11. TERRESTRIAL ECOLOGY

This chapter summarises the findings of the supplementary terrestrial ecology assessment undertaken to address updates to the project description made since the Surat Gas Project Environmental Impact Statement (EIS) (Coffey Environments, 2012b) was finalised.

The Supplementary Terrestrial Ecology Assessment, prepared by 3D Environmental and EcoSmart Ecology is included in Appendix 9. The study supplements the Terrestrial Ecology Impact Assessment presented in Appendix K of the EIS, the main findings of which are summarised in Chapter 17 of the EIS.

Matters of national environmental significance (MNES) identified through the terrestrial ecology assessments completed for the EIS and supplementary report to the EIS (SREIS) are presented in Attachment 1, Matters of National Environmental Significance. *Environment Protection and Biodiversity Conservation Act 1999* (Cwth) (EPBC Act) listed ecological communities, flora and fauna species are described within the individual community and species profiles contained in Appendix 9, Supplementary Terrestrial Ecology Assessment, Appendices B, C and D.

Potential impacts on groundwater values, including groundwater dependent ecosystems, are discussed in Chapter 8, Groundwater. Surface water impacts, including overland flow, are discussed in Chapter 9, Surface Water. Information on the aquatic flora and fauna values are discussed in Chapter 10, Aquatic Ecology.

The revised project description is provided in Chapter 3, Project Description, and aspects relevant to terrestrial ecology are discussed in this chapter. In addition to the study findings, a list of key issues raised in the submissions to the EIS is presented in this chapter, with responses to all issues provided in Part B, Chapter 19, Submission Responses. An updated list of commitments is also provided in this chapter.

11.1 Studies and Assessments Completed for the EIS

This section provides an overview of the terrestrial ecology impact assessment completed for the Surat Gas Project EIS and the main conclusions from that assessment.

The assessment identified and described terrestrial ecology values within the project development area through desktop research and field surveys in selected areas.

The desktop study included a review of relevant literature, database searches, and examination of aerial photography to inform the selection of sites to target during the field surveys. Sites for field surveys were selected to sample a range of ecosystems and validate their presence, and to identify sensitive vegetation communities and in particular potential core habitat for flora and fauna species. The surveys were undertaken at 399 sites over 2 seasons in 2009, comprising 29 days between October and December (a period when chances of detecting most fauna species were relatively high) and an additional 6 days in May 2010.

Based on the desktop studies and field surveys, habitat within the project development area was defined and mapped for flora and fauna species in terms of core habitat including ‘core habitat known’ and ‘core habitat possible’. This approach was adapted from the Biodiversity Planning Assessment Mapping (DERM, 2008) methodology. The results of the desktop research and the field surveys were a key input to the constraints analysis and mapping. The constraints mapping guides the selection of sites and routes to avoid and reduce potential impacts, including on terrestrial ecology values, and forms an integral part of Arrow’s environmental framework approach to project development. The approach relies on identifying constraints to development and

establishing environmental management controls that should apply to project activities in these constrained areas.

Two nationally significant threatened ecological communities listed under the EPBC Act were identified within the project development area during the field surveys and an additional four communities were considered as 'possible' or 'likely' occurrences.

Thirty-five regional ecosystems (REs) (listed under the *Vegetation Management Act 1999* (Qld) (VM Act)) were mapped in the project development area. Using the biodiversity status, 11 regional ecosystems were listed as 'endangered' and 7 as 'of concern', while 17 were identified as being of 'no concern at present'. The field surveys refined the mapping extent of REs detected.

Seventy-four flora species listed under the *Nature Conservation Act 1992* (Qld) (NC Act) were identified during EIS desktop searches as being potentially present within the project development area. Of these, 40 were later excluded from the assessment due to the absence of recent records and suitable habitat within the project development area. Six NC Act listed species were verified during EIS field surveys.

Thirty-nine EPBC Act listed flora species were identified during EIS desktop searches as being potentially present within the project development area. Of these, 21 were later excluded from the assessment due to the absence of recent records and suitable habitat within the project development area. Two EPBC Act listed flora species were verified during EIS field surveys.

Potential impacts from project activities (construction, operation and decommissioning) identified by the terrestrial ecology impact assessment include:

- Habitat fragmentation and isolation of populations.
- Habitat loss or degradation and fauna mortality.
- Pest species invasion and resource competition.
- Edge effects.
- Alteration of ecological processes.

The constraints mapping and analysis developed for the EIS assessment relies on a vegetation based GIS package. The accuracy of this package, and hence analysis, is dependent on background data availability and accuracy. The EIS noted that ongoing data collection, particularly of high value sites in particular threatened ecological communities and 'endangered', 'vulnerable' and 'near threatened' (EVNT) species should be undertaken through further survey work in specific areas identified for development and preconstruction clearance surveys. These surveys should be ongoing with the results used to refine areas of 'core habitat known' and 'core habitat possible' for EVNT species.

Commitments relating to minimising impacts to terrestrial ecology values were developed based on professional advice from 3D Environmental and EcoSmart Ecology. The EIS found that project design and site selection for specific infrastructure that seeks to avoid these high-value sites is the primary means by which protection for terrestrial ecology values will be achieved. Table 11.1 lists the commitments presented in the EIS to avoid (where required) and reduce the significance of impacts to terrestrial ecology values in the project development area.

Table 11.1 Terrestrial ecology commitments presented in the EIS

No.	Commitment
C217	Avoid the following areas: • Wondul Range National Park, Bendidee 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, 11.8.2a), including three natural grassland road reserves (Dalby Kogan, Dalby Cecil Plains and Dalby St George Road).
C218	Aim to avoid: • 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, Bendidee 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.
C249	Where not possible to avoid Bendidee State Forest (which provides habitat for the 'endangered' bull oak jewel butterfly), conduct activities in predisturbed areas following the development and implementation of a bull oak jewel butterfly management plan with regard to the existing recovery plan (Lundie-Jenkins & Payne, 2000).
C523	Should Arrow seek to work within disturbed areas within the Bendidee State Forest, a preconstruction clearance survey of the forest will also be conducted with input from a butterfly specialist to inform the critical habitat and food resource of the bull oak jewel butterfly (*Hypochrysops piceata*).
C220	Conduct preconstruction clearance surveys to identify any additional areas that may need to be avoided.
C227	Manage potential impacts to Category A, B and C ESAs through implementation of the buffers proposed in Table 17.10.
C157	Implement a 100-m buffer zone from the high bank of all watercourses to ensure that no development or clearance occurs within these buffers (other than construction of watercourse crossings for roads, pipelines and discharge infrastructure and associated stream monitoring equipment).
C228	Ensure boundaries are clearly marked for site-specific sensitive areas that require avoidance.
C229	Ensure relevant workers, including contract plant and machinery operators, are made aware of the location of significant remnant vegetation and buffers and are guided by qualified personnel when clearing is undertaken.
C230	Demarcate buffers and inform workers and machinery operators of buffer locations when working within the vicinity of national- and state-listed communities and areas identified for potential avoidance.
C245	Implement site planning, preparation and management requirements in accordance with a developed and approved decommissioning and rehabilitation plan.
C246	Decommission the pipeline corridors in a manner that minimises potential impacts on the environment.

Table 11.1 Terrestrial ecology commitments presented in the EIS (cont'd)

No.	Commitment
C247	Identify areas for rehabilitation.
C248	Prioritise areas for rehabilitation based on the preconstruction clearance survey baseline characteristics.
C250	Advise, through procedures and plans, on requirements for rehabilitation in identified areas that are no longer in use.
C015	Clear areas progressively and implement rehabilitation as soon as practicable following construction activities.
C251	Reinstate self-supporting drainage lines.
C252	Inspect rehabilitation areas after decommissioning for regrowth similar to the surrounding environment.
C020	Minimise the disturbance footprint and vegetation clearing.
C231	Minimise the width of construction ROWs within areas of sensitivity to the greatest extent practicable without compromising the safety of workers.
C232	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.
C234	Retain habitat trees, where practicable.
C239	Translocate or propagate significant species where it is deemed necessary for use during rehabilitation or in offsets in accordance with relevant legislation.
C244	Consider the preconstruction clearance survey baseline characterisation when rehabilitating project sites.
C224	Develop threatened species management procedures as and when project activities are identified as likely to impact upon individuals.
C225	Avoid construction activities in waterbodies frequented by migratory species.
C191	Design gathering lines and tracks to avoid watercourses, drainage lines and riparian area (particularly permanent watercourses or perennial aquatic habitat), where practicable.
C240	Construct production wells, gathering lines and access tracks within cleared areas, where possible, with the aim of avoiding remnant vegetation and high-value regrowth.
C254	Implement noise control techniques in accordance with the noise and vibration commitments and standard industry noise suppression techniques.
C255	Minimise light spill from project activities to reduce disturbance to nocturnal fauna.
C256	Prohibit disturbance or harassment of wildlife and the unauthorised collection of flora and forest products.
C033	Confine project traffic to designated roads and access tracks, where practicable.
C241	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.
C242	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.
C261	Install and maintain sediment and erosion control structures at work sites.

Table 11.1 Terrestrial ecology commitments presented in the EIS (cont'd)

No.	Commitment
C176	Use coal seam gas water for dust suppression on roads or for construction and operations activities authorised in the environmental authority, in accordance with the water quality parameters described in the environmental authority.
C035	Apply appropriate international, Australian and industry standards and codes of practice for the handling of hazardous materials (such as chemicals, fuels and lubricants).
C048	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).
C038	Carry out corrective actions immediately upon the identification of any contamination of soil or groundwater that has occurred as a result of project activities.
C193	Identify declared weeds during the preconstruction field survey.
C188	Develop a declared weed and pest management plan in accordance with the Petroleum Industry - Pest Spread Minimisation Advisory Guide (Biosecurity Queensland, 2008). Undertake species-specific management for identified key weed species at risk of spread through project activities (mesquite, parthenium, African lovegrass 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, and monitoring effectiveness of control measures.
C179	Ensure all relevant personnel are made aware of the location and extent of weed infestations in the vicinity of the work area and the risks involved in moving from one site or property to another.
C190	When sourcing maintenance materials, ensure that such materials as bedding sand, topsoil, straw bales and sand bags are only brought to site after it is ascertained that the materials are not contaminated with weeds and plant or animal pathogens. A Weed Hygiene Declaration form must be requested from the supplier where there is possible risk of contamination in products.
C187	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.
C180	Do not wash down vehicles in watercourses.
C099	Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites.
C258	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.
C259	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.
C214	Design dams to have an egress (escape point) for wildlife.
C233	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.
C260	Implement speed limits on project-controlled roads to reduce the potential for vehicle collisions with wildlife.
C235	Assess trees prior to felling for potential nesting hollows. If identified, fell trees in the presence of a qualified fauna spotter and roll them so that the hollows are facing upwards allowing fauna to escape

Table 11.1 Terrestrial ecology commitments presented in the EIS (cont'd)

No.	Commitment
C236	Identify key koalas trees (*Eucalyptus tereticornis* and *Eucalyptus populnea*), and visually inspect prior to clearing to ensure that they are free of koalas. If koalas are located, the tree should be retained until the animals have moved on, typically overnight.
C237	Use appropriately trained personnel or a wildlife handler to capture injured wildlife, where possible. If further action is required, consult with a qualified vet to determine appropriate action.
C243	Erect fauna-exclusion fences around project dams.
C473	During rehabilitation works, care will be taken when moving stockpiled logs and vegetation to avoid fauna mortality.
C238	Retain woody debris, logs and rocks for use in rehabilitation. These should be spread 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.
C253	Select plant species for the purposes of rehabilitation that are specific to the original ecosystem and local provenance, wherever practicable.
C221	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.
C223	Develop fire plans for production facilities.
C219	Where avoidance is not possible, implement an offset strategy approved by a relevant government agency and comply with reporting conditions of an offset plan.
C533	Inspect areas of avoidance to ensure that boundaries are clearly marked prior to clearing activities.
C534	Monitor clearing activities to ensure marked boundaries are adhered to.
C535	Inspect marked areas after clearing activities to ensure areas of avoidance remain and that no unauthorised encroachment has occurred.
C536	Supervise construction activities in sensitive areas to ensure appropriate methods (e.g., narrowing of ROW) are being implemented, where required.
C500	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 DERM Wildnet database.
C478	Carry out routine monitoring of rehabilitation success.
C482	Inspect and monitor the success of newly propagated or translocated listed species, in accordance with the approved translocation or management plan.
C505	Inspect erosion and sediment control measures following significant rainfall events to ensure effectiveness of measures are maintained.
C508	Routinely inspect for pest flora and evidence of pest fauna species within project disturbed areas.
C212	Inspect food scrap bins and exclusion fences to ensure they are properly operated and maintained.
C303	Develop monitoring programs that are site-specific and based on the identified risk to the conservation or maintenance of a viable population.

11.2 Study Purpose

The supplementary terrestrial ecology assessment was undertaken to address updates to the project description that occurred after finalisation and exhibition of the EIS and to provide further information on the environmental values of the project development area obtained through improved vegetation mapping and additional field surveys. The field surveys were carried out on five Arrow owned or leased properties identified for development and sought to validate the findings of the EIS with respect to the terrestrial ecology values present (in particular listed species and communities) and the effectiveness of the proposed mitigation and management measures in managing potential impacts on these values. The study also took into account any relevant legislative updates.

11.2.1 Project Description Updates

The main updates to the project description with the potential to change or refine the results of the terrestrial ecology impact assessment, as presented in the EIS, include:

- A reduced project development area through the relinquishment of tenements by Arrow (from 8,600 km^2 to 6,100 km^2) (see Figure 1.1).
- Identification of locations for four central gas processing facilities (CGPFs) (two with associated water treatment facilities) and one temporary workers accommodation facility.
- Discharge of treated or untreated coal seam gas water to watercourses under normal operations rather than only emergency situations.
- Power supply from Queensland's electricity network as the preferred power option. Approximately 70% of the power distribution lines within the field development will be placed in the same trench as the gas and water gathering network. The remainder will be overhead lines with similar impacts to other linear infrastructure.
- The addition of multi-well pads comprising of up to 12 wells per pad, approximately 8 m apart. The EIS conceptualised that vertical wells would be drilled with a separation distance between wells averaging a minimum of 800 m across the project development area. Separation between pads of up to 2,000 m may be possible. The introduction of multi-well pad sites also reduces the total surface impact of the well pads.

The project development area now comprises a series of 11 drainage areas (see Figure 3.1). A staged development approach has identified four CGPF facilities for early development which will be located within drainage areas 2, 7, 8 and 9. Two CGPFs will be co-located with a water treatment facility and are located within drainage areas 2 and 9. The temporary workers accommodation facility (TWAF) will be located within drainage area 7. The exact location of infrastructure within these sites has yet to be determined. The siting of infrastructure will be informed by the site specific constraints identified in the results of the terrestrial ecology assessments completed for the SREIS.

11.2.2 Additional Information

Regional ecosystem mapping (v6.0) (DERM, 2009c) and regrowth mapping databases (DERM, 2009a) were developed and operated by the Department of Heritage and Protection (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, 2012d).
- Mature Regrowth digital data (EHP, 2012a).

The release of Version 7.0 Regional Ecosystem digital data mapping is specifically for use in projects regulated under the *Environmental Protection Act 1994* (Qld) (EP Act) where 'biodiversity status' should be applied rather than 'vegetation management status' (under the VM Act).

Prior to the release of EHP's Mature Regrowth digital data, regional ecosystem types were not attributed to regrowth vegetation, formerly recognised as 'high value regrowth'. The revised dataset now attributes regional ecosystem 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 uncleared subsequent to 31 December 1989.

11.2.3 Legislative Update

Legislation, policies and guidelines related to the protection of terrestrial ecology environmental values in the project development area are described in Chapter 17 of the EIS. Since the EIS was finalised, there have been some updates to policies, guidelines and legislation that impact on the management of terrestrial ecology values and these are summarised below. These changes have introduced new species to protected lists, changed the listing status of some species and communities, and changed offset requirements.

Further details are provided in Attachment 7, Legislation and Policy.

Environmental Protection Act 1994 (Qld) (EP Act)

The EP Act was revised in June 2012 and EHP now recognises Mature Regrowth vegetation by regional ecosystem type in accordance with the updated Mature Regrowth digital data (EHP, 2012a). The Environmental Protection Regulation 2008 provides a mechanism to enforce the EP Act by defining environmentally sensitive areas (ESAs) which include category B regional ecosystems scheduled as 'endangered' (biodiversity status).

The revised mapping identifies new areas as ESAs within the project development. These areas can be subject to increased protection and offset requirements.

Species or Habitats Schedules Revision

A number of species or habitats have had their status under either the EPBC Act or the Nature Conservation (Wildlife) Regulation 2006 revised since the publication of the EIS. While the Surat Gas Project is a controlled action under the EPBC Act, in accordance with Section 158A of the act, the upgrade of the species status does not impact on the project as the listing event occurred after the approval process decision. The SREIS considers species status as it was at the time of the controlled action decision and the delisting of species will be addressed when EA applications are made for the project prior to construction. Changes to species of relevance to the Surat Gas Project are as follows:

- *Dichanthium queenslandicum* (king blue grass) has had its EPBC Act status upgraded from 'vulnerable' to 'endangered' in January 2013.
- *Gonocarpus urceolatus* has been removed in July 2012 (previously listed as 'vulnerable') from schedules of the Nature Conservation (Wildlife) Regulation 2006 under the NC Act.
- *Paradelma orientalis* (brigalow scaly-foot) has been delisted (April 2013) from 'vulnerable' under the EPBC Act.
- *Phascolarctos cinereus* (koala) has been listed under the EPBC Act (only for Queensland, New South Wales and the ACT). In May 2012, referral guidelines were released which outline criteria for assessing critical habitat, important populations, and significant impacts for the koala in New South Wales and Queensland.

