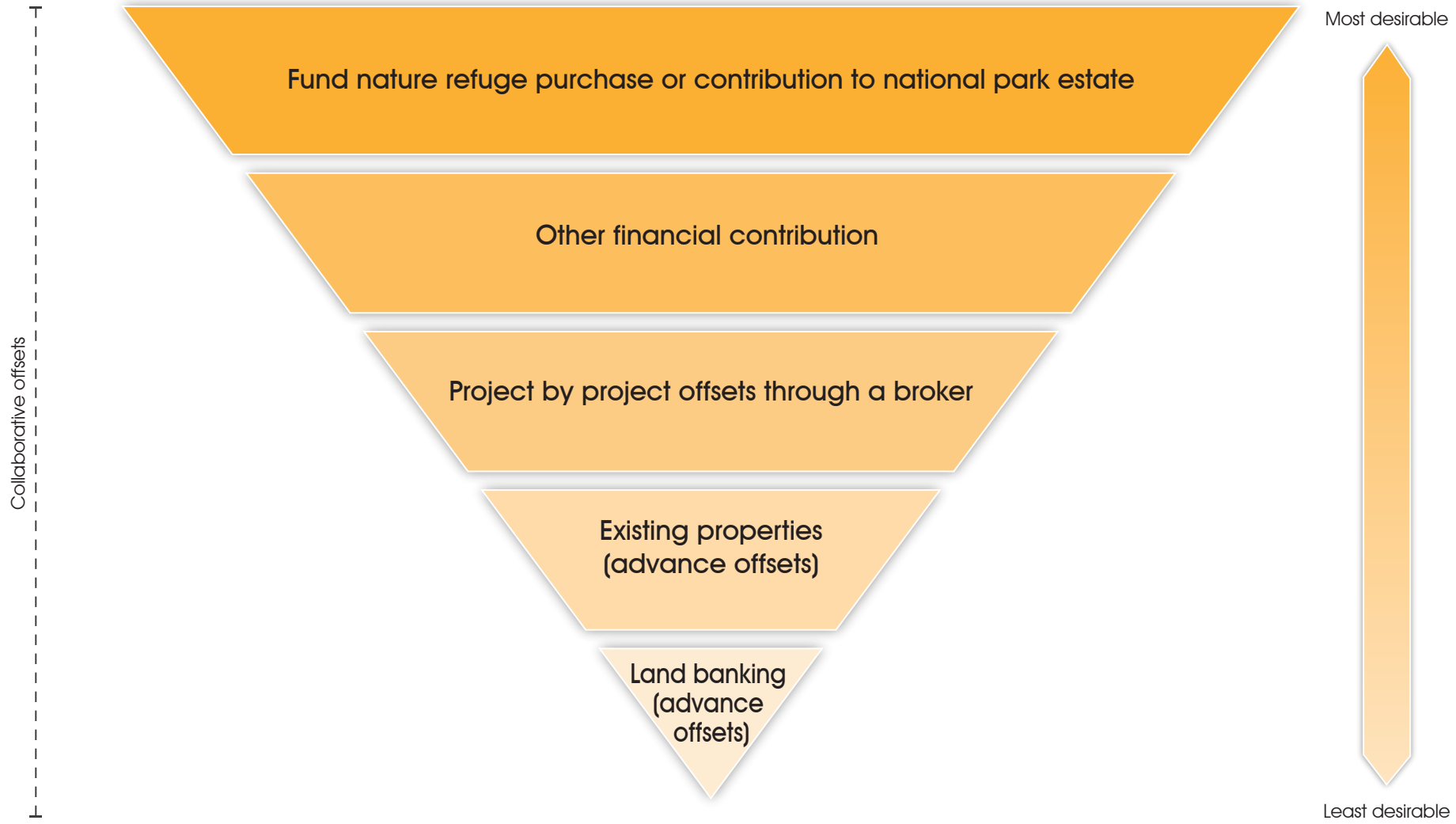
Offset Sites

While Arrow recognises its statutory obligation to offset ‘like for like’ it also recognises that offsets based on restoration of ecological communities or ecosystems have overwhelming landscape values for terrestrial ecology. Its offset strategy therefore incorporates ‘like for like’ offsets for species within the context of a landscape approach to ecosystem restoration and protection.

Arrow’s preferred hierarchy for the delivery of offsets (Figure 10.1) to fulfil its offset obligations is to source properties in which the government has a biodiversity interest, as this option requires less management inputs than other options over the life of the offset. The delivery of this type of offset may be as a nature refuge, additional national park estate, or the purchase of a property where the long term management can be passed to another party. This method allows for multiple offsets to be grouped and to be used in a staged approach to the delivery of offsets.

The approach outlined above is a pragmatic way to manage the inherent inaccuracy in data used to inform the estimate of area of disturbance and the uncertainty associated with the incremental nature of coal seam gas development.

It is noted that as field development progresses, prediction of likely unavoidable impacts will become more accurate and greater certainty about the need for offsets in advance of the relevant reporting period will be possible. This will, in some instances, enable offsets to be secured in advance of actual losses.



Note: Reproduction of Figure 4 of Arrow Energy's Draft Environmental Offset Strategy 2012	coffey environments	Date: **18.06.2013**	**Arrow Energy**	arrow energy go further	**Arrow's preferred hierarchy to deliver offsets**	Figure No: **10.1**
		File Name: **7040_12_ATT6_F10.01_VS**	**Surat Gas Project**			

11. DEVELOPMENT OF OFFSET

Consistent with Arrow's environmental offset strategy, the company will consult with relevant agencies on its assessment of the offsets required for the Surat Gas Project. The discussions will confirm the vegetation communities, species and habitat to be offset and the quantum of the offset.

The following advice from EHP is noted in relation to the provision of offsets to satisfy Queensland and Australian government requirements.

> Where a development condition requires a proponent to provide an offset for a species or community under the EPBC Act, the Queensland Government will not require an offset for the same species or ecosystem (EHP pers comm, 2012).

Further analysis using GIS will identify potential opportunities for offsets having regard to Queensland and Australian government environmental offset policies and Arrow's preferred hierarchy of offsets. Offset proposals will be developed and presented to the Queensland and Australian governments for approval in accordance with the approach described in Section 10.

12. REFERENCES

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Appendix A

Arrow Energy Draft Environmental Offset Strategy 2012

DRAFT ENVIRONMENTAL OFFSET STRATEGY

ARROW ENERGY

2012

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1 Introduction

1.1 Purpose

The purpose of this strategy is to define and communicate how environmental offsets will be managed by Arrow Energy Ltd to its staff, contractors and government stakeholders. It provides direction for all of Arrow's current and future projects, including:

- Exploration and appraisal projects
- Domestic gas fields and pipelines
- LNG project (upstream, midstream and downstream components).

Environmental offsets are a mechanism to compensate for loss of environmental values from an area resulting from a development. The offset process involves quantifying the value to be lost and replacing it (or a similar acceptable value) at another location. Offsets are used by regulators in Australia and other countries as a mitigation measure to protect natural environmental values, whilst allowing appropriate development to proceed. Offset management aims for a 'no net loss' or a 'net gain' to ensure that the environmental value will be replaced, and it may be replaced by direct or indirect offsets.

Various offset plans are required to provide strategic direction for the company and to satisfy project approvals and allow projects to proceed. The plans will operate at a range of project scales and for varying purposes from supporting large project approvals to detailed singular site plans. They may be required to address:

- the EIS commitments prepared for large projects
- the conditions of Environmental Authorities (environmental licence to operate) for individual tenements
- the unavoidable need to remove threatened plants or habitat for fauna
- removing significant values such as threatened vegetation communities identified by Queensland or the Australian government.

1.2 Objectives

The objectives for this strategy are to:

1. Identify the government framework and policies that must be addressed.
2. Identify the key guiding principles to guide offset planning, implementing and management.
3. Identify the types of plans to be developed to enable projects to proceed.
4. Support projects to proceed by providing a coordinated method to address offset management.
5. Reduce implementation costs and improve environmental outcomes by exploring innovative solutions.
6. Determine the preferred methods to implement offsets.
7. Identify actions to support offset management.

This strategy does not incorporate offsets for carbon or other gaseous emissions, or identify environmental offset required in New South Wales. It commits Arrow to satisfy or exceed its obligations for environmental offsets, to enable its business of coal seam gas exploration, domestic gas production and LNG export to proceed.

2 External regulatory framework

To ensure that Arrow's operations are conducted at, or above, the legal requirements and standards expected by stakeholders and the broader community; the strategy has considered the Queensland and Australian government's regulatory framework for environmental offsets that have been developed to consider national priorities and international conventions. **Figure 1** illustrates the interaction between the significant external policies and legislation related to environmental offsetting and developing this strategy. The national and state policies for offsets are not linked. The environmental values identified by each government are generally different and their methods for evaluating a potential offset vary. However some values, such as brigalow woodland and bluegrass grasslands for example, may trigger offsets by the Australian and Queensland government. **Figure 1** also highlights the linkages to other Arrow policies and standards and has been designed to be consistent with Arrow's Environmental Policy, Sustainable Development Policy and the Biodiversity management standard. The standard, in particular, aims to:

- provide continuous improvement in managing significant environmental impacts
- reduce environmental impacts and protecting the natural habitats, biodiversity and landscape function
- ensure all activities comply with applicable environmental laws and regulations
- report environmental impacts and encouraging improvements.