- *Rostratula australis (*Australian painted snipe) has had its EPBC Act status upgraded from 'vulnerable' to 'endangered' in April 2013.

Environmental Offsets Policy

Recent changes made to state and Australian government offset requirements (implemented through new and updated policy and guidance documents) are described in Attachment 6, Draft Environmental Offsets Strategic Management Plan. Offsets are only to be proposed after all reasonable avoidance and mitigation measures have been considered. Offsets are therefore designed to compensate for the residual impact of a project, after the implementation of avoidance and mitigation measures.

11.3 Study Method

The supplementary terrestrial ecology assessment has been conducted largely in accordance with the desktop and survey methods described in the EIS. Additional methods were used to expand the understanding of the sensitivity of terrestrial ecology values.

The studies completed for the SREIS included an updated literature review and targeted field surveys in areas identified for potential early stage development. The methods are consistent with the environmental framework approach to site selection described in the EIS.

Mapping areas were referred to in the EIS as 'targeted survey areas'. These areas are referred to in this chapter and the 3D Environmental technical study (Appendix 9, Supplementary Terrestrial Ecology Assessment) as the 'detailed mapping area'. 'Targeted survey area' is now applied to areas subject to field surveys completed to inform the SREIS which sit within the detailed mapping area.

11.3.1 Updated Literature Review and Desktop Mapping

A database search and literature review was completed to update and supplement the desktop study completed for the EIS. All databases used for the EIS were updated with the latest information including the upgrade of mapping areas in accordance with Version 7.0 Regional Ecosystem digital data (EHP, 2012d) and the Mature Regrowth digital data (EHP, 2012a) where field surveys had not been undertaken. The assessment of nationally threatened communities and species was undertaken in accordance with 3.01(c) of Schedule 4, Environment Protection and Biodiversity Conservation Regulations 2000 and guidelines to assess MNES (DEWHA, 2009). The guidelines were applied to targeted survey areas and demonstrate the approach of site specific impact assessment that Arrow will undertake as part of preconstruction clearance surveys.

Two additional databases for flora and fauna values, supplemented the information gathered for the EIS:

- Queensland Wetland Data (DERM, 2010g). Mapping of wetland habitat based on aerial photograph/ satellite image interpretation, topography and site database of RE mapping produced by EHP (EHP, 2012d).
- Arrow's Threatened Species Database (Arrow Energy, 2012). Records of flora and fauna species detected in Arrow's preliminary site investigations and preconstruction clearance surveys in areas currently operating under an environmental authority.

Additional sources were examined however were of limited value to the assessment due to the absence of location specific data. These included:

- Results from the Back on Track species prioritisation framework (Back on Track) for the Condamine Natural Resource Management (NRM) region (DERM, 2010b), Border Rivers Maranoa-Balonne NRM region (DERM, 2010a) and Fitzroy NRM region (DERM, 2010c). The

Back on Track framework aims to identify threatened species that require conservation (independent of legislative status).

- Aquatic Conservation Assessment (ACA) (Fielder et al., 2011) provides baseline wetland conservational and ecological information to identify 'priority' species for conservation purposes.

High resolution imagery of the project development area was captured by Arrow in August 2012. The imagery provides greater certainty around the representativeness of captured vegetation boundaries and their contemporary distribution. The process of attributing the refined boundaries was limited to the detailed mapping area (1100 km^2) as presented in the EIS, and areas identified for targeted ecological assessment (184 km^2).

Relevant specialists and experts, books, journal articles and digital data sources were used to provide further detailed information on terrestrial ecology values within the project development area. Other sources of information and data included technical and impact assessment reports such as those of other proponents of coal seam gas development and other major infrastructure projects in the region.

11.3.2 Regional Ecosystem Calculations

The area calculations for REs within the project development area presented in the EIS were updated to take account of the relinquishment of Arrow tenements, the change in the regulatory tool for REs from the VM Act to the EP Act (to recognise the biodiversity status of REs), and changes to RE mapping through the inclusion of the Mature Regrowth dataset. The revised calculations also took into account the updates to the detailed mapping area, the desktop reviews and targeted field surveys (see below).

11.3.3 Targeted Ecological Assessments

The environmental framework approach described in the EIS stated that once locations or areas for proposed facilities were identified, surveys would be carried out to validate the presence of sensitive ecosystems, communities and species.

Ecological assessments were focused on five areas located on properties that are Arrow-owned and/or leased and where project infrastructure will be sited. The ecological surveys carried out on the five properties (survey areas 2, 7, 8, 9 and F) identified for development were designed to sample and validate the presence and extent of sensitive vegetation communities, habitat and species within these areas. Environmental controls can then be applied to specific areas within these properties that reflect the sensitivity of the environmental values as verified through the targeted ecological surveys.

The targeted survey areas have been numbered to correspond with the drainage area within which they are located. Preliminary desktop assessments were carried out to inform the location and design of the field work to be carried out in the survey areas. Comprehensive field investigations were conducted on the two properties with proposed CGPFs and co-located water treatment facilities (survey area 2 and survey area 9). Trapping was not undertaken in survey areas 7, 8 and F. Broad scale ecological investigations were undertaken at these sites.

The following sections summarise the methods used. Further detail is provided in Appendix 9, Supplementary Terrestrial Ecology Assessment.

Preliminary Desktop Assessment

High resolution imagery was used to refine RE mapping in areas subject to development (survey areas 2, 7, 8, 9 and F). The detailed mapping area of these areas presented in the EIS (at 1: 40,000 scale) was upgraded to a spatial scale of 1:10,000. While a 1:50,000 scale is considered optimal for the mapping of REs, some vegetation communities listed under the EPBC Act that are

known or potentially present within the project development area require a finer spatial scale to identify their presence and extent (e.g., the scale of delineation on vine thicket). Historical imagery was used for areas outside of the detailed mapping area for the EIS to provide coverage for properties subject to development, specifically survey area 2 and the southern portion of survey area 9. The imagery was used to determine the age of regrowth vegetation, determine prior land use activities and vegetation condition, and assist determination of land zone used to inform the RE classification.

A site specific list was developed of known or potentially present conservation listed species and communities within the survey areas based on the updated literature review and desktop mapping. Survey methods were then designed to provide a robust survey effort for EVNT and non EVNT species in accordance with Australian government (DEWHA, 2009) and state government (Eyre et al., 2012; Neldner et al., 2012) guidelines.

Floristic Fieldwork

The floristic fieldwork for the SREIS was completed over two periods in February and March 2013 and corresponds to the optimal sampling period for ground covers in savannah and grassland habitats (Neldner et al., 2004).

Data collection methods were consistent with those described in the EIS (see Chapter 17 and Appendix K of the EIS) using a combination of formalised secondary, tertiary and quaternary level sampling procedures. In addition, the following methods were employed:

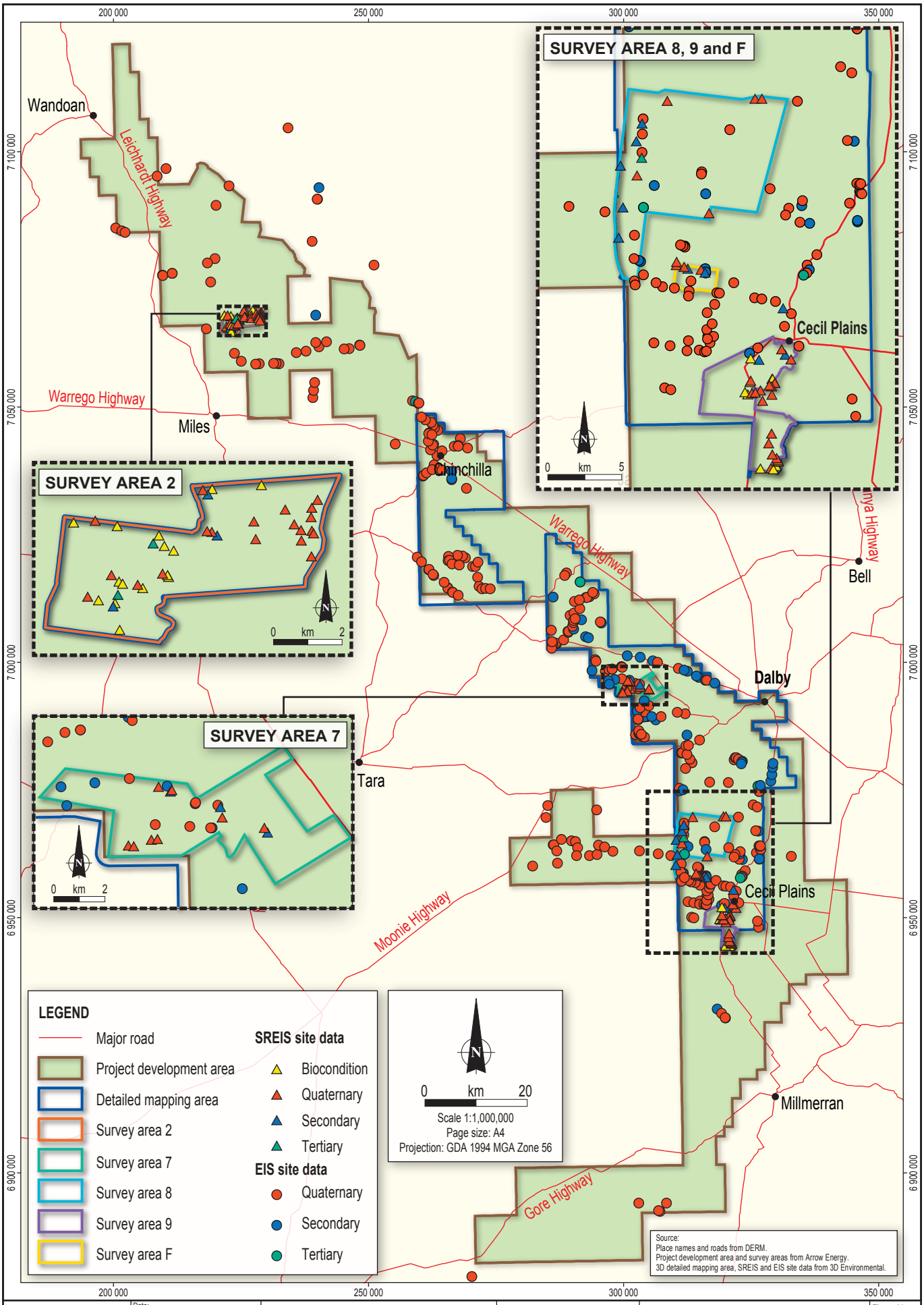
- Biocondition sites as detailed in the Ecological Equivalence Method Guideline (DERM, 2011b) were completed with representative habitats for survey areas 2 and 9. The aim was to collect structural data to provide baseline information for habitat offsets required under the Policy for Vegetation Management Offsets and Queensland Biodiversity Offsets Policy.
- For REs that provide suitable habitat for threatened flora species, meander searches were extended by 30 minutes and focused on biocondition sites as a priority. These searches included a 100 m buffer around the centre of the site.

In total, 130 sites were assessed as shown in Figure 11.1 and Table 11.2.

Table 11.2 Summary of sites surveyed during SREIS and EIS floristic survey efforts in survey areas 2, 7, 8, 9 and F

Project Location (survey area)	Biocondition Sites		Secondary Sites		Tertiary Sites		Quaternary Sites		Total Sites
	EIS	SREIS	EIS	SREIS	EIS	SREIS	EIS	SREIS	
2	0	15	0	1	0	2	0	19	37
7	0	0	5	3	0	0	6	8	22
8	0	0	5	5	1	1	9	5	26
9	0	13	1	3	0	0	1	17	35
F	0	0	2	2	0	0	2	4	10
Total sites	28		27		4		71		130

Data on the flora in the survey areas was incorporated into the detailed mapping area to validate the 1:10,000 mapping of RE types and extent. The data was also used in the revised habitat suitability assessment and core habitat mapping for EVNT flora and fauna species.



coffey environments	Date: 08.06.2013 MXD: 7040AE_12_GIS057_v1_1 File Name: 7040_12_F11.01_GIS_HB	Arrow Energy Surat Gas Project	arrow energy go further	Floristic survey locations	Figure No: 11.1

Fauna Fieldwork

A pilot study was carried out in survey areas 2 and 9 followed by a baseline assessment and systematic trapping.

The pilot study was guided by mapping developed for the EIS that show areas of 'core habitat known' and 'core habitat possible' for EVNT species. Visual assessments of existing vegetation were undertaken to confirm the presence of core habitat.

Survey design (i.e., location and number of trap sites) was modified following the visual assessment to reduce survey effort where 'core habitat possible' was not found. Survey efforts were increased in areas where new 'core habitat possible' was identified.

The methods used for the baseline assessment and systematic trapping are summarised below.

Baseline Assessment and Systematic Trapping

Within survey area 2, trapping was carried out at sites selected based on the information gathered during the pilot study. Trapping sites were located in areas that contained 'potential core habitat' for threatened fauna species, had potentially high vertebrate diversity (areas with abundant ground debris) or had natural features to assist and maximise trapping, and allowed for broad-scale sampling of vegetation groups. Survey area 9 was surveyed by active searches (including spotlighting) and observational sites according to weather conditions at the time. Survey areas 7, 8 and F were subject to systematic habitat assessments to identify potential habitats for both EVNT and non-EVNT species.

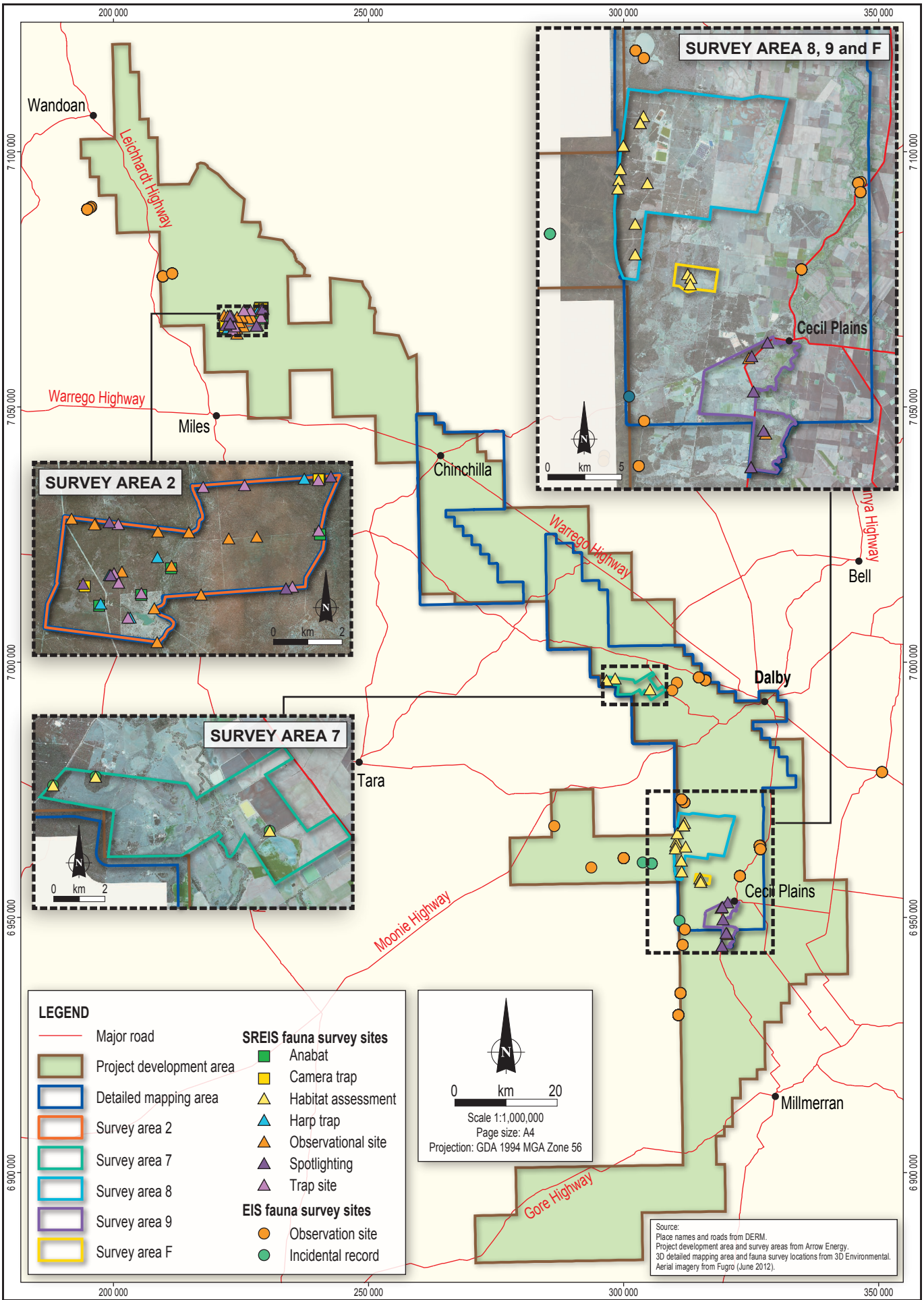
Sites sampled for fauna presence are shown in Figure 11.2. Fauna detection methods employed at survey areas 2, 7, 8, 9 and F are presented in Table 11.3. Fauna detection methods included:

- All species (habitat assessment, observational, active searching and spotlighting).
- Bats (harp trapping and anabat).
- Bird surveys (detected by 'all species' methods which include visual and aural observations).
- Mammal, reptile, and amphibian surveys (pitfall and funnel traps).
- Mammal surveys (camera traps).

Habitat assessment methods are consistent with those described in the EIS and were used in the absence of trapping to focus on habitat characteristics known to influence vertebrate community diversity and composition (including active searching and aural observations). Observational sites include habitat assessment techniques, but unlike habitat sites, greater survey effort is given to finding species and not to a detailed assessment of habitat characteristics.