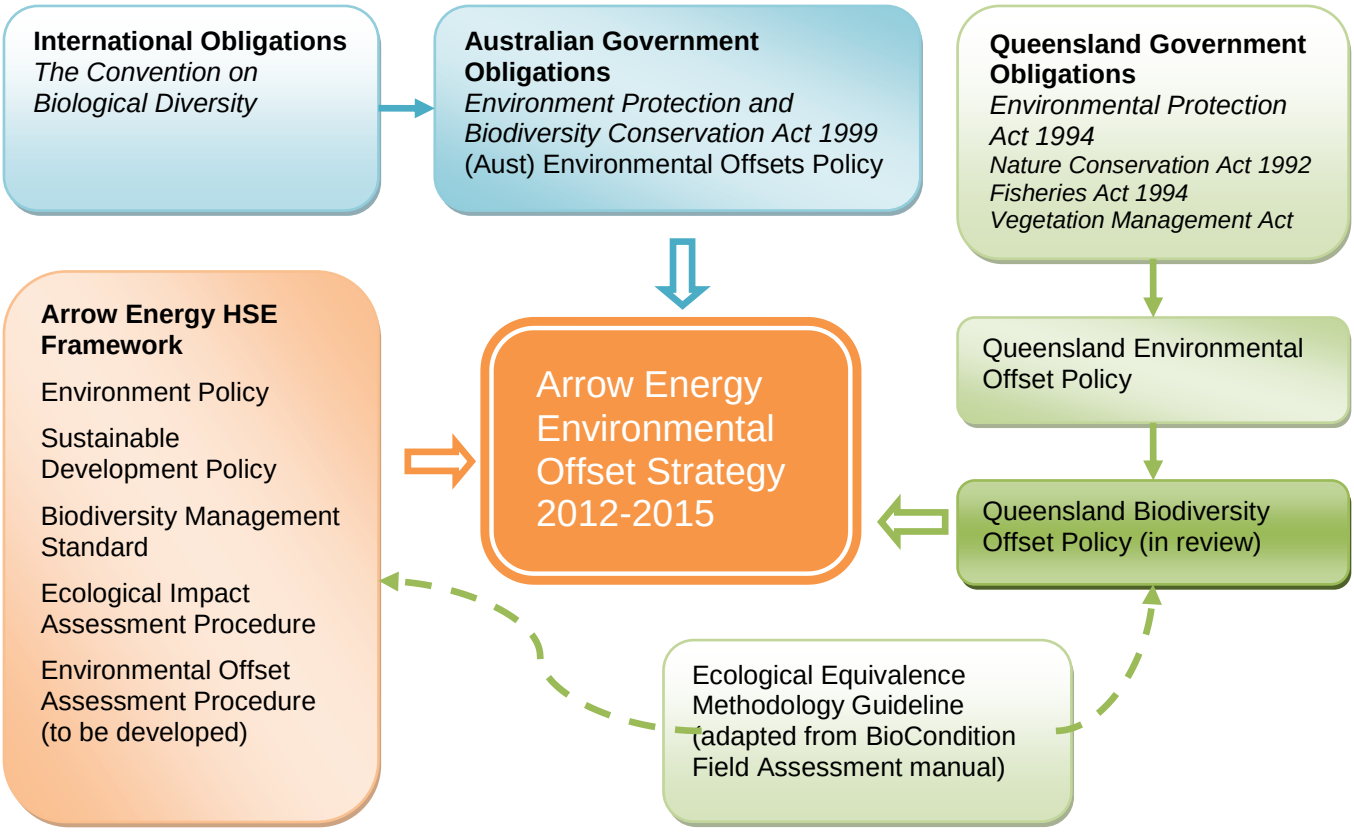

Figure 1: Arrow's Environmental Offset Strategy – identifying the linkages to relevant policy frameworks

Environmental offsetting is a maturing process in Australia and the key policies are currently being reviewed. This strategy accepts that these policies may be amended and therefore Arrow's approach to implement environmental offsets may require revising. Depending on the project, environmental offsets will be approved by the Australian and/or Queensland government. Project specific environmental offset triggers are identified in **Appendix 1**.

2.1 Hierarchy for managing environmental impacts at a project scale

Arrow aims to operate in a manner that protects and promotes the health and well-being of the natural environment and actively protects, where practicable, the significant biodiversity values of the areas in which it operates. However, Arrow recognised that unavoidable impacts to environmental values may occur. Providing offsets will allow critical projects to progress whilst complying with environmental regulations, and ensuring overall environmental values are maintained or improved.

All mechanisms to deliver environmental offsets require considerable resources and lead time to source the offset area, legally secure the area and obtain regulatory approval. Good planning, design and execution of projects plays a crucial role in ensuring that Arrow's activities avoids and minimises impacts on environmental values, thereby avoiding the necessity for offsets.

Strategies to avoid or mitigate impacts to environmental values are specific to the type, magnitude and location of the proposed impact and the nature of the value to be impacted; however, adhering to the concept of 'avoiding, minimising, and mitigating' will reduce the environmental impact of a project, reducing the risk of an offset liability (**Figure 2**).

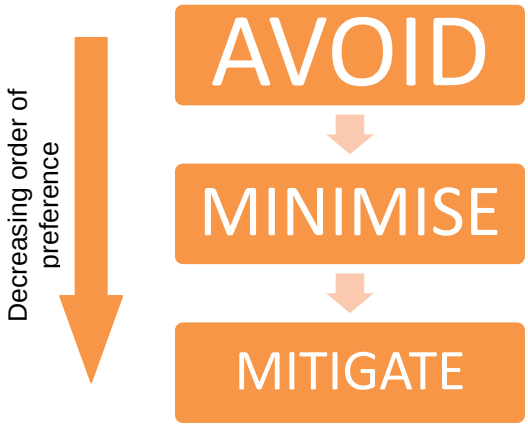

Figure 2: Hierarchy to minimise impacts

Where impacts to an environmental value are known or likely to occur from a project, the preferred order to address the identified impacts should be to first avoid the impact (e.g. relocate the infrastructure). When the impact cannot be avoided, then the impact should be minimised (e.g. by utilising alternative vegetation clearing methods) to as low as reasonably practicable. Where residual impacts to the environmental value are likely to remain, measures can be implemented to mitigate those impacts. Offsetting the environmental value that cannot be avoided or minimised is an acceptable method for mitigating the impact.

2.2 Guiding principles of external policies

Environmental offsets in Queensland are currently governed by Australian and Queensland government legislation and policies, however the two over-arching policies are the:

- Australian Government *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy (August 2001, consultation draft)
- Queensland Government Environmental Offsets Policy (June 2008) (under review).

The policies identify principles to ensure the delivery and management of environmental offsets are aligned to the objectives of each policy. The principles of each policy are presented in **Table 1** and represent the most recent

published version of the respective policies. Both the Queensland and Australian government policies are under review as of September, 2012.

Table 1: External policy principles

AUSTRALIAN GOVERNMENT	QUEENSLAND GOVERNMENT
Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed development	Offsets will not replace or undermine legislative requirements
Be efficient, effective, transparent, proportionate, scientifically robust and reasonable	Environmental impacts must first be avoided and minimised
Be built around direct offsets but may include other compensatory measures	Offsets must achieve an equivalency or a conservation gain
Be of a size and scale proportionate to the impacts being offset	Offsets must provide environmental values as similar as possible to those being lost.
Be in proportion to the level of statutory protection that applies to the affected species or community	Offset provision should minimise the time-lag between the impact and delivery of the offset.
Effectively manage the risks of the offset not succeeding but may include other compensatory measures	Offsets must provide additional protection or management actions
Be additional to what is already required determined by law or planning regulations or agreed under other schemes or programs	Offsets must be legally secure.
Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	

2.3 Arrow's environmental offset principles

Arrow's principles for offset management have been developed to align with the offset principles from the external policies and to guide offset planning:

- Offsets will meet the requirements of current government policy.
- Offsets will only be used once the hierarchy to minimise impact (avoid, minimise, mitigate) has been followed.
- Offsets will contribute to managing and protecting biodiversity.
- Offsets will be implemented strategically and economically.

These principles will be used to guide offsets at all planning levels.

3 Managing environmental offsets for a project

3.1 Biodiversity values to be considered

Queensland has been divided into 13 distinct bioregions based on broad landscape patterns that reflect unique combinations of underlying geology, climate and vegetation communities. Arrow holds exploration tenements within many of these bioregions; however the majority of tenements, including all existing and proposed petroleum tenures, are located wholly within the Brigalow Belt (North and South) and South East Queensland bioregions. Bioregions support unique native flora, fauna and communities contributing to Australia's biodiversity.

The Brigalow Belt bioregion is named for vegetation communities dominated by brigalow (*Acacia harpophylla*) that once covered much of the region. Due to excessive land clearing in the past, brigalow communities are now at less than 10% of their original coverage and are protected under Queensland and Australia legislation. Consequently, many animals, plants and other features that are associated with brigalow vegetation are now considered at risk of extinction and are also protected. The region contains several protected areas in the form of National Parks, Conservation Reserves and State Forests and other significant features such as major river systems, wetlands and unique geological landscapes.

The South East Queensland (SEQ) bioregion includes exploration tenures near Brisbane and contains the proposed LNG facility on Curtis Island. The SEQ bioregion is a highly biodiverse bioregion owing to its location at a subtropical latitude and the variable topography from coastal plains to the Great Dividing Range. This combination has resulting in diverse range of vegetation communities including tidal flats, heathlands, dry sclerophyll forests and subtropical rainforests. The bioregion also contains a high number of endemic animal and plant species that are protected under legislation due to threats from disease, land clearing, urbanisation, exotic pests and climate change.

Each project site must be assessed to determine whether any significant values will be impacted by the proposed activities.

3.2 Project planning and approval phase

The likelihood for triggering an environmental offset must be identified early in the planning phase of the project. The process for identifying and delivering the offset will involve locating and securing the offset and ensuring that appropriate management arrangements are formalised to maintain the land and environment on which the offset is located. This may take many months or years to achieve and the associated costs can be significant. Depending upon the offset delivery model chosen for the project, there may also be a significant investment in time negotiating with landholders, offset brokers, lawyers and government agencies to secure the offset.

Arrow has implemented a constraints based approach to infrastructure development by establishing and maintaining detailed maps of environmental values and locating infrastructure away from these areas, where possible. This approach is the primary mitigation measure, where the need for offsets will be avoided by strategically locating infrastructure away from the significant environmental values.

The mechanism governing environmental offsets for projects that result in unmitigated impacts to environmental values are the conditions of the Environmental Authority for tenure based activities, and the EIS for project based activities with which the company will need to comply.

Identifying when offsets will be required as early as possible in the project's planning and design phase will reduce impediments to the project's schedule and delivery. It will also ensure the project has budgeted financially for the cost to the project for offset design, approving and implementing.

Offset plans are required for a range of purposes, as outlined in **section 1.1**, and each plan will require a level of detail determined by the project stage of development, knowledge of the site conditions, and requirements requested by the relevant authority. To enable projects to be approved, project specific offset plans must be prepared. The strategy aims to ensure that each plan is consistent in quality and delivery; that it identifies and delivers offsets cost effectively; and that offsets can be integrated in their delivery, where possible.

3.3 Offset planning framework

Arrow's environmental offset strategy aims to provide a clear and consistent approach to manage offset obligations across the company. The strategy is supported by a number of management plans at three distinct levels, which aims to provide more detail for each planning level. These are:

- Environmental Offset Strategic Management Plans (EOSMP)
- Environmental Offset Operational Management Plans (EOOMP)
- Project Environmental Offset Management Plans (PEOMP).

EOSMPs are required for each new upstream, midstream and downstream major LNG project and will be developed at the pre-approval phase. They will be developed to comply with the relevant EIS conditions for each project. The EOSMP will provide a high-level analysis of likely impacts on biodiversity values, where an offset requirement may be triggered. The EOSMP will identify the preferred model for offset delivery for each individual project and provide a framework for each subordinate EOOMP.

EOOMPs are required to ensure the company complies with the Environmental Authority (EA) conditions for each of its coal seam gas tenements. The (EOOMP) will identify the likely impacts on biodiversity values and appropriate methods to offset the impacts on those values. Depending on the gas field design and planning, this plan should estimate the extent of the values that may require offsetting to assist with identifying suitable offsets as early as possible in the project's life and to support integrated advance offsets.

PEOMPs are required when a significant environmental value is identified on a site, and it cannot be avoided. The plan will require: a detailed ecological assessment to identify and quantify the significant environmental values to be removed on the site; identifying a suitable match for the value to be replaced; and identifying the ratio for the offset. (Each ratio will be determined by the relevant government policy.) The plan will need to be submitted and approved, prior to project construction. For some projects the site may need to be secured, prior to the project commencing construction, or it may be allowable to delay implementing the offset until a date specified by the state.

The offset management framework is summarised in **Table 2** and **Figure 3** outlines how each plan will integrate with each project and the other plans. **Table 2** identifies who will be responsible for coordinating the development of each plan.