Table 11.3 Summary of sites surveyed during SREIS fauna survey efforts in survey areas 2,7,8,9 and F

Project Location (survey area)	Habitat Assessment	Observational Site	Spot-lighting	Anabat	Camera Trap	Harp Trap	Pitfall/ Funnel Traps	Total Sites
2	0	13	6	5	2	6	10	**42**
7	3	0	0	0	0	0	0	**3**
8	12	0	0	0	0	0	0	**12**
9	0	2	6	0	0	0	0	**8**
F	3	0	0	0	0	0	0	**3**
Total sites	**18**	**15**	**12**	**5**	**2**	**6**	**10**	**68**



coffey environments	Date: 14.06.2013 MXD: 7040AE_12_GIS058_v1_1 File Name: 7040_12_F11.02_GIS_HB	Arrow Energy Surat Gas Project	arrow energy go further	Fauna survey locations	Figure No: 11.2

The inclusion of observational sites improves spatial representation, allows sampling of habitats too small to trap, and assists in determining locations or habitats for EVNT and non-EVNT species. This approach also allows for rare habitats (e.g., waterbodies, rocky gorges) to be adequately considered.

Fauna data collected in the survey areas was incorporated into the detailed mapping area to validate the presence and extent of core habitat for fauna species.

Riparian Assessments

The riparian vegetation of Bottle Tree Creek in survey area 2 was assessed using biocondition sites (flora) and habitat assessment (fauna). Representative sites were selected within the upper and lower reaches of the creek line.

The floristic value of riparian vegetation along the Condamine River in survey area 9 was assessed using the same survey techniques as Bottle Tree Creek. Fauna survey effort was restricted to side branches of the river due to flooding at the time. Floristic survey effort informed the assessment of potential habitat for fauna species.

The results of the riparian assessment have been used to inform the preliminary environmental flows assessment in Appendix 7, Supplementary Surface Water Assessment Part C – Preliminary Environmental Flows Assessment. This analysis assessed the volume, frequencies and regimes of treated water that can sustainably be discharged with minimal impacts to the terrestrial ecology in and adjacent to the riparian environment.

Habitat Suitability Assessment

An assessment of habitat suitability for EVNT species was undertaken for the EIS and is presented in Chapter 17 of the EIS. The habitat requirements of EVNT species were further assessed during the SREIS desktop study and supplemented with the results of field surveys, to define a series of mapping rules relevant to individual species listed under either the NC Act or the EPBC Act. The following datasets were used to provide comprehensive mapping of habitat for individual flora and fauna species across the project development area.

- Version 7.0 Regional Ecosystem digital data clipped to the project development area (EHP, 2012d).
- Mature Regrowth digital data clipped to the project development area (EHP, 2012a).
- Detailed mapping area (surveys completed at 1:40, 000 and 1:10, 000 scales for specific areas of the project development area).

The likelihood of species occurring was assessed based on information from available records, known habitat distribution and habitat suitability. Habitat assessments were carried out for individual EPBC Act and NC Act listed species to determine areas of ‘core habitat known’ and ‘core habitat possible’. The detailed assessments are included in Appendix 9, Supplementary Terrestrial Ecology Assessment, Appendix C, D, F and G.

Following targeted ecological surveys, intact (remnant) habitats mapped as ‘core habitat known’ or ‘core habitat possible’ for EPBC Act or NC Act listed species are mapped as ‘high value’ habitats. Disturbed regrowth habitats mapped as ‘core habitat known’ or ‘core habitat possible’ for listed species are mapped as ‘medium value’ and other habitat such as cleared agricultural and cultivated land is mapped as ‘low value’.

11.3.4 Study Limitations

The original survey plan comprised a minimum of four consecutive nights of trapping and habitat assessment of each survey area (2 and 9). Inclement weather (including widespread flooding) required modification to the survey method and resulted in three consecutive nights trapping within survey area 2, and survey area 9 was surveyed by active searches only.

While trapping was not undertaken at survey area 9, a total of 86 hours of active man-hour searches was conducted including spotlight searches. Active searching and spotlighting is suitable for the detection of EVNT species considered likely to occur at this site based on habitat suitability (e.g., rough collared frog (*Cyclorana verrucosa*) and grey snake (*Hemiaspis damelii*). The lack of trapping is recognised as a survey limitation as some species are difficult to detect through searching alone (e.g., five-clawed worm-skink, *Anomalopus mackayi*).

Systematic trapping in survey areas 7, 8 and F was not planned, although most areas of vegetation were accessed by foot. Access within the derived grasslands associated with 'Long-Swamp' within survey area 8 was not possible due to wet conditions at the time.

Where suitable habitat on all properties was located, EVNT species are assumed to be present unless verified otherwise. The lack of site-specific knowledge in these cases, due to inclement weather impeding survey effort, does not pose a significant threat to conservation outcomes.

11.3.5 Impact Assessment Method

The potential impacts of the project on terrestrial ecology values were assessed in the EIS using the significance assessment method described in Chapter 7 of the EIS, and Chapter 17 Section 17.2.4 of the EIS. The SREIS assessment draws on both extensive desktop investigations and field investigations to provide further definition through a qualitative assessment of the sensitivity of habitat, local flora and fauna populations and likelihood of occurrence. In particular, the assessment updated and further refined the sensitivity criteria for terrestrial ecology values. The revised criteria were then applied to all species assessed in the EIS, and additional species identified from the SREIS database searches, together with a review of the likelihood of occurrence in the project development area.

Detailed information on this assessment method is provided in Appendix 9, Supplementary Terrestrial Ecology Assessment, Appendix A4.

11.4 Study Findings

This section presents the findings of the supplementary terrestrial ecology study undertaken by 3D Environmental and EcoSmart Ecology.

11.4.1 Sensitivity of Terrestrial Ecology Values

The sensitivity of terrestrial ecology values in the project development area was reviewed and any changes from the EIS are presented in Table 11.4.

Table 11.4 Updates to terrestrial ecology values

Values of Major Conservation Significance	Status	Occurrence within the Project Development Area from EIS*	Sensitivity of Terrestrial Ecology Value from EIS	Revised Assessment in SREIS**
Weeping Myall Woodlands	EPBC Act - Endangered	Possibly occurring	High	**Known to occur;** confirmed to occur within survey area 7
Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions	EPBC Act - Endangered	Likely to occur	Moderate	Sensitivity assessed as **High.** **Known to occur;** confirmed to occur within survey area 7
Digitaria porrecta (finger panic grass)	EPBC Act –Endangered; NC Act -Near Threatened	Known to occur	Moderate	Sensitivity assessed as **High**
Acacia curranii (curly bark wattle)	EPBC Act- Vulnerable; NC Act- Vulnerable	Known to occur	High	Sensitivity assessed as **Moderate**
Denhamia parviflora (small leaved denhamia)	EPBC Act- Vulnerable; NC Act- Vulnerable	Known to occur	High	Sensitivity assessed as **Extremely High**
Philotheca sporadica (Kogan waxflower)	EPBC Act- Vulnerable; NC Act- Vulnerable	Known to occur	High	Sensitivity assessed as **Moderate**
Picris evae (hawkweed)	EPBC Act- Vulnerable; NC Act- Vulnerable	Likely to occur	High	Sensitivity assessed as **Moderate**
Acacia handonis (Hando's wattle)	EPBC Act- Vulnerable; NC Act- Vulnerable	Possibly occurring	High	Sensitivity assessed as **Moderate**
Acacia wardellii (Wardell's wattle)	EPBC Act- Vulnerable; NC Act- Vulnerable	Possibly occurring	High	Sensitivity assessed as **Moderate**
Cadelia pentastylis (ooline)	EPBC Act- Vulnerable; NC Act- Vulnerable	Possibly occurring	High	Sensitivity assessed as **Extremely High**
Rhaponticum australe (Austral cornflower)	EPBC Act- Vulnerable; NC Act- Vulnerable	Possibly occurring	High	Sensitivity assessed as **Moderate**
Eucalyptus virens (shiny-leaved ironbark)	EPBC Act- Vulnerable; NC Act - Vulnerable	Unlikely to occur	Not Assessed	Assessed as **Possibly** occurring; Sensitivity assessed as **High**

Table 11.4 Updates to terrestrial ecology values (cont'd)

Values of Major Conservation Significance	Status	Occurrence within the Project Development Area from EIS*	Sensitivity of Terrestrial Ecology Value from EIS	Revised Assessment in SREIS**
Eucalyptus argophloia (Queensland white gum)	EPBC Act- Vulnerable; NC Act - Vulnerable	Unlikely to occur	Not Assessed	Assessed as **Possibly** occurring; Sensitivity assessed as **Moderate**
Acacia lauta (Tara wattle)	EPBC Act- Vulnerable; NC Act - Vulnerable	Unlikely to occur	Not Assessed	Assessed as **Possibly** occurring; Sensitivity assessed as **Moderate**
Cymbonotus maidenii	EBPC Act – Not Listed NC Act - Endangered	Not assessed	Not Assessed	Assessed as **Known to Occur**; Sensitivity assessed as **Moderate**
Dasyurus m. maculatus (spotted-tail quoll)	EPBC Act- Vulnerable; NC Act -Endangered	Possibly occurring	Moderate	Species considered **unlikely to occur** in project development area and not considered further in SREIS (see Table 11.9).
*Tympanocryptis cf. tetraporophora (*Darling Downs earless dragon)	EPBC Act –Endangered; NC Act -Endangered	Known to occur	High	Sensitivity assessed as **Extremely High**
Egernia rugosa (yakka skink)	EPBC Act- Vulnerable; NC Act- Vulnerable	Possibly occurring	Moderate	Sensitivity assessed as **High**
Geophaps scripta scripta (squatter pigeon)	EPBC Act- Vulnerable; NC Act- Vulnerable	Known to occur	Moderate	Sensitivity assessed as **High**
Category A ESAs: Wondul Range National Park (ATP689), Bendidee National Park (ATP689), Lake Broadwater Conservation Park (PL260).	NA	Known to occur	Extremely High	Bendidee National Park lies within a relinquished sub-block and is of no further relevance to the project.

Table 11.4 Updates to terrestrial ecology values (cont'd)

Values of Major Conservation Significance	Status	Occurrence within the Project Development Area from EIS*	Sensitivity of Terrestrial Ecology Value from EIS	Revised Assessment in SREIS**
Category C ESAs: Barakula State Forest, Whetsone State Forest, Western Creek State Forest, Gurulmundi State Forest, Dunmore State Forest, and Kumbarilla State Forest, Lake Broadwater Resources Reserve, Bendidee State Forest. See relevant individual assessments for REs with Biodiversity Status of 'of concern'.	NA	Known to occur	Moderate to High	Bendidee State Forest lies within a relinquished sub-block and is of no further relevance to the project

* Species listed as unlikely to occur were not subject to the EVNT significance assessment for the EIS.

** Occurrence within the project development stands as assessed in the EIS if a revised assessment is not presented.

11.4.2 Nationally Threatened Ecological Communities

Areas of EPBC Act listed ecological communities were identified within the project development area, from the detailed mapping area developed from EIS and SREIS surveys overlayed with the updated RE (EHP 2012d) and Mature Regrowth datasets (EHP 2012a). The inclusion of the Mature Regrowth dataset following updates to EHP RE mapping has added a further 27,136 ha of vegetation to consider in the project development area.

The EPBC listed ecological communities in the project development area include the following:

- 7,387 ha of the Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community ('endangered').
- 678 ha of the Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland ('critically endangered').
- 206 ha of the Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions ('endangered').
- 35 ha of the Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions ('endangered').
- 260 ha of the White Box – Yellow Box – Blakely's Red Gum grassy woodland and derived native grassland ('critically endangered').
- 0.85 ha of the Weeping Myall ecological community ('endangered').

Nationally threatened ecological community mapping and information within the project development area was reviewed and has resulted in revisions to the assessment undertaken in the EIS of two threatened ecological communities. These are Weeping Myall Woodlands and Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions. The targeted ecological surveys carried out for the SREIS confirmed the presence within the project development of both these communities which were considered as a possible occurrence in the EIS.

The revisions are presented in Table 11.5.

Table 11.5 Revised sensitivity assessment and likelihood of occurrence for nationally threatened ecological communities in the project development area

Nationally Threatened Ecological Community	Status	Occurrence within Project Development Area from EIS	Assessed Sensitivity of Terrestrial Ecology Value from EIS	Revised Assessment of Sensitivity	Revised Assessment of Likelihood of Occurrence
Weeping Myall Woodlands	EPBC Act – 'endangered'	Possibly occurring	High	High	Known to occur; confirmed to occur within survey area 7
Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions	EPBC Act – 'endangered'	Likely to occur	Moderate	High	Known to occur; confirmed to occur within survey area 7

The detailed assessments and distribution maps of nationally threatened communities are presented in Appendix 9, Supplementary Terrestrial Ecology Assessment, Appendix B.

11.4.3 State Classified Vegetation Communities (Regional Ecosystems), Environmentally Sensitive Areas, and Essential Habitat

The supplementary terrestrial ecological assessment identified several changes to state classified vegetation communities (REs), ESAs and essential habitat. These updates are summarised below.

Regional Ecosystems

The EIS identified 35 REs within the project development area. Due to the relinquishment of sub-blocks of Arrow tenements, 32 REs are now mapped within the project development area. The assessment of sensitivity remains unchanged for all REs.

Table 17.8 of the EIS incorrectly listed REs 11.3.2, 11.3.25, 11.3.4, 11.3.27 and 11.9.7 as 'least concern', when they are listed as 'of concern'. This update does not change the sensitivity (moderate) of these REs.

Table 11.6 presents a comparison of RE distribution in the project development area and bioregion. Figures 11.3a, 11.3b and 11.3c show the distribution of REs in accordance with the requirements of the EP Act.

The extent of most REs within the project development area has been reduced through Arrow's relinquishment of tenements sub-blocks. Consequently, the proportion of the bioregional extent of each of the REs represented in the project development area has also reduced.

Of the five REs that increased in mapped extent, three were minor increases and two were larger, namely RE 11.9.5, which is associated with the widely distributed Brigalow (*Acacia harpophylla* dominant and co-dominant) community and RE 11.3.2 (*Eucalyptus populnea* woodland on alluvial plains). The inclusion of the mature regrowth vegetation mapping now recognises brigalow regrowth vegetation and accounts for the increase in mapping extent of RE 11.9.5. The increase in RE 11.3.2 is due to large areas of regrowth mapped in areas adjacent to remnant RE 11.3.2.

Table 11.6 Summary of extent for regional ecosystems within the project development area

RE Number	Regional Ecosystem Description	VM Class	Biodiversity Status	EPBC Act Status	EIS Calculations For RE Distribution in the Project Development Area*		SREIS Calculations For RE Distribution in the Project Development Area**		Total Remaining in the Bioregion***	Bioregional extent represented in the project development area****
					(ha)	(%)	(ha)	(%)	ha	%
Regional ecosystems of extremely high sensitivity (associated with EPBC Act listed communities)										
11.3.21	*Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils.	'Endangered'	'Endangered'	'Critically endangered'	717	0.08	608	0.3	51,721	1.18
11.3.24	*Themeda avenacea* grassland on alluvial plains. Basalt-derived soils.	'Endangered'	'Endangered'	'Critically endangered'	125	0.01	101	<0.01	104	97.12
11.8.2a	*Eucalyptus tereticornis* and *E. melliodora* occurring on low hills.	'Least concern'	'No concern at present'	'Critically endangered'	1,138	0.13	383	0.2	35,812	1.07
Regional ecosystems of high sensitivity (associated with EPBC Act listed communities)										
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains.	'Endangered'	'Endangered'	'Endangered'	774	0.09	289	0.1	80,610	0.36
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	'Of concern'	'Of concern'	'Endangered'	259	0.03	210	0.1	281,071	0.07
11.4.3, 11.4.3a	*Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains.	'Endangered'	'Endangered'	'Endangered'	4,616	0.54	1,254 37	0.6 <0.01	75,622	1.71

Table 11.6 Summary of extent for regional ecosystems within the project development area (cont'd)

RE Number	Regional Ecosystem Description	VM Class	Biodiversity Status	EPBC Act Status	EIS Calculations For RE Distribution in the Project Development Area*		SREIS Calculations For RE Distribution in the Project Development Area**		Total Remaining in the Bioregion***	Bioregional extent represented in the project development area****
					(ha)	(%)	(ha)	(%)	ha	%
Regional ecosystems of high sensitivity (associated with EPBC Act listed communities) (cont'd)										
11.4.10	*Eucalyptus populnea* or *E. pilligaensis, Acacia harpophylla, Casuarina cristata* open forest to woodland on margins of Cainozoic clay plains.	'Endangered'	'Endangered'	'Endangered'	1,784	0.21	105	0.1	6461	1.63
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.	'Endangered'	'Endangered'	'Endangered'	3,792	0.45	4,998	2.4	165,917	3.01
11.9.6	*Acacia melvillei* ± *A. harpophylla* open forest on fine-grained sedimentary rocks.	'Endangered'	'Endangered'	'Endangered'	152	0.02	157	0.1	345	45.51
11.9.4a	Semi-evergreen vine thicket or *Acacia harpophylla* with a semi-evergreen vine thicket understorey on fine-grained sedimentary rocks.	'Endangered'	'Endangered'	Endangered	12	<0.01	35	<0.01	33,533	0.10
11.8.3*****	Semi-evergreen vine thicket on Cainozoic igneous rocks.	'Of concern'	'Of concern'	'Endangered'	19	<0.01	0	0	26,208	0.00
Regional ecosystems of high sensitivity										
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains.	'Of concern'	'Endangered'	Not listed	4,412	0.52	233	0.1	35,847	0.65

Table 11.6 Summary of extent for regional ecosystems within the project development area (cont'd)

RE Number	Regional Ecosystem Description	VM Class	Biodiversity Status	EPBC Act Status	EIS Calculations For RE Distribution in the Project Development Area*		SREIS Calculations For RE Distribution in the Project Development Area**		Total Remaining in the Bioregion***	Bioregional extent represented in the project development area****
					(ha)	(%)	(ha)	(%)	ha	%
Regional ecosystems of high sensitivity (cont'd)										
11.9.10	*Acacia harpophylla, Eucalyptus populnea* open forest on fine-grained sedimentary rocks.	'Of concern'	'Endangered'	Not listed	175	0.02	133	0.1	33,533	0.16
11.4.12	*Eucalyptus populnea* woodland on Cainozoic clay plains.	'Endangered'	'Endangered'	Not listed	946	0.11	515	0.2	7,340	6.9
Regional ecosystems of moderate sensitivity										
11.3.2	*Eucalyptus populnea* woodland on alluvial plains.	'Of concern'	'Of concern'	Not listed	5,333	0.63	6,420	3.1	443,768	1.45
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains.	'Of concern'	'Of concern'	Not listed	4,945	0.58	4,254	2.1	183,695	2.32
11.3.25, g	*Eucalyptus tereticornis* or *Eucalyptus camaldulensis* woodland fringing drainage lines.	'Least concern'	'Of concern'	Not listed	9,550	1.12	7,014	3.4	513,711	1.37
11.3.27 a, b, c, d	Freshwater wetlands.	'Least concern'	'Of concern'	Not listed	910	0.11	682	0.3	49,086	1.39
11.9.7	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks.	'Of concern'	'Of concern'	Not listed	704	0.08	781	0.4	108,857	0.72

Table 11.6 Summary of extent for regional ecosystems within the project development area (cont'd)

RE Number	Regional Ecosystem Description	VM Class	Biodiversity Status	EPBC Act Status	EIS Calculations For RE Distribution in the Project Development Area*		SREIS Calculations For RE Distribution in the Project Development Area**		Total Remaining in the Bioregion***	Bioregional extent represented in the project development area****
					(ha)	(%)	(ha)	(%)	ha	%
Regional ecosystems of low sensitivity										
11.3.14	*Eucalyptus* spp., *Angophora* spp., *Callitris* spp. woodland on alluvial plains.	'Least concern'	'No concern at present'	Not listed	222,910	26.24	6554	3.2	80,277	8.16
11.3.18	*Eucalyptus populnea, Callitris glaucophylla, Allocasuarina luehmannii* shrubby woodland on alluvium.	'Least concern'	'No concern at present'	Not listed			2098	1	79,674	2.63
11.3.19*****	*Callitris glaucophylla, Corymbia* spp. and/or *Eucalyptus melanophloia* open forest to woodland on Cainozoic alluvial plains.	'Least concern'	'No concern at present'	Not listed	See above	See above	0	0	92,152	0.00
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains.	'Least concern'	'No concern at present'	Not listed			101	<0.01	43,601	0.23
11.5.1, 11.5.1a	*Eucalyptus crebra, Callitris glaucophylla, Angophora leiocarpa, Allocasuarina luehmannii* woodland on Cainozoic sand plains/remnant surfaces.	'Least concern'	'No concern at present'	Not listed			52,129	25.3	477,161	10.92
11.5.20	*Eucalyptus moluccana* and/or *E. microcarpa/E. pilligaensis*§ ± *E. crebra* woodland on Cainozoic sand plains.	'Least concern'	'No concern at present'	Not listed			11,248	5.5	151,772	7.41

Table 11.6 Summary of extent for regional ecosystems within the project development area (cont'd)

RE Number	Regional Ecosystem Description	VM Class	Biodiversity Status	EPBC Act Status	EIS Calculations For RE Distribution in the Project Development Area*		SREIS Calculations For RE Distribution in the Project Development Area**		Total Remaining in the Bioregion***	Bioregional extent represented in the project development area****
					(ha)	(%)	(ha)	(%)	ha	%
Regional ecosystems of low sensitivity (cont'd)										
11.5.21	*Corymbia bloxsomei* ± *Callitris glaucophylla* ± *Eucalyptus crebra* ± *Angophora leiocarpa* woodland on Cainozoic sand plains/remnant surfaces.	'Least concern'	'No concern at present'	Not listed	See above	See above	8,721	4.2	71,764	12.15
11.5.4	*Eucalyptus crebra, Callitris glaucophylla, C. endlicheri, E. chloroclada, Angophora leiocarpa* on Cainozoic sand plains/remnant surfaces. Deep sands.	'Least concern'	'No concern at present'	Not listed			18,154	8.8	108,556	16.72
11.7.2	*Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	'Least concern'	'No concern at present'	Not listed			2,274	1.1	366,646	0.62
11.7.4, 11.7.4c	*Eucalyptus decorticans* and/or *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp., *Lysicarpus angustifolius* on Cainozoic lateritic duricrust.	'Least concern'	'No concern at present'	Not listed			39,811	19.3	222,810	17.87
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks.	Least concern	'No concern at present'	Not listed			10,405	5	62,871	16.55
11.7.6	*Corymbia citriodora* or *Eucalyptus crebra* woodland on Cainozoic lateritic duricrust.	Least concern	'No concern at present'	Not listed			2,389	1.2	337,345	0.71

Table 11.6 Summary of extent for regional ecosystems within the project development area (cont'd)

RE Number	Regional Ecosystem Description	VM Class	Biodiversity Status	EPBC Act Status	EIS Calculations For RE Distribution in the Project Development Area*		SREIS Calculations For RE Distribution in the Project Development Area**		Total Remaining in the Bioregion***	Bioregional extent represented in the project development area****
					(ha)	(%)	(ha)	(%)	ha	%
Regional ecosystems of low sensitivity (cont'd)										
11.7.7	*Eucalyptus fibrosa* subsp. *nubila* ± *Corymbia* spp. ± *Eucalyptus* spp. on Cainozoic lateritic duricrust.	'Least concern'	'No concern at present'	Not listed	See above	See above	17,717	8.6	170,919	10.37
11.9.9, 11.9.9a	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks.	'Least concern'	'No concern at present'	Not listed			5,780	2.8	122,045	4.74
11.10.1/11.10.1d	*Corymbia citriodora* open forest on coarse-grained sedimentary rocks.	'Least concern'	'No concern at present'	Not listed			553	0.3	879,089	0.06
13.12.5*****	*Eucalyptus youmanii on igneous rocks.*	'Least concern'	'No concern at present'	Not listed			0	0	345	0

* Calculations of extent did not include the regrowth dataset (DERM, 2009a) for the EIS.

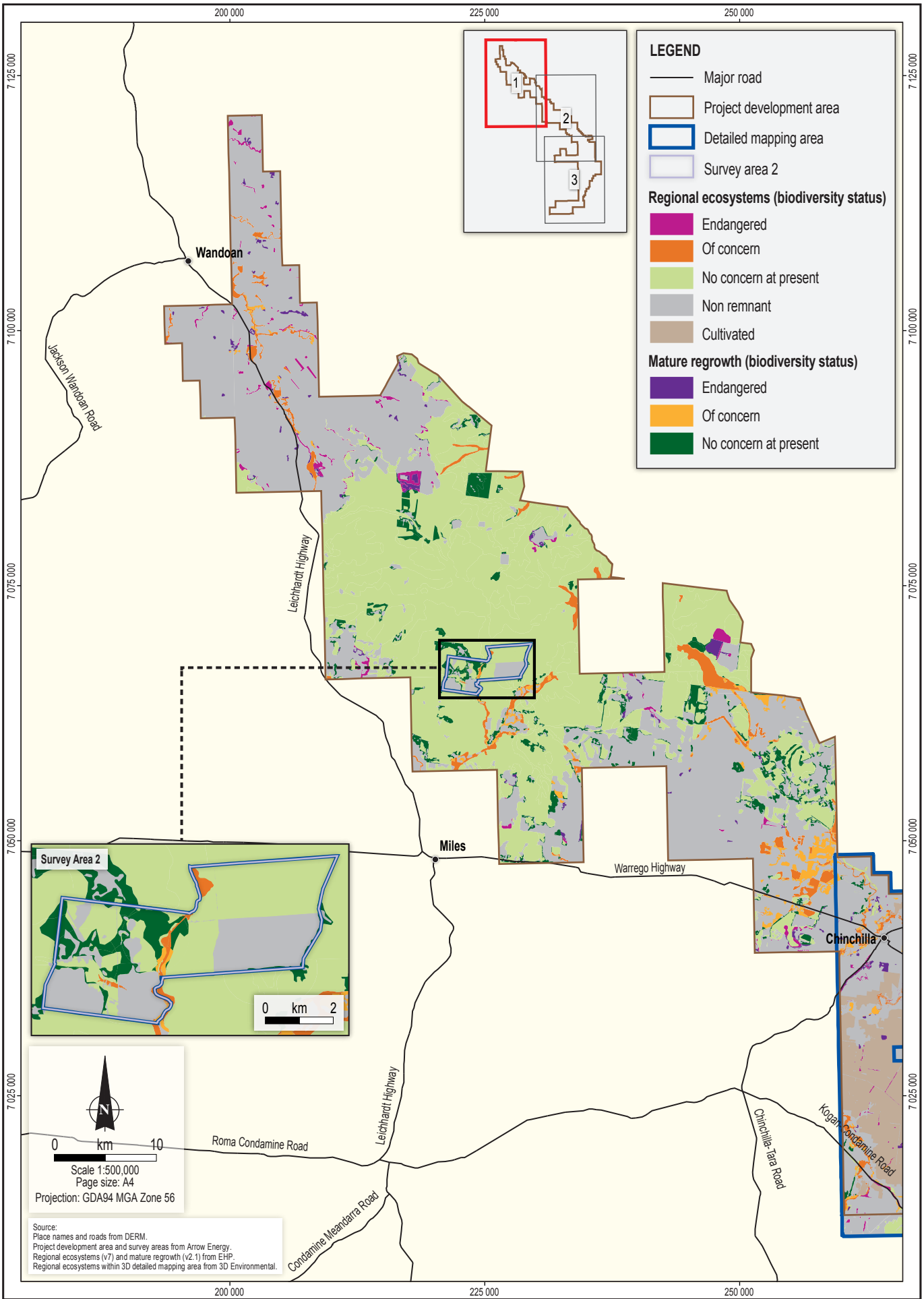
** Calculations of extent include the regrowth dataset (EHP, 2012a) for the SREIS.

*** Calculations use the EHP V7.0 dataset (EHP, 2012d) + regrowth dataset (EHP, 2012a) + detailed mapping over laying the area.

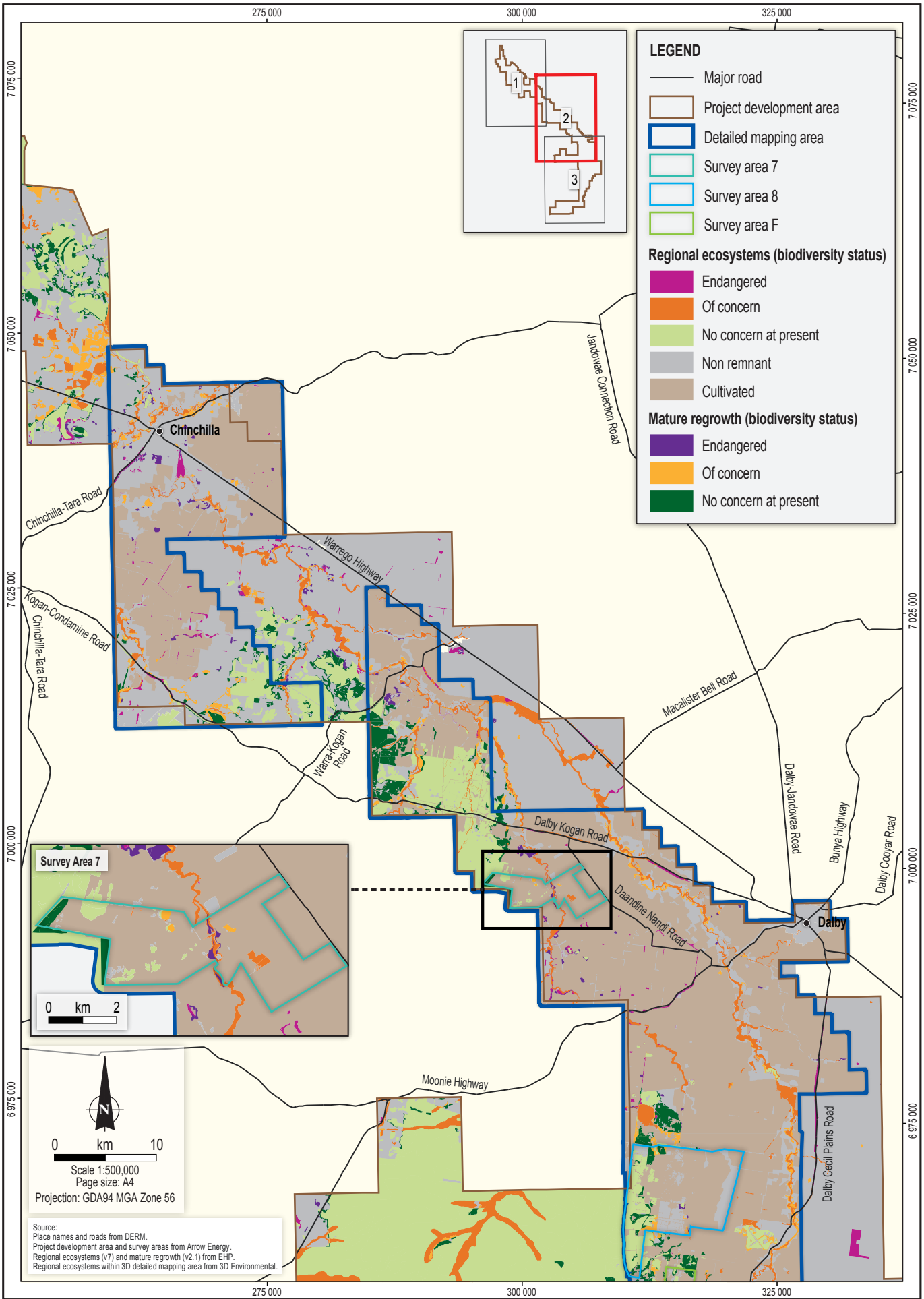
**** Calculated using the SREIS calculations against the bioregional calculation (Accad et. al., 2012).

***** RE no longer occurs in the project development area due to the relinquishment of Arrow tenements.

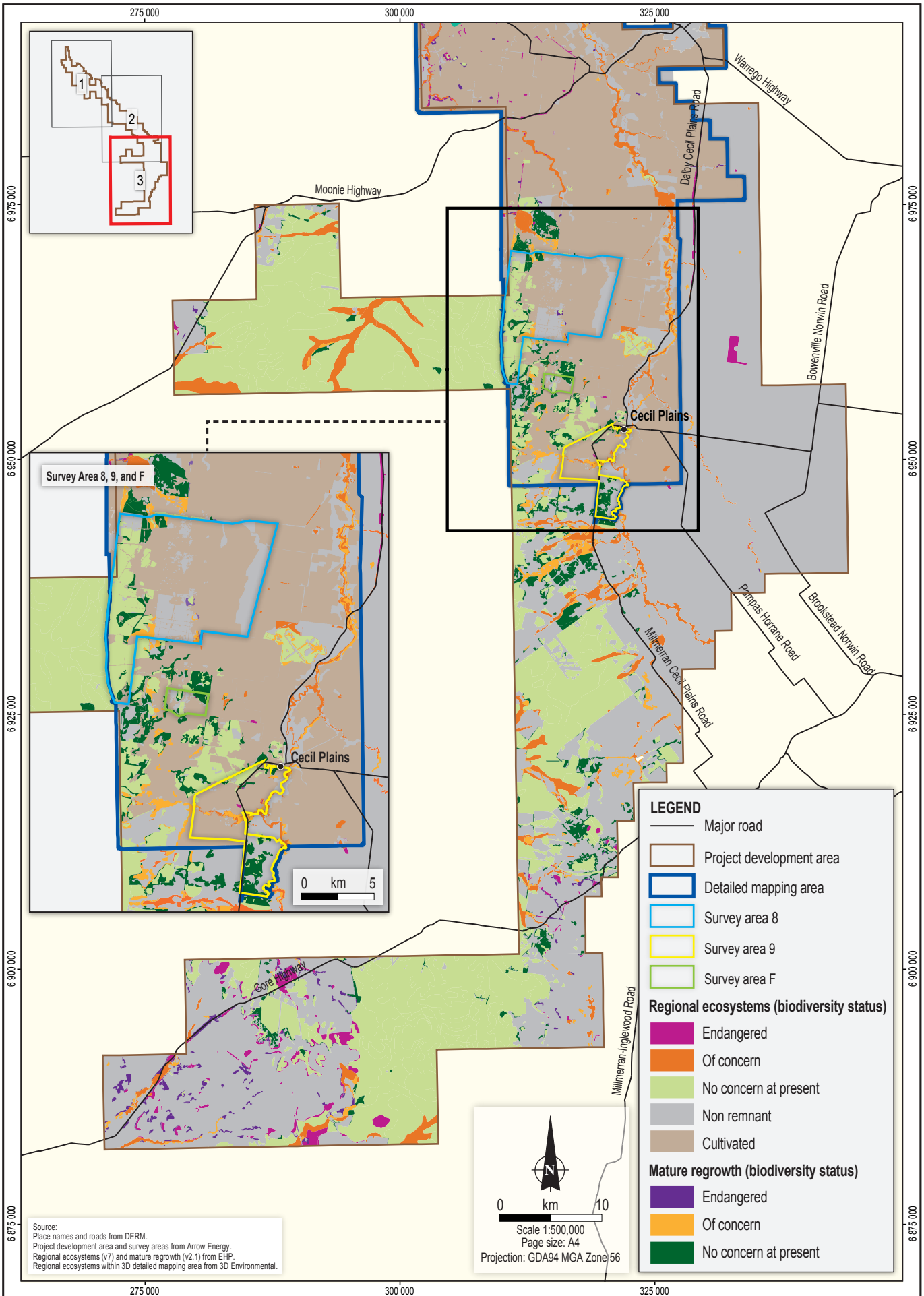
§ *Eucalyptus pilligaensis* has been subsumed within the broader reclassification of *Eucalyptus woollsiana.*



coffey environments	Date: 19.06.2013 MXD: 7040AE_12_GIS068_v1_2 File Name: 7040_12_F11.03a_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: 11.3a



coffey environments	Date: 19.06.2013 MXD: 7040AE_12_GIS069_v1_2 File Name: 7040_12_F11.03b_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: 11.3b



coffey environments	Date: 19.06.2013 MXD: 7040AE_12_GIS070_v1_2 File Name: 7040_12_F11.03c_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: 11.3c

Environmentally Sensitive Areas

Two ESAs (identified by tenure), Bendidee National Park (category A ESA) and Bendidee State Forest (category C ESA) are now located outside the project development area due to the relinquishment of Arrow tenements. The relinquishment of tenements on the eastern and southern boundary of the project development area has significantly reduced the presence of category B ESAs.