Table 2: Plans within the environmental offset planning framework

← INCREASING LEVEL OF DETAIL	ARROW OFFFSET FRAMEWORK	DESCRIPTION
	Environmental Offset Strategy	This is the overarching document that describes the use of offsets under the current regulatory system. It identifies the linkages between subordinate plans that identify, deliver and manage offsets.
	Environmental Offset Strategic Management Plans	The EOSMPs primarily ensure compliance with conditions associated with the specific EIS project approvals. They provide a high-level analysis of likely impacts on biodiversity values within the specific EIS project area or tenement where an offset requirement may be triggered.
	Environmental Offset Operational Management Plans	The EOOMPs ensure that the company complies with the Environmental Authority (EA) conditions for each of its coal seam gas tenements. They will identify the likely impacts on biodiversity values and appropriate methods to offset the impacts on those values.
	Project Environmental Offset Management Plans	Where offsets have been identified as a requirement of a project, the offset management plan will provide details regarding how the proposed offset will meets all relevant policies and how the offset will be managed over the life of the offset.

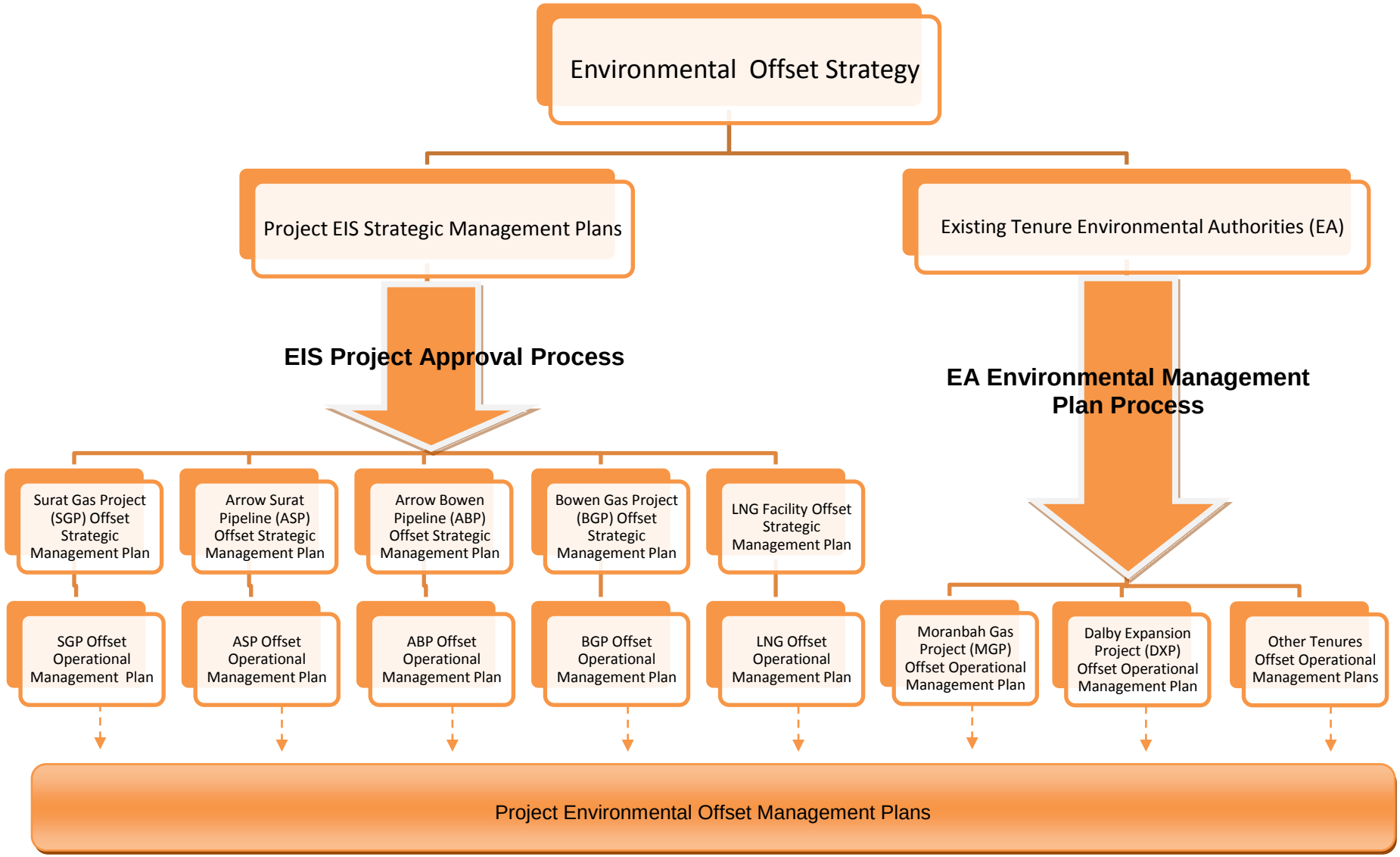

Figure 3: Environmental offset planning framework

3.4 Implementing the project – offset delivery options

Arrow's activities have the potential to cause unavoidable impacts to environmental values. In particular circumstances, an offset will be required to restore significant values, prior to a project proceeding. There are many potential scenarios that will trigger an offset, depending on the environmental value to be impacted, the type and nature of the infrastructure being developed, the location of the infrastructure and the tenure of the land.

Where a project will result in disturbing an environmental value (as listed in the various Queensland and Australian legislation and policies) then the activity may trigger an offset. The offset itself would be assessed under the relevant offset policy and may include:

- a direct offset, including:
  - use or partial use of Arrow's existing properties for offsets
  - purchase of land for a specific offset requirement
  - a collaborative effort to pool resources from other companies to secure an offset area
  - land banking, whereby an area of land is purchased as it contains environmental values that could be used as an offset in the future.
- an offset transfer, whereby Arrow discharges it's offset delivery obligations to a third party such as an offset broker to find the offset area
- an indirect offset, including:
  - investing in environmental programs that aim to restore or enhance biodiversity values or provide multiple benefits such as community and landholder engagement, erosion and sediment control or expanding the national park estate
  - contributing to research or to a recovery plan for a species or community
  - contributing to Balance the Earth Trust or other similar organisation to either purchase land or fund research into environmental values where knowledge is deficient
- a combination of the above methods.

Arrows aims to comply with the conditions of the respective offset policies and any other conditions of approval relating to offsets. Given this is a new method for mitigating residual impacts, it is prudent to consider offset options that may deliver more benefits to the company and the environmental outcomes of the project. Arrow also seeks to implement methods in offset delivery that provide opportunities for strategic, landscape-scale, decision making around whole of project offset liabilities (**Figure 1**). Offset options will be considered that will allow for advanced offsets, thus allowing groups of project offset requirements to be grouped together. This may improve the environmental benefit of the outcome, due to the scale of the offset (reduced deleterious effects from edge effects). Any method or arrangement to reduce costs to implement offsets will be supported.

Table 3 and **Figure 4** illustrates Arrow's preferred offset delivery options, identifying constraints to employing each delivery option. Constraints have been identified by completing a risk assessment for each delivery method according to the risk ranking matrix as shown in **Appendix 2**.

Arrow's preferred method to fulfil its offset obligations is to source properties that the government has a biodiversity interest in, requiring less management inputs than other options over the life of the offset. The delivery of this type of offset may be as a nature refuge, additional national park estate, or to purchase a property where the long term management can be passed to another party. This method allows for multiple offsets to be grouped, but accepts that the offset site selected may not meet all the ecological equivalence criteria for all the values that need to be offset.

Providing a financial contribution is recognised as a favourable method also, however this is not a method that is consistent with current policies, as a sole method of meeting the delivery obligations.

Broking offsets on a project by project basis, and securing those offsets on part of a property managed by a landholder is recognised as an expensive and resource intensive method for delivery. It may be a solution for sourcing offsets for threatened species, where the habitat is limited and for some projects it may be the only solution consistent with external policy.

Arrow owns some property, where its current facilities and future facilities will be located. It may be possible to secure offsets on these properties, however this option will require managing and securing the area for the life of the offset. These properties have the advantage that they can provide multiple purposes to the company, and where suitable would be value adding to the company.

Land banking, or purchasing properties to secure offsets on, is seen as the least preferred option because of the long term management inputs required by the company. This may be the only alternative to meet certain offset requirements.

There are several options available to use land identified to be suitable for an environmental offset. Importantly, an offset does not necessarily have to be located within an Arrow tenement for it to be considered an offset. Other strategic delivery options include accumulating minor offset liabilities that would be compensated by a single offset package at a later stage, or a staged approach to offset delivery to coincide with the LNG project ramp up (eg. advance offsets, land banking).