The following ESAs are affected by the update to RE mapping in accordance with the EP Act:

- Category B ESAs – REs scheduled as 'endangered' (biodiversity status).
- Category C ESAs – REs scheduled as 'of concern' (biodiversity status).

Two category A ESAs (Wondul Range National Park and Lake Broadwater Conservation Park) remain as described in the EIS.

The revised mapping presents the updated distribution of ESAs based on biodiversity status (see Figures 11.3a, 11.3b, and 11.3c). Table 11.7 shows the changes to the extent of category B and C ESAs.

Table 11.7 The extent of category B and category C ESAs in the project development area for the EIS and SREIS based on RE biodiversity status

ESA	Extent in the Project Development Area (ha)	
	EIS*	SREIS**
Category B ESAs	17,153.7	9,345
Category C ESAs	30,467.5	26,337.7

* Calculations used the DERM v6.0 dataset (DERM, 2009c) + detailed mapping area overlaying the area (EIS mapping).

** Calculations use the EHP V7.0 dataset (EHP, 2012d) + regrowth dataset (EHP, 2012a) + detailed mapping area over laying the area (SREIS mapping).

Essential Habitat

Essential habitat for NC Act listed species (regulated under the VM Act) was captured in the mapping for 'core habitat known'. The revised Mature Regrowth digital data has not changed the extent of essential habitat presented in the EIS for category C ESAs.

11.4.4 Flora Assessment

The EIS identified 38 state and nationally listed species as either known or likely to occur within the project development area. An oversight in preparing Table 17.5 of the EIS meant that *Dichanthium queenslandicum* (king blue grass) ('vulnerable' under the EPBC Act and NC Act) and *Cadellia pentastylis* (ooline) (from vulnerable under the NC Act) were excluded (however were considered in the assessment in Appendix K of the EIS).

The preliminary desktop study for flora species identified additional species that required assessment and those that should be discounted from the assessment on the basis that they were unlikely to occur in the project development area. Information supporting the discounting of species is presented in Appendix 9, Supplementary Terrestrial Ecology Assessment, Table 8.

The SREIS desktop review identified an additional four flora conservation listed species not considered in the EIS studies, namely Tara wattle (*Acacia lauta*), shiny-leaved ironbark (*Eucalyptus virens*), Queensland white gum (*Eucalyptus argophloia*) and *Cymbonotus maidenii*. The former three species are all listed as 'vulnerable' under the EPBC Act and NC Act and

Cymbonotus maidenii is listed as 'endangered' under the NC Act. Shiny-leaved ironbark (*Eucalyptus virens*) was assessed as having a sensitivity of high while the other three species were assessed as moderate sensitivity. Moderate and low residual impacts to the species are expected in the project development area to all four species following implementation of relevant mitigation and management measures.

The sensitivity and likelihood of occurrence of species presented in the EIS was also reviewed. The sensitivity of two species was upgraded and six species were downgraded. The four species not considered for the EIS assessment were also assessed. The updated assessment is presented in Table 11.8.

Table 11.8 Updated sensitivity assessment and likelihood of occurrence for national- and state-listed flora species

Nationally Threatened Flora Species	Status	Occurrence within Project Development Area from EIS	Sensitivity of Terrestrial Ecologyl Value from EIS	Revised Assessment in SREIS
Digitaria porrecta (finger panic grass)	EPBC Act – Endangered; NC Act -Near Threatened	Known to occur	Moderate	Sensitivity assessed as **High**
Acacia curranii (curly bark wattle)	EPBC Act- Vulnerable; NC Act- Vulnerable	Known to occur	High	Sensitivity assessed as **Moderate**
Denhamia parviflora (small leaved denhamia)	EPBC Act- Vulnerable; NC Act- Vulnerable	Known to occur	High	Sensitivity assessed as **Extremely High**
Philotheca sporadica (Kogan waxflower)	EPBC Act- Vulnerable; NC Act- Vulnerable	Known to occur	High	Sensitivity assessed as **Moderate**
Picris evae (hawkweed)	EPBC Act- Vulnerable; NC Act- Vulnerable	Likely to occur	High	Sensitivity assessed as **Moderate**
Acacia handonis (Hando's wattle)	EPBC Act- Vulnerable; NC Act- Vulnerable	Possibly occurring	High	Sensitivity assessed as **Moderate**
Acacia wardellii (Wardell's wattle)	EPBC Act- Vulnerable; NC Act- Vulnerable	Possibly occurring	High	Sensitivity assessed as **Moderate**
Cadelia pentastylis (ooline)	EPBC Act- Vulnerable; NC Act- Vulnerable	Possibly occurring	High	Sensitivity assessed as **Extremely High**
Rhaponticum australe (Austral cornflower)	EPBC Act- Vulnerable; NC Act- Vulnerable	Possibly occurring	High	Sensitivity assessed as **Moderate**
Eucalyptus virens (shiny-leaved ironbark)	EPBC Act- Vulnerable; NC Act - Vulnerable	Unlikely to occur	Not assessed	Assessed as **Possibly** occurring; Sensitivity assessed as **High**

Table 11.8 Updated sensitivity assessment and likelihood of occurrence for national- and state-listed flora species (cont'd)

Nationally Threatened Flora Species	Status	Occurrence within Project Development Area from EIS	Sensitivity of Terrestrial Ecology Value from EIS	Revised Assessment in SREIS
Eucalyptus argophloia (Queensland white gum)	EPBC Act-Vulnerable; NC Act - Vulnerable	Unlikely to occur	Not assessed	Assessed as **Possibly** occurring; Sensitivity assessed as **Moderate**
Acacia lauta (Tara wattle)	EPBC Act-Vulnerable; NC Act - Vulnerable	Unlikely to occur	Not assessed	Assessed as **Possibly** occurring; Sensitivity assessed as **Moderate**
Cymbonotus maidenii	EBPC Act – Not Listed NC Act - Endangered	Not assessed	Not assessed	Assessed as **Known** to Occur; Sensitivity assessed as **Moderate**

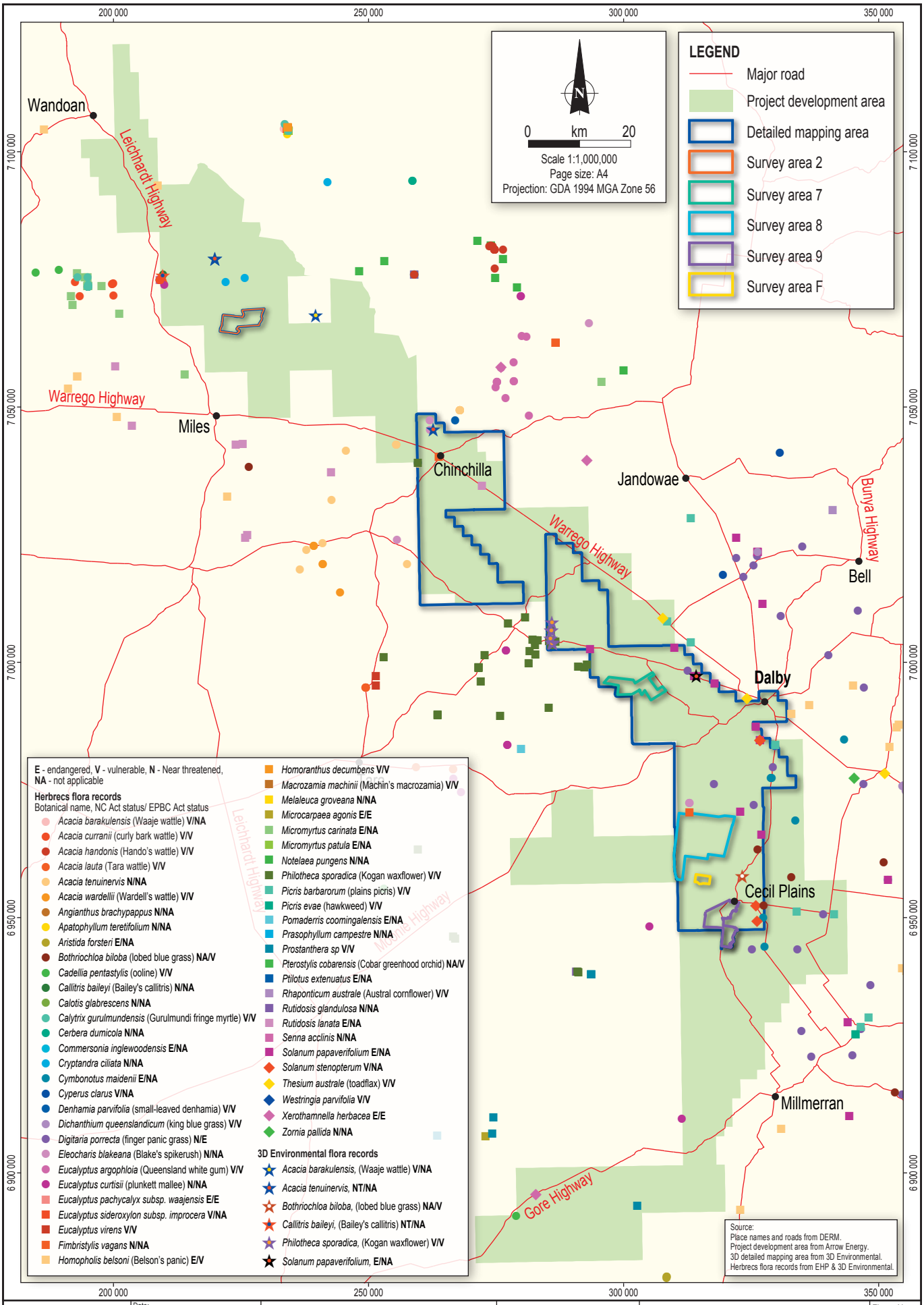
Surveys undertaken for the EIS verified the presence of six species listed under the NC Act and two EPBC Act listed species. Surveys undertaken for the SREIS did not identify the presence of any EVNT species although suitable habitat was found to be present and was recorded as 'core habitat possible'. The findings of the desktop studies informed the assessment of presence of new species records. The revised flora species records to within 25 km of the project development area are shown on Figure 11.4.

Revised mapping of areas of 'core habitat known', 'core habitat possible', 'general habitat' and 'absence suspected' for EVNT flora species are presented in Figure 11.5. No 'least concern' flora species, including but not limited to bioregionally and culturally significant species were detected during field surveys.

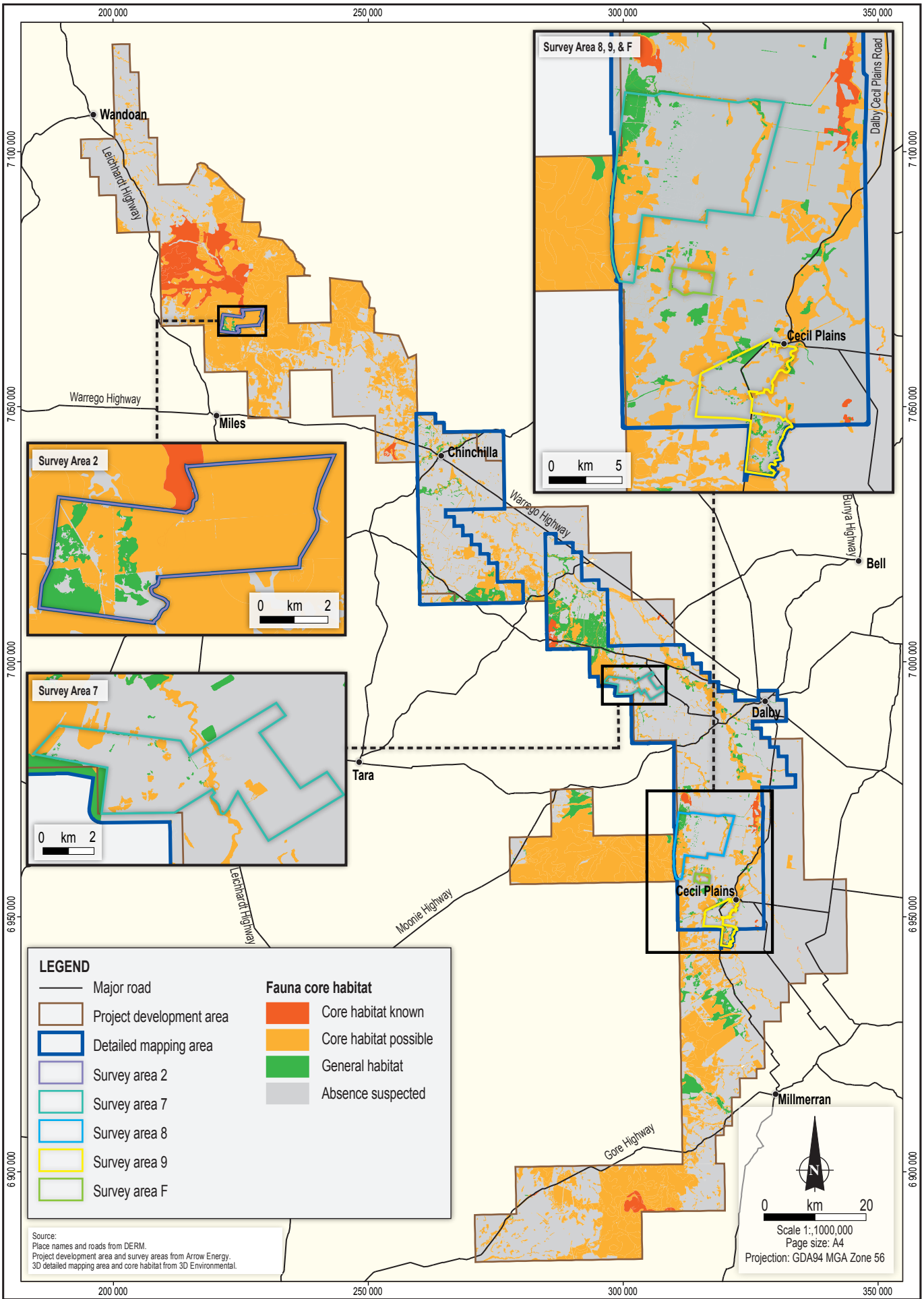
11.4.5 Fauna Assessment

The preliminary SREIS desktop study verified the exclusion of species from the EIS assessment on the basis that they were unlikely to occur in the project development area. Information supporting the discounting of species is presented in Appendix 9, Supplementary Terrestrial Ecology Assessment, Table 10.

Two species identified in the EIS were excluded from assessment in the SREIS and will not be impacted by project activities. The review of relevant fauna information suggests that the spotted-tail quoll (*Dasyurus maculatus maculatus*) is 'unlikely to occur 'in the project development area, a downgrade from 'possibly occurring' in the EIS. One special 'least concern' species, platypus (*Ornithorhynchus anatinus*) is 'unlikely to occur' based on the refined desktop searches. Assessed in the EIS as possibly occurring, this species has been downgraded as the review of databases shows the individual platypus record as occurring near Millmerran, outside of the project development area.



coffey environments	Date: 08.06.2013 MXD: 7040AE_12_GIS059_v1_2 File Name: 7040_12_F11.04_GIS_HB	Arrow Energy Surat Gas Project	arrow energy go further	Records of listed flora species in the project development area	Figure No: 11.4



coffey environments	Date: 08.06.2013 MXD: 7040AE_12_GIS066_v1_3 File Name: 7040_12_F11.05_GIS_VS	Arrow Energy Surat Gas Project	arrow energy go further	Core habitat for listed flora species in the project development area	Figure No: 11.5

The sensitivity and likelihood of occurrence of species presented in the EIS was reviewed and the sensitivity of three species was upgraded. The updated assessment is presented in Table 11.9.