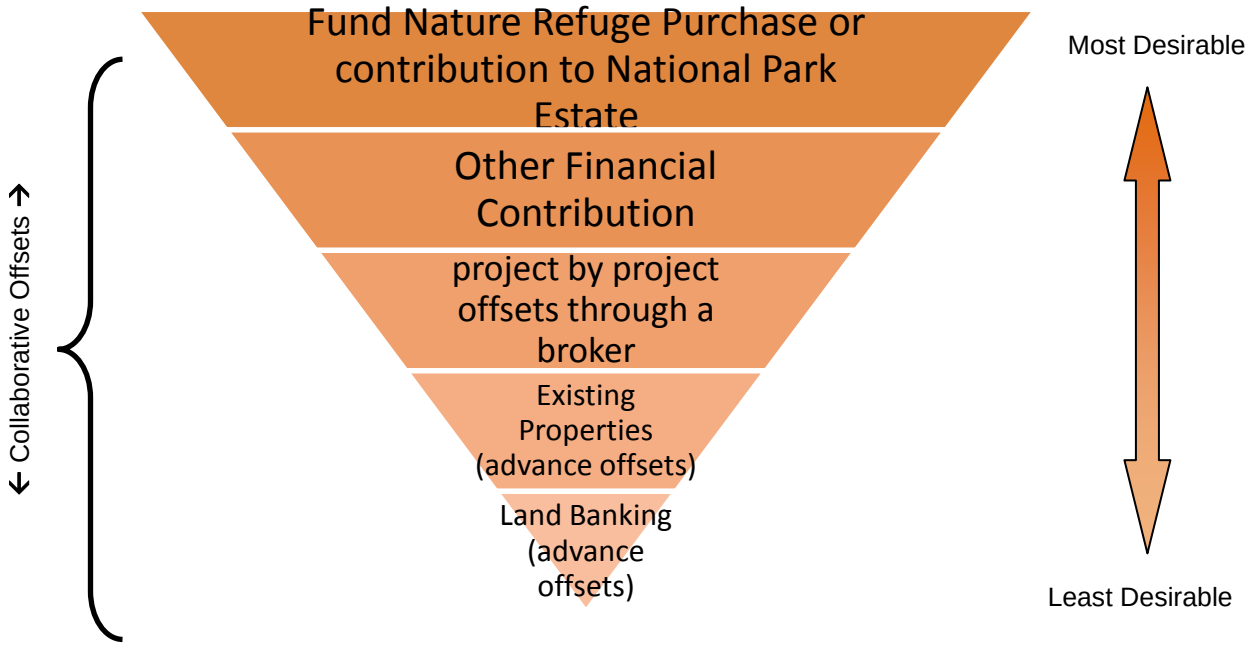

Figure 4: Arrow's Preferred Hierarchy to deliver offsets

Table 3 Risk ranking for offset delivery over the life of the LNG project

OFFSET DELIVERY METHOD	UPFRONT COST	COMMERCIAL MANAGEMENT	PERCEPTION	AVAILABILITY	TIMING	MANAGEMENT
Contribution to National Park Estate	3A	2B	1A	4C	5E	2B
Land Banking	3E	2C	4E	2D	3D	2C
Financial Contribution	4A	1A	3D	1A	3B	1A
Existing Properties	1C	2C	1C	5C	2C	2C
Broking Offsets	3C	2C	4D	2D	2C	2C
Collaborative Offsets	3B	3E	2C	3D	5D	1C
Purchase Nature Refuge	3A	2B	1A	4C	5E	2B

3.5 On-going management and discharging obligations

Depending upon the offset delivery options chosen for each project, on-going management of the offset is critical for the success of the offset (ie. the objectives of the offset are met to the satisfaction of the regulator) and eventual discharge of Arrow's responsibility for the offset. Each delivery method is unique in terms of the amount and type of on-going management required and the length of time Arrow will be obligated to manage til the offset's has met its offset criteria. The length of time for responsibility of each offset delivery option is:

- short-term (<1 – 3 years) responsibility – financial contributions, purchase of Nature Reserves, contributing to National Park estate or negotiating suitable offset through a broker
- long-term (>3 years and up to 50 years) responsibility – land banking, existing properties, collaborative offsets or broking offsets

Broking offsets can be a short-term or long-term proposition depending upon the offset delivery option chosen and the state of the land-based offset provided.

Arrow's intention is to give preference to offset delivery options that result in discharging offset responsibilities within the shortest possible timeframe. Exceptions will be considered where offset areas are located adjacent to semi-permanent infrastructure (e.g. compressor stations, dams).

3.6 Auditing, reporting and monitoring offsets

Managing all the offsets obligations for the company will be complex, as the requirements will need to be maintained for a long duration.

An offset register will be established to provide a single source for all information relating to offsets management for Arrow. The register will collect information to:

- Demonstrate how an offset has met the requirements for a particular project, for example what was being offset, what the ratio for offsetting was, method of securing the offset, when the obligations are planned to be met, any additional management requirements and links to source approval documents.
- Identify any properties that will be suitable for other complementary offsets as an advanced offset. For example, if an area of brigalow has been sourced, an additional area may be available for another project in the future.
- Regulators undertaking audits.
- Provide records for ongoing management within the company.

It is expected that the company will need to provide records to regulators, and Arrow will be audited, to demonstrate that obligations have been met.

4 Action plan

To ensure that the strategy will be implemented, some key actions and the responsible department have been identified in the following table.

Table 4: Environmental Offset Strategy – Action Plan

ITEM	RESPONSIBLE DEPARTMENT & POSITION	TIMEFRAME
Develop environmental offset register	Corporate HSE, Corporate Environment Advisor – Biodiversity & Fauna	Q4 2012
Prepare Environmental Offset Strategic Management Plans	EIS Manager for the project	As dictated by EIS project timeframes
Prepare Environmental Offset Operational Management Plans for EIS projects	EIS Manager for the project	As dictated by EIS project timeframes
Prepare Environmental Offset Operational Management Plans for individual tenements	Corporate HSE, Corporate Environment Advisor – Biodiversity & Fauna	As required
Prepare Project Environmental Offset Management Plans	Relevant Project Manager for the project (Asset, Upstream LNG, Exploration & Appraisal) with technical support from Ecologist (Land Access team).	As required prior to project approval
Environmental Offset Assessment Procedure	Corporate HSE, Corporate Environment Advisor – Biodiversity & Fauna	Q4 2012

5 Summary

The Environmental Offset Strategy has been developed to communicate to employees, contractors and government stakeholders Arrow Energy's direction for using and managing environmental offsets to compensate for residual impacts. The strategy seeks to manage offsets as a part of Arrow's established environmental management framework, and to maintain or improve environmental values in the locations where it operates.

The regulatory framework for offsets in Queensland and Australia are identified and opportunities for strategically implementing offsets are explored. Environmental offsets in Queensland are currently governed by Australian and Queensland government legislation and policies, the two over-arching policies are: the Australian Government *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy (August 2001, consultation draft); and the Queensland Government Environmental Offsets Policy (June 2008). Both the Queensland and Australian government policies are under review as of September, 2012. Offset planning and management policy is still undergoing development. Therefore, this strategy must have the ability to adapt to changes in policy. It is well accepted that environmental offsets are, and will increasingly become a common regulatory and environmental management tool. Offset planning and approvals must become embedded into Arrow's project management to minimise project risks and delays. To guide decision making processes within the company, principles for offset management within the company have been developed to align with the offset principles from the external policies and to guide offset planning.

The strategy aims to provide a clear and consistent approach to managing offset obligations for the company. It identifies a number of management plans at three distinct levels that need to be developed, which aim to provide more detail for each planning level. These are: Environmental Offset Strategic Management Plans (EOSMP), Environmental Offset Operational Management Plans (EOOMP); and Project Environmental Offset Management Plans (PEOMP). The strategic plans need to: identify the types of environmental values that will require offsetting; to plan for offsets in a coordinated way; and to be efficient and effective in delivering the offsets.