Table 11.9 Updated sensitivity assessment and likelihood of occurrence for fauna species assessed in the EIS

Fauna Species	Status*	Occurrence within Project Development Area from EIS	Sensitivity of Terrestrial Ecology Value from EIS	Revised Assessment in SREIS
Hypochrysops picatus (bulloak jewel)	EPBC Act – N/A NC Act – Endangered	Known to occur	Extremely high	Downgraded to **possibly** occurring due to the relinquishment of tenement around Bendidee National Park and state forest.
Dasyurus m. maculatus (spotted-tail quoll)	EPBC Act - Endangered NC Act – Vulnerable	Possibly occurring	Moderate	Downgraded to **unlikely** to occur. The current presence of this species in the Brigalow Belt is uncertain, with the last record of this species in 1990. The Granite Belt and the Border Ranges are the only regions in Queensland where this subspecies is still recorded regularly. Probably locally extinct
Ornithorhynchus anatinus (platypus)	N/A	Possibly occurring	Not assessed	Downgraded to **unlikely** to occur due to refinement of WildNet searches. The revised representation of data shows the individual platypus record as occurring near Millmerran, outside of the project development area.
Tympanocryptis cf. tetraporophora (Darling Downs earless dragon*)	EPBC Act – Endangered; NC Act - Endangered	Known to occur	High	Sensitivity assessed as **Extremely High**.
Egernia rugosa (yakka skink)	EPBC Act- Vulnerable; NC Act- Vulnerable	Possibly occurring	Moderate	Sensitivity assessed as **High**.
Geophaps scripta scripta (squatter pigeon)	EPBC Act- Vulnerable; NC Act- Vulnerable	Possibly occurring	Moderate	Sensitivity assessed as **High** and upgraded to **known to occur** from updated database search results.

* Referred to in the EIS as the grassland earless dragon.

The significance of potential impacts on EVNT fauna species was revised to take account of the updated sensitivity of three species. Moderate residual impacts are expected in the project development area for all species assessed as highly sensitive following implementation of relevant mitigation and management measures. One species, the Darling Downs earless dragon (*Tympanocryptis cf. tetraporophora)*, assessed as being of extremely high sensitivity, requires additional management around areas of core habitat known to reduce impacts on this species.

Management of these species is detailed in Attachment 1, Matters of National Environmental Significance, Section 8.5 with residual impacts to extremely sensitive species discussed in Attachment 1, Matters of National Environmental Significance, Section 9.

Surveys undertaken for the EIS verified the presence of three species listed under the NC Act. No EPBC Act listed species were detected. Surveys undertaken for the SREIS verified the presence of four species listed under the NC Act and two species listed under the EPBC Act. Figure 11.6 presents the revised fauna species records to within a 25 km buffer of the project development area, inclusive of species records discounted from assessment. Special 'least concern' species, including but not limited to bioregionally and culturally significant species were detected during field surveys.

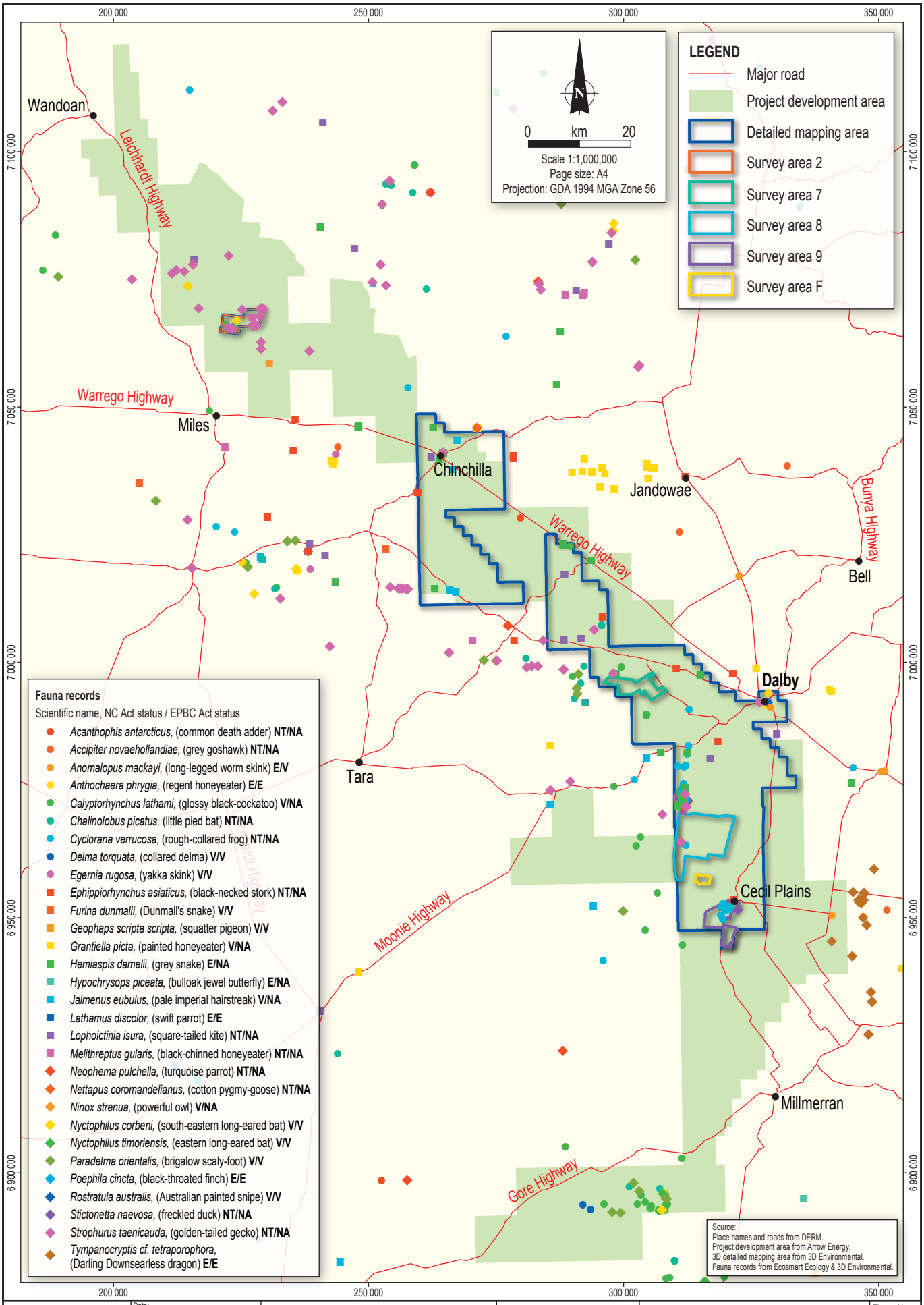
Areas mapped as of 'core habitat known', 'core habitat possible', 'general habitat' and 'absence suspected' for EVNT fauna species were revised (Figure 11.7). The revisions were based on the desktop assessment of habitat suitability, relinquished tenements, refined mapping and field survey results. Areas of 'core habitat known' were significantly reduced due to the relinquishment of Bendidee National Park and Bendidee State Forest.

11.4.6 Bioregional Corridors

The Biodiversity Planning Assessment (DERM, 2008) for the Brigalow Belt bioregion shows state significant corridor vegetation is scattered throughout the project development area. Larger corridors within the project development are noted as follows:

- A broad east-west trending corridor passing through Barakula and Gurulmundi state forests to the north of Chinchilla. This corridor extends in a limited way into survey area 2 along the northern boundary of the property.
- Riparian vegetation along the Condamine River, which extends in a south-east orientation through the central portion of the project development area provides an extensive continuous corridor. This corridor passes through survey area 9 in the southern portion of the project development area.
- A major bioregional corridor crosses the southern part of the project development area trending in a north-south direction. The majority of this corridor is outside the project development area but is connected to Bringalilly State Forest and Wondul Range National Park.

Corridors provide a vital ecological role in fragmented landscapes and areas of habitat for EVNT species. The impact of corridor loss will depend on the existing value and function of the corridor, the types of species affected (i.e., community composition), and the habitat structure of modified areas. The susceptibility of individual EVNT species to fragmentation of vegetation contained in corridors is presented in Table 11.10. The evaluation provided relates to the ability of a fauna species to move across open ground (i.e., between populations or habitat patches) and does not reflect the species sensitivity to loss of habitat. Bioregional corridors of significance within the project development area are shown on Figure 11.8.



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File Name: 7040_12_F11.06_GIS_HB

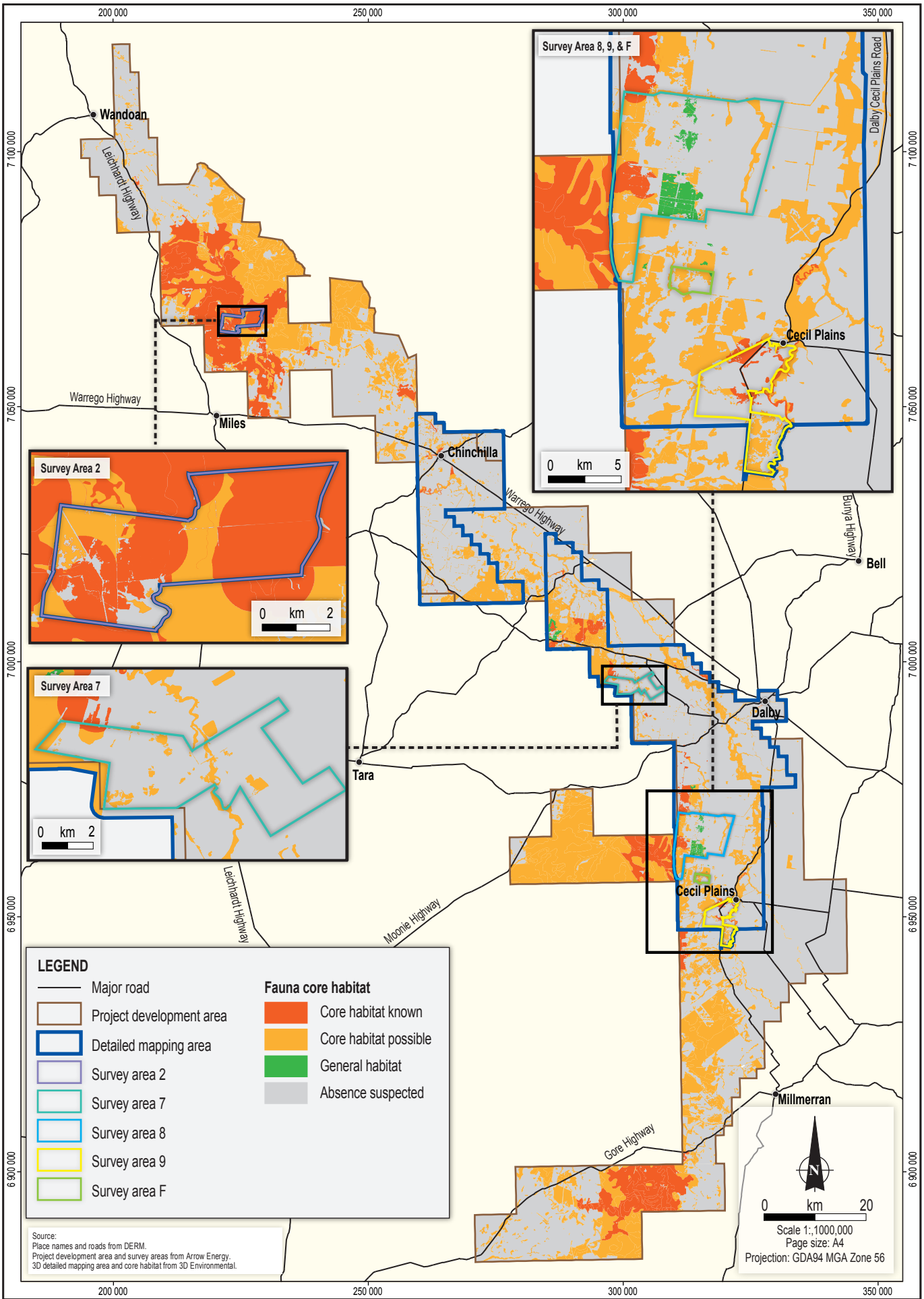
Arrow Energy

Surat Gas Project

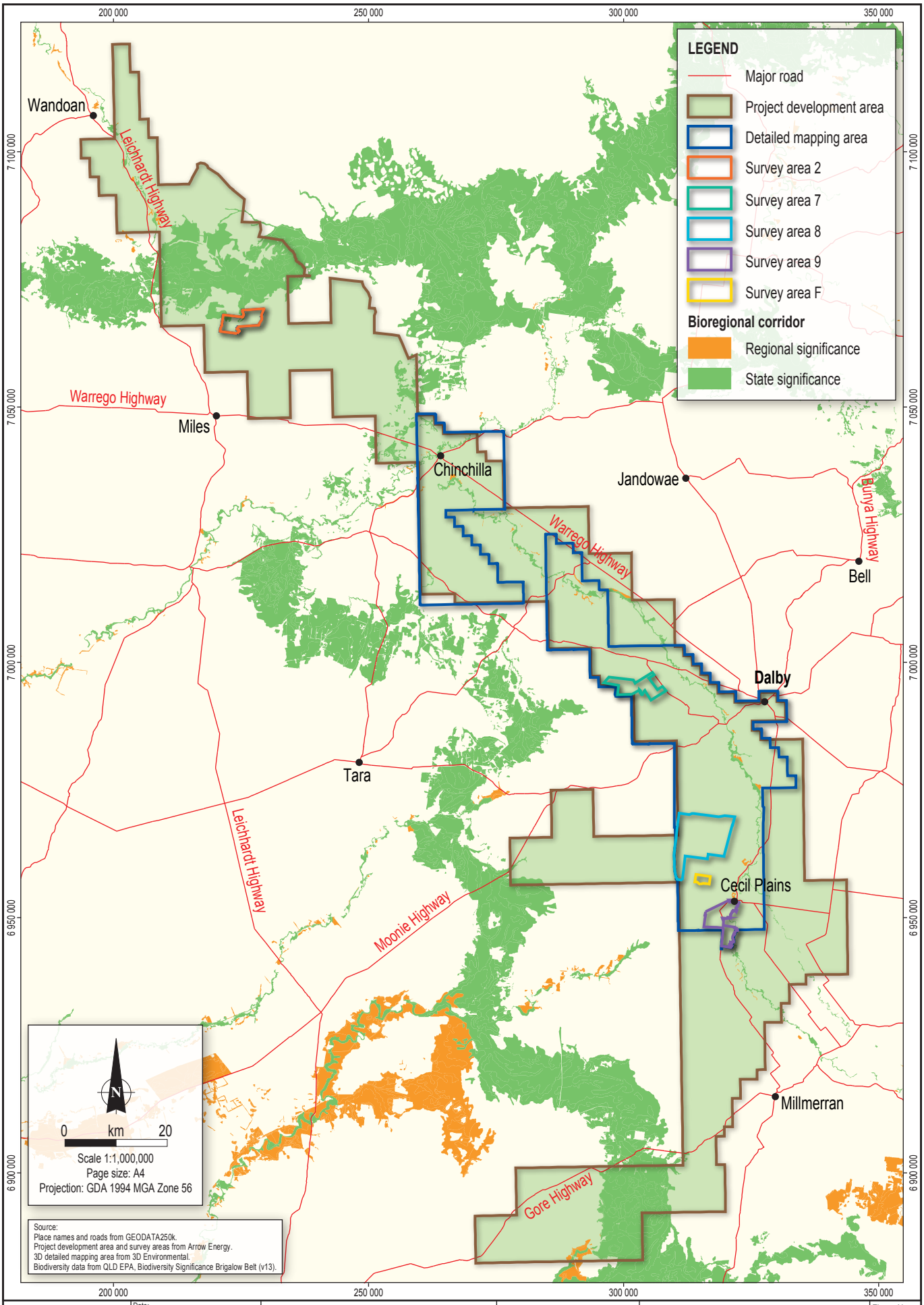
arrow energy go further

Records of listed fauna species in the project development area

Figure No: 11.6



coffey environments	Date: 08.06.2013 MXD: 7040AE_12_GIS067_v1_3 File Name: 7040_12_F11.07_GIS_VS	Arrow Energy Surat Gas Project	arrow energy go further	Core habitat for listed fauna species in the project development area	Figure No: 11.7



coffey environments	Date: 08.06.2013 MXD: 7040AE_12_GIS061_v1_2 File Name: 7040_12_F11.08_GIS_HB	Arrow Energy Surat Gas Project	arrow energy go further	Bioregional corridors in the project development area and landscape context	Figure No: 11.8

Table 11.10 EVNT fauna species highly susceptible to vegetation fragmentation

Group	Species	EPBC Act Status	NC Act Status	Susceptibility to fragmentation	Sensitivity
Reptiles	*Delma torquata* (collared delma)	V	V	Very high	Extremely high
	Anomalopus mackayi (five-clawed worm-skink)	V	E	Very high	Extremely high
	Eernia rugosa (yakka skink)	V	V	High	Extremely high
	Tympanocryptis cf. tetraporophora (Darling Downs earless dragon)	E	E	High	Extremely high
	Acanthopis antarcticus (common death adder)	_	NT	High	Moderate
Mammals	*Nyctophilus corbeni* (south-eastern long-eared bat)	V	V	High	Moderate

11.4.7 Referable Wetlands

Three types of wetlands as classified by the Queensland Wetlands Program– riverine, lacustrine and palustrine – contribute to habitat diversity in the project development area. The location and extent of these wetlands within the project development area is discussed in EIS Chapter 15, Section 15.3.7.

Palustrine wetlands have been identified in the project development area, particularly associated with the Condamine River floodplain. These wetlands are in addition to Lake Broadwater which is a lacustrine Wetland of National Significance.

Wetlands are incorporated under two datasets – wetland protection areas of high ecological significance within catchments of the Great Barrier Reef, and wetland management areas (which are wetlands of general or high ecological significance located outside the Great Barrier Reef catchment area).

There are no wetland protection areas within the project development area. Information on the extent and location of wetland management areas within the project development area is presented in Appendix 9, Supplementary Terrestrial Ecology Assessment, Section 5.5 and Table 13.

11.4.8 Groundwater Dependent Ecosystems

The EIS concluded that no groundwater dependant ecosystems were known to occur in the project development area. Since the EIS was finalised, additional information on groundwater interactions with vegetation communities has become available (Chapter 8, Groundwater and Attachment 1, Matters of National Environmental Significance, Section 5.1).

The additional information on groundwater dependent ecosystems has allowed a greater understanding of potential source aquifers and the ecological communities they support. The information indicates that certain types of groundwater dependent ecosystems have the potential to occur within the project development area:

- Springs, spring wetlands and spring-fed watercourses.

- Groundwater discharge to rivers and wetlands.
- Ecosystems dependent on the subsurface presence of groundwater via plant roots accessing shallow groundwater.

The Underground Water Impact Report (UWIR) prepared for the Surat Cumulative Management Area (CMA) (OGIA, 2012) identifies springs with the potential to be impacted, and assigns a responsible tenure holder to each potentially impacted spring. A spring is considered to be potentially affected by the exercise of underground water rights if it overlies an aquifer of the Great Artesian Basin where the long-term predicted drawdown at the location of the spring exceeds 0.2 m. Where a tenure holder is identified as responsible for a spring, they must prepare a spring impact management strategy specific to the spring and in accordance with the requirements set out in the Surat CMA UWIR.

Appendix 4, Supplementary Groundwater Assessment outlines the requirements of the Surat CMA UWIR and the spring impact management strategy to be developed by responsible tenure holders. The strategy should include:

- Identification of potentially affected springs.
- Assessment of the connectivity to underlying aquifers and the risks to the springs.
- A spring monitoring program.
- A spring impact mitigation strategy.

No potentially impacted springs have been identified within the project development area. Arrow is not the designated responsible tenure holder for any potentially impacted springs outside the project development area.

Arrow will undertake periodic reporting and will review of its obligations under the Surat UWIR should the groundwater level and quality data collected as part of the Arrow Spring Impact Management Strategy show significant changes in spring function or associated source aquifer groundwater levels that could potentially impact vegetation communities and associated species. These requirements will determine the actions to be taken in the event that a previously unidentified groundwater dependent ecosystem is identified. Arrow is also involved in the preparation of a Joint Industry Plan for an Early Warning System for the Monitoring and Protection of EPBC Springs with other coal seam gas proponents operating within the Surat CMA.

Commitments for the management of groundwater dependent ecosystems are presented in Chapter 8, Groundwater.

11.4.9 Targeted Ecological Assessments

The survey findings for the five survey areas are summarised below including updates to the terrestrial ecology values of each area based on the targeted ecological assessments carried out. Further details are included in Appendix 9, Supplementary Terrestrial Ecology Assessment, Section 5.6 and 6.1.

The verification of regional ecosystems and detection of species informs the identification of areas of ‘core habitat known’. If structural elements of habitat exist but the species was not found, then ‘core habitat possible’ remains.

Survey Area 2

Survey area 2 occurs within drainage area 2 and is located northeast of Miles (see Figure 11.1). The survey area has an area of 2,416 ha of which about half is remnant vegetation. The area has

been logged in the past and has few large trees and some habitat fragmentation. Regrowth vegetation is currently not mapped as 'advanced regrowth', and is not protected under legislation.

Based on the survey results, remnant vegetation is relatively intact and regrowth habitat contains minimal weed intrusions. In their current condition, remnant and regrowth areas are known or likely to be inhabited by a number of sensitive taxa.

Terrestrial ecology values of moderate to high sensitivity (known or potentially present) in survey area 2 are presented in Table 11.11.

Table 11.11 Summary of moderate to highly sensitive terrestrial ecology values in survey area 2

	Sensitivity	Occurrence	Core Habitat Known (ha)	Core Habitat Possible (ha)
EPBC Act Listed Community				
None likely to be present on site				
RE (Biodiversity Status)				
11.3.4 ('of concern')	Moderate	Confirmed	Yes	-
11.3.25 ('of concern')	Moderate	Confirmed	Yes	-
Conservation Listed Flora Species (EPBC Act Status, NC Act Status)				
Bothriochloa biloba (Lobed blue grass) (V, -)	Moderate	Possible	No	Yes
Peterostylis cobarensis (Cobar greenhood orchid) (V, -)	High	Possible	No	Yes
Callitris baileyi (Bailey's callitris) (-, NT)	High	Possible	No	Yes
Conservation Listed Fauna Species (EPBC Act Status, NC Act Status)				
Strophurus taenicauda (golden-tailed gecko) (-, NT)	Moderate	Confirmed	Yes	Yes
Paradelma orientalis (brigalow scaly-foot) (V, V)	Moderate	Confirmed	Yes	Yes
Calyptorhynchus lathami (glossy black-cockatoo)* (-, NT)	Moderate	Confirmed	Yes	Yes
Melithreptus gularis (black-chinned honeyeater) # (-, NT)	Moderate	Confirmed	Yes	Yes
*Nyctophilus corbeni** (south-eastern long-eared bat) (V, LC)	Moderate	Confirmed	Yes	Yes
Chalinolobus picatus (little pied bat) # (-, NT)	Moderate	Confirmed	Yes	Yes
Geophaps scripta scripta (squatter pigeon) (V, V)	High	Possible	No	Yes
Furina dunmalli (Dunmall's snake) (V, V)	Moderate	Possible	No	Yes
Acanthophis antarcticus (death adder) (-, NT)	Moderate	Possible	No	Yes
Lophoictinia isura (square-tailed kite)# (-, NT)	Moderate	Possible	No	Yes

Table 11.11 Summary of moderate to highly sensitive terrestrial ecology values in survey area 2 (cont'd)

	Sensitivity	Occurrence	Core Habitat Known (ha)	Core Habitat Possible (ha)
EPBC Act Listed Migratory Species				
Ardea modesta (eastern great egret)	N/A[§]	Confirmed	Listed migratory species have been assessed as being widespread throughout the project development area in suitable habitat – these species are wide ranging and associated with many different habitats. No important populations of listed migratory species were identified and no core habitat was assessed.	
Haliaeetus leucogaster (white-bellied sea-eagle)	N/A[§]	Confirmed		
Hirundapus caudacutus (white-throated needletail)	N/A[§]	Confirmed		
Merops ornatus. (rainbow bee-eater)	N/A[§]	Confirmed		
Culturally Significant Species				
Tachyglossus aculeatus (short-beaked echidna)	N/A[§]	Possible	Not assessed**	
Phascolarctos cinereus (koala)	N/A[§]	Possible		
Additional Back-on-Track Species				
No additional back-on-track species (other than conservation listed species above) were recorded				
Bioregionally Significant Species				
Limnodynastes salmini (salmon-striped frog)	N/A[§]	Confirmed	Not assessed **	
Intellagama lesueurii (eastern water dragon)	N/A[§]	Confirmed		
Burhinus grallarius (bush stone-curlew)	N/A[§]	Confirmed		
Pyrrholaemus sagittatus (speckled warbler)	N/A[§]	Confirmed		

* Back on Track species.

[#] Associated with riparian corridor.

[§] The significance assessment was not applied.

** Core habitat mapping was undertaken for species assessed under the significance assessment.

Confirmed = Species recorded in field surveys. Known = A species record exists in the survey area. Likely = A species record exists within close proximity to the survey area and suitable habitat is present. Possible = A record is not present within close proximity to the survey area however suitable habitat is present.

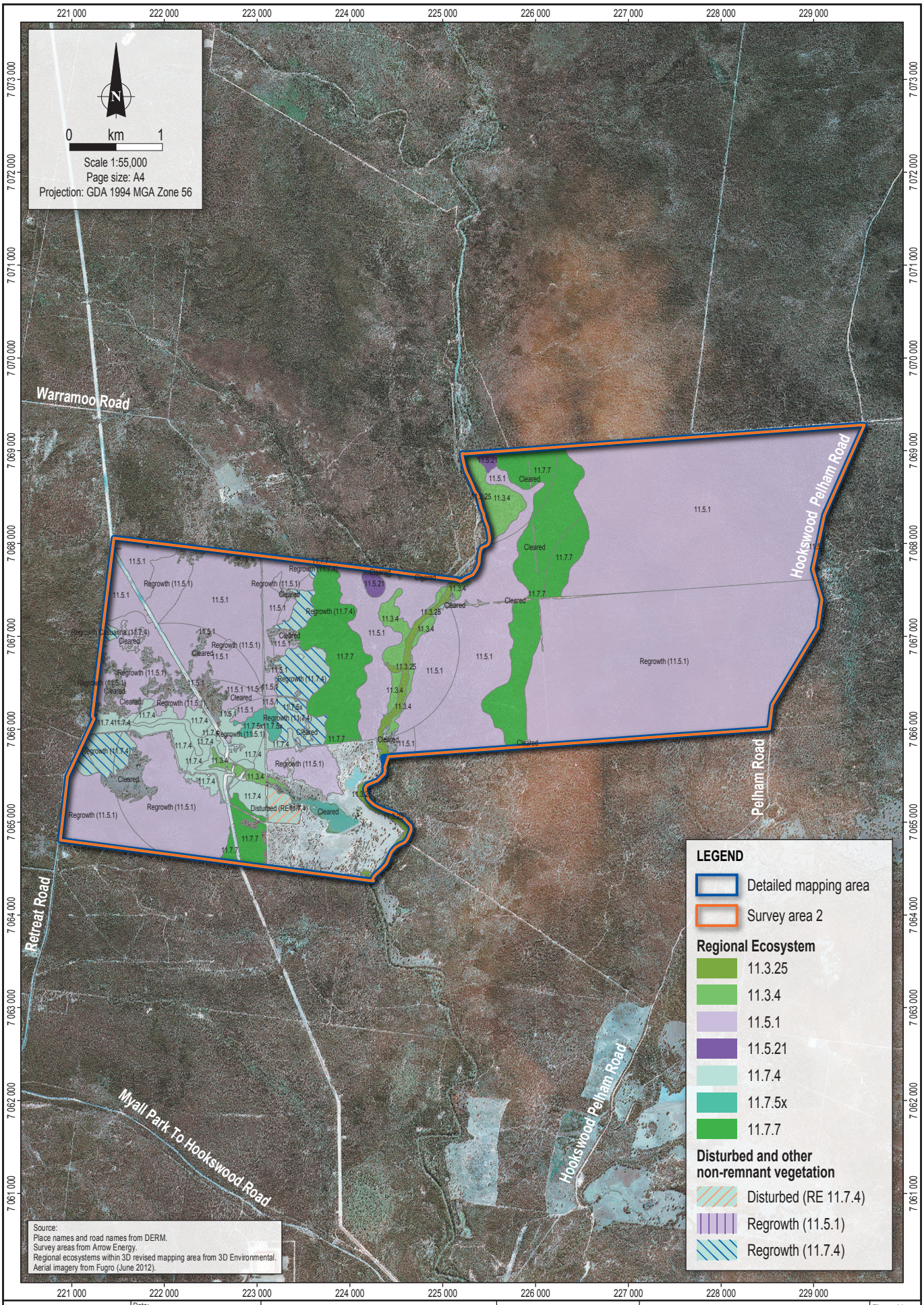
EPBC Act status: CE = Critically Endangered, E = Endangered, V = Vulnerable, - = Not Listed.

NC Act status: E = Endangered, V = Vulnerable, NT = Near Threatened, - = Not Listed.

No EPBC Act listed communities were identified during the targeted ecological surveys in survey area 2 and none are shown on EHP vegetation mapping.

Two REs of moderate sensitivity were confirmed to be present and represented as riparian vegetation along Bottle Tree Creek. These ecosystems are ‘of concern’ biodiversity status and recognised as category C ESAs. Other vegetated areas of survey area 2 contain REs of low sensitivity however some provide areas of ‘core habitat known’ and ‘core habitat possible’ (see below).

The EPBC Act listed ecological community and REs within survey area 9 are shown on Figure 11.9.



coffey environments	Date: 29.05.2013 MXD: 7040AE_12_GIS071_v1_1 File Name: 7040_12_F11.09_GIS_HB	Arrow Energy Surat Gas Project	arrow energy go further	Regional ecosystems within survey area 2	Figure No: 11.9

No EVNT flora species were identified in the survey area through the desktop studies and targeted surveys. The surveys included investigations for two highly sensitive species, *Callitris baileyi (*Bailey's callitris*)* and *Peterostylis cobarensis* (Cobar greenhood orchid). The survey period was outside the optimal sampling period for detection for *Peterostylis cobarensis* (Cobar greenhood orchid). 'Least concern' RE 11.5.1, widely distributed throughout the survey area may contain core habitat for both species. A third species, *Bothriochloa biloba* (lobed blue grass*),* considered moderately sensitive, may be present in grassland areas in association with RE 11.3.4., Habitat remains as 'core habitat possible' due to the potential isolated occurrence of these species and no 'core habitat known' has been identified in this survey area.

Two species (*Nyctophilus corbeni* (south-eastern long-eared bat) and *Paradelma orientalis* (brigalow scaly-foot)) listed under the EPBC Act and five species (*Strophurus taenicauda* (golden-tailed gecko), *Paradelma orientalis* (brigalow scaly-foot), *Calyptorhynchus lathami* (glossy black-cockatoo), *Melithreptus gularis* (black-chinned honeyeater), *Chalinolobus picatus* (little pied bat), listed under the NC Act (totalling six EVNT species) were identified as being present in survey area 2 as a result of the desktop studies and the targeted surveys. Plates 11.1, 11.2 and 11.3 show species caught by trapping methods. All species are considered moderately sensitive and were found to be present in remnant vegetation. Four species not detected in surveys are mapped with 'core habitat possible' as suitable habitat is present.

Four EPBC Act listed migratory species were observed within survey area 2. Two of these species were present around the large artificial farm dam in the area. This occurrence is likely to be the extent of their presence on survey area 2, which may vary from permanent residency to sporadic use for each species. The other two species were observed in cleared land and regrowth shrub which is typical of habitats for these species. This habitat is not an area of 'known core habitat' due to the broad range of habitats these species occupy.

Four bioregionally significant species and one 'Back on Track' species were identified as being present in survey area 2 as a result of the desk studies and the targeted surveys. Culturally significant species were not recorded although suitable habitat was identified for all species considered likely to occur.

Riparian vegetation along Bottle Tree Creek was mostly open grassy woodlands, although denser woodland habitats (RE 11.3.4) (Plate 11.4) extended to near the creek bank. The areas of open grassy woodlands with contiguous surrounding vegetation and limited weed intrusions are uncommon within the bioregion.

The limited abundance of hollows and dense grass along Bottle Tree Creek provide little value for birds (absence of hollows) and reptiles (limited basking opportunity in dense grass). The riparian vegetation is consistent with known habitat for three EVNT species (square-tailed kite (*Lophoictinia isura*)*, Chalinolobus picatus* (little pied bat), *Melithreptus gularis* (black-chinned honeyeater)) with two species recorded from immediately adjacent woodland habitats. While habitat is suitable for an additional three EVNT species, these species are uncommon, sporadic or vagrants in the region and are not considered likely.

Survey Area 9

Survey area 9 occurs within drainage area 9 and is located south of Cecil Plains (see Figure 11.1). The survey area has an area of 2,950 ha of which about three quarters is cleared vegetation.

Photo credit: Coffey

Plate 11.1
Strophurus taenicauda
(golden-tailed gecko)
in survey area 2

Photo credit: Coffey

Plate 11.2
Paradelma orientalis
(Brigalow scaly-foot)
in survey area 2

Photo credit: Coffey

Plate 11.3
Nyctophilus corbeni
(south-eastern long-eared bat)
in survey area 2

Photo credit: 3D Environmental

Plate 11.4
Bottle Tree Creek
in survey area 2

The Condamine River forms the eastern boundary of the property and riparian vegetation along the river forms part of a major north-south trending wildlife corridor which passes through the project development area. Away from the riparian corridor, areas of vegetation are highly fragmented, comprising isolated fragments of regrowth vegetation.

Terrestrial ecology values of moderate to high sensitivity (known or potentially present) in survey area 9 are presented in Table 11.12.

Table 11.12 Summary of moderate to highly sensitive terrestrial ecology values in survey area 9

	Sensitivity	Occurrence	Core Habitat Known (ha)	Core Habitat Possible (ha)
EPBC Act Listed Community				
Brigalow (*Acacia harpophylla* dominant and co-dominant) community (also mapped as RE 11.4.3 below)	High	Confirmed	Yes	-
RE (Biodiversity Status)				
11.3.4 ('of concern')	Moderate	Confirmed	Yes	-
11.3.25/11.3.25g ('of concern')	Moderate	Confirmed	Yes	-
11.3.17 ('endangered')	High	Confirmed	Yes	-
11.3.2 ('of concern')	Moderate	Confirmed	Yes	-
11.3.27c/11.3.27d ('of concern')	Moderate	Confirmed	Yes	-
11.4.3 ('endangered')	High	Confirmed	Yes	-
Conservation Listed Flora Species (EPBC Act Status, NC Act Status)				
Homopholis belsonii (Belson's panic) (V, V)	High	Possible	No	Yes
Solanum stenopterum (- , V)	High	Possible	No	Yes
Xerothamnella herbaceae (Xerothamnella) (V, V)	High	Possible	No	Yes
Thesium australe (austral toadflax) (V, V)	High	Possible	No	Yes
Rutidosis lanata (-, E)	High	Possible	No	Yes
Digitaria porrecta (finger panic grass) (E, NT)	High	Possible	No	Yes
Bothriochloa biloba (lobed blue grass) (V, NT)	Moderate	Possible	No	Yes
Peterostylis cobarensis (Cobar greenhood orchid) (V, -)	High	Possible	No	Yes
Eleocharis blakeana (Blake's spikerush) (-, NT)	Moderate	Possible	No	Yes
Fimbristylis vagans (-, NT)	Moderate	Possible	No	Yes
Cyclorana verrucosa (rough collared frog) [#] (-, NT)	Moderate	Confirmed	Yes	Yes
Hypochrysops piceata (bulloak jewel) (-, NT)	Extremely high	Possible	No	Yes
Melithreptus gularis (black-chinned honeyeater) [#] (-, NT)	Moderate	Possible	No	Yes

Table 11.12 Summary of moderate to highly sensitive terrestrial ecology values in survey area 9 (cont'd)

	Sensitivity	Occurrence	Core Habitat Known (ha)	Core Habitat Possible (ha)
Conservation Listed Flora Species (EPBC Act Status, NC Act Status) (cont'd)				
Calyptorhynchus lathami (glossy black-cockatoo)* (-, NT)	Moderate	Possible	No	Yes
Geophaps scripta scripta (squatter pigeon) # * (V, V)	High	Possible	No	Yes
Conservation Listed Fauna Species (EPBC Act Status, NC Act Status)				
Lophoictinia isura (square-tailed kite) # (-, NT)	Moderate	Possible	No	Yes
Chalinolobus picatus (little pied bat) # * (-, NT)	Moderate	Possible	No	Yes
Hemiaspis damelii (grey snake) # * (-, E)	Moderate	Possible	No	Yes
EPBC Act Listed Migratory Species				
Gallinago hardwickii (Latham's snipe)	N/A§	Confirmed	Listed migratory species have been assessed as being widespread throughout the project development area in suitable habitat – these species are wide ranging and associated with many different habitats. No important populations of listed migratory species were identified therefore no core habitat was assessed.	
Culturally Significant Species				
Tachyglossus aculeatus (short-beaked echidna)	N/A§	Possible	Not assessed**	
Phascolarctos cinereus (koala)	N/A§	Confirmed		
Additional Back-on-Track Species				
No additional back-on-track species (other than conservation listed species above) were recorded				
Bioregionally Significant Species				
Limnodynastes salmini (salmon-striped frog)	N/A§	Confirmed	Not assessed**	
Intellagama lesueurii (eastern water dragon)	N/A§	Confirmed		
Trichosurus vulpecular (common brushtail possum)	N/A§	Confirmed		
Pyrrholaemus sagittatus (speckled warbler)	N/A§	Confirmed		

* Back on Track species.