Arrow's preferred method to fulfil its offset obligations is to source properties that the government has a biodiversity interest in, that can be used to meet offset obligations from multiple projects, and will require minimal ongoing management inputs over the life of the offset. These types of offsets may be set up as nature refuges, additional national park estate, or as a property where the long term management can be passed on to another party. Multiple offsets, grouped into one offset solution, may need to accept that the offset site selected does not meet all the ecological equivalence criteria for all the values that need to be offset. However, this type of offset is likely to provide better environmental outcomes for Queensland, than small disjointed offsets, established for individual projects. Other delivery solutions are discussed, as it is likely that offset delivery will require a range of tools and methods for the varying sized projects requiring offsets as part of their approval process.

6 Glossary & Abbreviations

TERM	DEFINITION
Advanced offset	Advance offsets are direct offsets, which are secured before future development will take place. It can avoid delaying projects because an offset solution is already available.
CSG	Coal seam gas. A naturally occurring gas that is held within coal seams under pressure.
EIS	Environmental Impact Statement
Environmental value	Any environmental value that is considered to trigger an offset under the current regulatory framework. Examples include waterways, wetlands, significant vegetation communities, threatened plants, animals or communities, and vegetation containing such values.
Land banking	Strategic purchase or leasing of a property that has environmental values that can be put forward as an offset at a later date.
LNG	Liquefied natural gas. CSG that has been cooled and condensed ready from transport.
Offset broker	A third party person or company which facilitates negotiations between proponents and the landholder on which the offset area is to be located.
SEQ	South East Queensland, including the coastal area north of the New South Wales border to Gladstone and east to Toowoomba

7 Associated Documents

99-V-POL-0002 Arrow Energy Environmental Policy

99-H-MSS-0034 Biodiversity Standard

Arrow Energy Sustainable Development Policy

Ecological Equivalence Methodology Guideline, version 1, October 2011

Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy

Queensland Government Environmental Offsets Policy, June 2008

Queensland Biodiversity Offsets Policy, October 2011

Appendix 1 – Offset Regulatory Framework

APPROVALS	LEGISLATION AND POLICIES	ARROW PROJECTS IMPACTED*	RESPONSIBLE AGENCY
Australian Government			
Project referral to determine controlled action status.	• *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). • Draft EPBC Act Environmental Offsets Policy.	All projects and operations. The DXP has been assessed under the EPBC Act and has been approved subject to conditions. Offsets are not considered as part of this approval unless threatened species or communities are significantly impacted.	Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC)
Queensland Government			

Environmental Authority (EA) required for each tenure or group of tenures comprising a single project to condition the activities under the *Petroleum and Gas (Production and Safety) Act 2004*	• *Environmental Protection Act 1994* (EP Act).
	• Environmental Authority
	  ○ Specific offset conditions
	  ○ Biodiversity Offset Policy
		All projects and operations, except infrastructure off tenure and infrastructure on tenure, but not a petroleum activity	Department of Environment and Heritage Protection (DEHP)

Clearing of assessable vegetation that is conducted outside of the EP Act.	• *Vegetation Management Act 1999* (VM Act) • Policy for Vegetation Management Offsets (Version 3.0)	LNG, infrastructure off tenure and infrastructure on tenure, but not a petroleum activity	DEHP
Clearing of marine fish habitat	• *Fisheries Act 1994* • Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss.	LNG, coastal tenures	Department of Agriculture, Forestry and Fisheries (DAFF)

Clearing of habitat for the Koala in south east Queensland within Koala Management Areas	• *Nature Conservation Act 1992* (NC Act).
	  ○ *Nature Conservation (Koala) Conservation Plan 2006*;
	  ○ Offsets for Net Gain of Koala Habitat in South East Queensland.
		LNG, tenures within south-east Queensland bioregion.	Department of National Parks, Recreation, Sport and Racing (DNPRSR)

Clearing of habitat for endangered, vulnerable or near threatened (EVNT) wildlife	• *Nature Conservation Act 1992* (NC Act).
	  ○ *Nature Conservation (Wildlife) Regulation 2006*;
	  ○ Offsets for Net Gain of Koala Habitat in South East Queensland.
		All projects and operations	DNPRSR

Key to Arrow Projects: LNG – Arrow LNG plant on Curtis Island; DXP – Dalby Expansion Project (all southern Petroleum Leases).

Appendix 2 – Risk Ranking Matrix

								Arrow Preference				
Impact								High		Moderate	Low	
Schedule	Total Cost	Commercial Management	Negative Perception	Availability	Timing	On-going Management		Almost Certain	likely	Moderate	Unlikely	Rare
								A	B	C	D	E
High Impact	> $500 m	> $1 m annual cost	Serious LT issues	Lack of suitable areas in Qld	> 3 year approval	> $1 m annual cost	5	5	10	15	20	25
	$100 - $500 m	$500 k - $1 m annual cost	Serious Med to LT issues	Lack of suitable areas in Bioregion	18 month - 3 year approval	$500 k - $1 m annual cost	4	4	8	12	16	20
Moderate Impact	$10 - $100 m	$250 k - $500 k annual cost	Moderate ST to Med issues	Lack of suitable areas in subregion	6 - 18 month approval	$250 k - $500 k annual cost	3	3	6	9	12	15
Low Impact	$1 m - $10 m	$50 k - $250 k annual cost	Minor Short term issues	Lack of suitable areas in project area	3-6 month approval	$50 k - $250 k annual cost	2	2	4	6	8	10
	< $1 m	< $50 k annual cost	Low level / no lasting issues	Lack of suitable areas in local area	< 1 - 3 month approval	< $50 k annual cost	1	1	2	3	4	5

Find out more online at
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BRISBANE DALBY MORANBAH GLADSTONE

Arrow Energy Pty Ltd
ABN: 73 078 521 936

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