§ The significance assessment was not applied.

Associated with riparian corridor.

** Core habitat mapping was undertaken for species assessed under the significance assessment.

Confirmed = Species recorded in field surveys. Known = A species record exists in the survey area. Likely = A species record exists within close proximity to the survey area and suitable habitat is present. Possible = A record is not present within close proximity to the survey area however suitable habitat is present.

EPBC Act status: CE = Critically Endangered, E = Endangered, V = Vulnerable, - = Not Listed.

NC Act status: E = Endangered, V = Vulnerable, NT = Near Threatened, - = Not Listed.

Based on EHP desktop mapping, nationally threatened ecological communities listed under the EPBC Act were not expected to be found in survey area 9. The targeted ecological survey found one nationally threatened ecological community. Brigalow (*Acacia harpophylla dominant* and *co-dominant*) community was identified as occurring (RE 11.4.3) (Plate 11.5), in small patch (approximately 5 ha) adjacent to the Millmerran to Cecil Plains Road which bisects the survey area.

Four moderately sensitive 'of concern' REs were expected to be found based on EHP mapping, and field surveys confirmed these REs to be present. One additional highly sensitive RE ('endangered') was recorded during field surveys (Plates 11.6), and was not mapped in EHP mapping. Remnant vegetation is concentrated in the riparian corridor of the Condamine River. Outside of this corridor, derived grassland, advanced regrowth and recent regrowth was identified amongst extensive cleared areas for grazing.

The EPBC Act listed ecological community and REs within survey area 9 are shown on Figure 11.10.

No EVNT flora species were identified at survey area 9 through the desktop studies and targeted surveys for the SREIS. Ten flora species of moderate or high sensitivity (listed under the EPBC Act and/or the NC Act) were mapped as having core habitat possible on the basis of association with a particular RE or specific habitat features being present which are known to be favoured by the species. Areas of core habitat possible are predominantly associated with the eucalypt and acacia woodland of the riparian corridor along the Condamine River. No core habitat known for EVNT flora species has been identified in survey area 9.

One EVNT fauna species was identified during field surveys, the rough collared frog (*Cyclorana verrucos*a) (Plate 11.7). The species was recorded throughout areas of open grassy woodlands and in cleared land where water pooled, although was less abundant away from the alluvial areas.

An additional seven fauna species of moderate or high sensitivity (listed under the EPBC Act and/or the NC Act) were mapped as having core habitat possible at survey area 9 on the basis of association with a particular RE or specific habitat features being present which are known to be favoured by the species. The majority of the core habitat for EVNT fauna species is associated with the areas of remnant vegetation on the alluvial plain of the Condamine River.

The desktop studies and targeted surveys in survey area 9 did not identify any 'Back on Track' species additional to the four conservation listed fauna species also listed as 'Back on Track' species possibly present.

Four bioregionally significant species were confirmed as being present. One culturally significant species, the koala (*Phascolarctos cinereus*) was confirmed from field surveys as being present at survey area 9, with two present in an area of Queensland blue gum in the south of the property. This species may be present along the riparian corridor of the Condamine River. The short-beaked echidna (*Tachyglossus aculeatus*) is also likely to occur at survey area 9.

One EPBC Act listed migratory species was observed within survey area 9, Latham's snipe (*Gallinago hardwickii*). Habitat is unlikely to support an important population of any EPBC Act listed migratory species.

The Condamine River (Plate 11.8) is fringed by open grassy eucalyptus woodlands habitat (REs 11.3.4/11.3.25) with large vegetated areas present along abutting drainage lines.

Photo credit: 3D Environmental

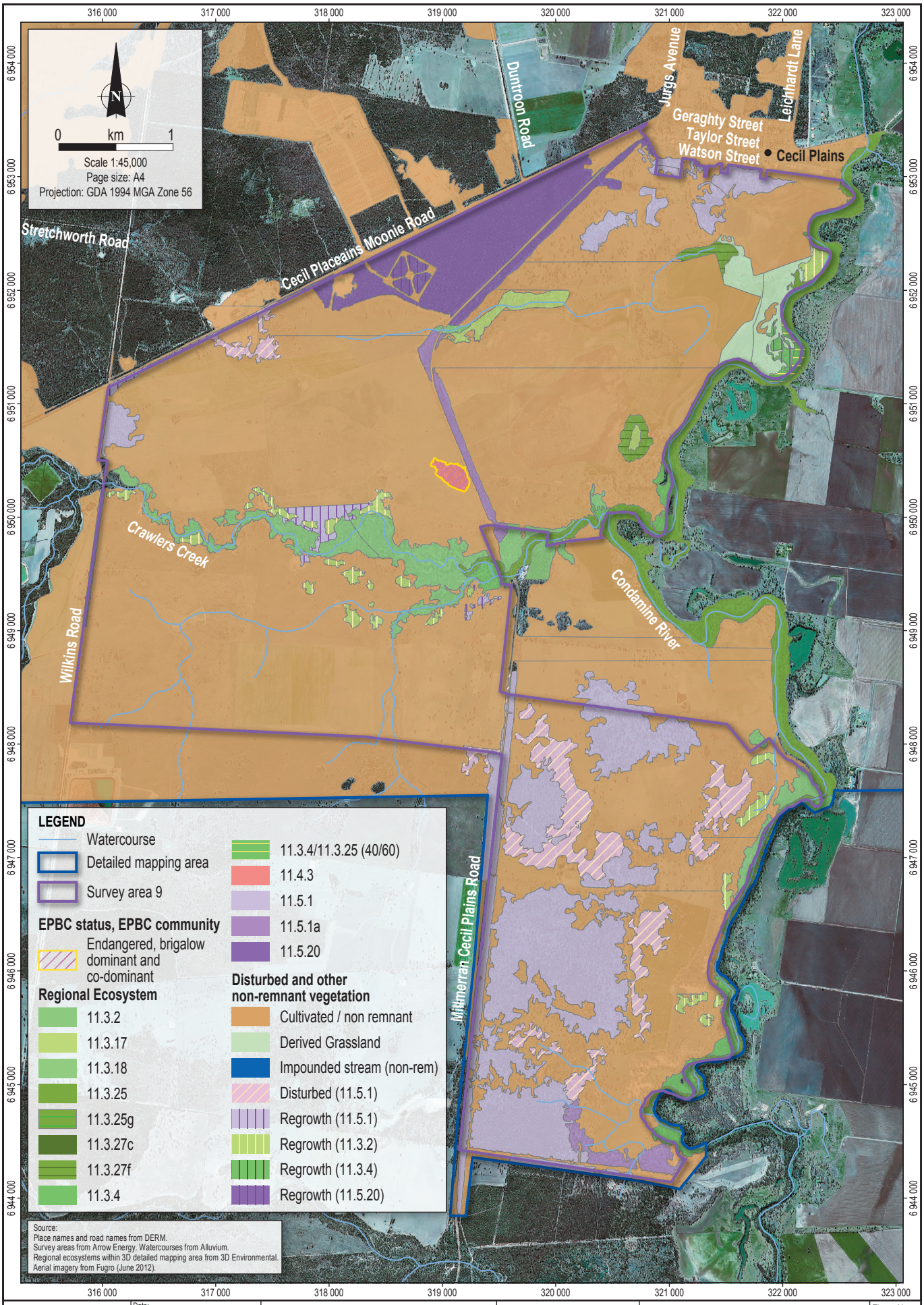
Plate 11.5

Brigalow (*Acacia harpophylla* dominant and co-dominant) (RE11.4.3, Biodiversity status of 'endangered')) in survey area 9

Photo credit: 3D Environmental

Plate 11.6

RE11.3.17 (Biodiversity status of 'endangered') in survey area 9



coffey environments	Date: 08.06.2013 MXD: 7040AE_12_GIS072_v1_3 File Name: 7040_12_F11.10_GIS_HB	Arrow Energy Surat Gas Project	arrow energy go further	EPBC communities and regional ecosystems in survey area 9	Figure No: 11.10

Photo credit: Coffey

Plate 11.7
Cyclorana verrucosa
(rough collared frog)
in survey area 9

Photo credit: Coffey

Plate 11.8
Condamine River
in survey area 9

Wetland habitats (RE 11.3.27) occur within the immediate river floodplain and provide riparian habitats for a number of wetland species. Dense weed infestations and areas of exotic grasses reduce the value of the habitat along some areas of the Condamine River.

The extent of the Condamine River and associated vegetation provides a near contiguous corridor with large trees forming an abundance of hollows for nesting species. The riparian vegetation provides potential habitat for six EVNT species although none were detected during the surveys. The riparian vegetation is highly sensitive due to the likely presence of EVNT species.

Survey Area 7

Survey area 7 occurs within drainage area 7 and is located east of Dalby (see Figure 11.1). The survey area has an area of 2,753 ha of which more than 90% is cleared of vegetation. The western boundary of the property adjoins Kumbarilla State Forest.

Vegetation is highly fragmented, with extensive clearing having been undertaken associated with prior agricultural activities. The riparian corridor of Wilkie Creek divides the property roughly into two halves with the floodplain forming a relatively wide expanse in the central portion of the property.

Terrestrial ecology values of moderate to high sensitivity (known or potentially present) in survey area 7 are presented in Table 11.13.

Table 11.13 Summary of moderate to highly sensitive terrestrial ecology values in survey area 7

	Sensitivity	Occurrence	Core Habitat Known (ha)	Core Habitat Possible (ha)
EPBC Act Listed Community				
Brigalow (>15 years regrowth not assigned an RE)	High	Confirmed	Yes	-
Coolibah –Black Box Woodlands	High	Confirmed	Yes[#]	-
Weeping Myall Woodlands	High	Confirmed	Yes	-
RE (Biodiversity Status)				
11.3.3 ('of concern')	Moderate	Confirmed	Yes	
11.3.4 ('of concern')	Moderate	Confirmed	Yes	-
11.3.25 ('of concern')	Moderate	Confirmed	Yes	-
11.3.27c ('of concern')	Moderate	Confirmed	Yes	-
Conservation Listed Flora Species (EPBC Act Status, NC Act Status)				
Acaia lauta (Tara wattle) (V,V)	Moderate	Possible	No	Yes
Bothriochloa biloba (lobed blue grass) (V, NT)	Moderate	Possible	No	Yes
Digitaria porrecta (finger panic grass) (E, NT)	High	Possible	No	Yes
Cyperus clarus (-, NT)	High	Possible	No	Yes
Eleocharis blakeana (Blake's spikerush) (-, NT)	Moderate	Possible	No	Yes
Eucalyptus virens (V,V)	High	Possible	No	Yes
Fimbristylis vagans (-, NT)	Moderate	Possible	No	Yes

Table 11.13 Summary of moderate to highly sensitive terrestrial ecology values in survey area 7 (cont'd)

	Sensitivity	Occurrence	Core Habitat Known (ha)	Core Habitat Possible (ha)
Conservation Listed Flora Species (EPBC Act Status, NC Act Status) (cont'd)				
Homopholis belsonii (Belson's panic) (V, V)	High	Possible	No	Yes
Xerothamnella herbaceae (Xerothamnella) (V, V)	High	Possible	No	Yes
Conservation Listed Fauna Species (EPBC Act Status, NC Act sStatus)				
Cyclorana verrucosa (rough collared frog) (-, NT)	Moderate	Likely	Yes	Yes
Hemiaspis damelii (grey snake) * (-, E)	Moderate	Likely	Yes	Yes
*Strophurus taenicauda (*golden-tailed gecko) * (-, NT)	Moderate	Likely	Yes	Yes
Paradelma orientalis (brigalow scaly-foot) * (V,V)	Moderate	Possible	No	Yes
Furina dunmalli (Dunmall's snake) * (V, V)	Moderate	Possible	No	Yes
Nyctophilus corbeni (south-eastern long-eared bat) * (V, LC)	Moderate	Possible	No	Yes
Chalinolobus picatus (little pied bat) * (-, NT)	Moderate	Possible	No	Yes
EPBC Act Listed Migratory Species				
Merops ornatus (rainbow bee-eater)	N/A[§]	Confirmed	Listed migratory species have been assessed as being widespread throughout the project development area in suitable habitat – these species are wide ranging and associated with many different habitats. No important populations of listed migratory species were identified therefore no core habitat was assessed.	
Culturally Significant Species				
Tachyglossus aculeatus (short-beaked echidna)	N/A[§]	Possible	Not assessed**	
Additional Back-on-Track Species				
No additional back-on-track species (other than conservation listed species above) were recorded				
Bioregionally Significant Species				
None recorded				

[#] Coolibah – Black Box Woodlands where patch size > 5 ha is portion of the extent of RE 11.3.3 due to minimum patch size requirements of the community.

* Back on Track species.

[§] The significance assessment was not applied.

** Core habitat mapping was undertaken for species assessed under the significance assessment.

Confirmed = Species recorded in field surveys. Known = A species record exists in the survey area. Likely = A species record exists within close proximity to the survey area and suitable habitat is present. Possible = A record is not present within close proximity to the survey area however suitable habitat is present.

EPBC Act status: CE = Critically Endangered, E = Endangered, V = Vulnerable, - = Not Listed.

NC Act status: E = Endangered, V = Vulnerable, NT = Near Threatened, - = Not Listed.

Three ecological communities listed under the EPBC Act were identified during the targeted ecological surveys, namely regrowth Brigalow (*Acacia harpophylla* dominant and co-dominant) (approximately 1 ha) (Plate 11.9), Weeping Myall Woodlands (approximately 1 ha) (Plate 11.10) and Coolibah –Black Box Woodlands (approximately 12 ha) (Plate 11.11).

Coolibah –Black Box Woodlands is restricted in comparison to RE 11.3.3 *(Eucalyptus coolabah* woodland on alluvial plains) due to areas of smaller-than-minimum community patch size requirement for this community. These fragmented patches of EPBC Act listed communities are present in an otherwise cleared landscape. The former two communities are present along the boundary of the property with Theten Road in the northwest, whilst the latter community is present to the east of Wilkie Creek.

One highly sensitive RE with 'endangered' status mapped by EHP mapping was not located during field surveys (RE 11.3.17). Three moderately sensitive REs with an 'of concern' status, not mapped by EHP were mapped during field surveys. Most remnant vegetation in survey area 7 is associated with a corridor along Wilkie Creek, or the margins of roads adjacent to the property.

The EPBC Act listed ecological communities and REs within survey area 7 are shown on Figure 11.11.

No EVNT flora species were identified in survey area 7. Nine flora species of moderate or high sensitivity (listed under the EPBC Act and/or the NC Act) were mapped as having core habitat possible on the basis of association with a particular RE or specific habitat features being present which are known to be favoured by the species. Areas of core habitat possible are predominantly associated with the remnant vegetation and regrowth brigalow habitat. No core habitat known for EVNT flora species has been identified in survey area 7.

No EVNT fauna species were identified in survey area 7. Three fauna species of moderate sensitivity (listed under the EPBC Act and/or the NC Act) were mapped as having core habitat known on the basis of previous records from the property or immediate adjacent area and the association with a particular RE or specific habitat features being present which are known to be favoured by the species. An additional four fauna species of moderate or high sensitivity (listed under the EPBC Act and/or the NC Act) were mapped as having core habitat possible in survey area 7.

The majority of the core habitat for EVNT fauna species is associated with the patchy areas of remnant vegetation in the west of survey area 7, as well as the vegetated corridor along Wilkie Creek and associated wetland areas on the floodplain.

Six 'Back on Track' species were identified as potentially being present. No bioregionally significant species were recorded and only one culturally significant species, the short-beaked echidna (*Tachyglossus aculeatus*) is likely to occur in this area.

One EPBC Act listed migratory species was observed within survey area 7, the rainbow bee-eater (*Merops ornatus*). The available habitat in the area is unlikely to support an important population of any EPBC Act listed migratory species.

Photo credit: 3D Environmental

Plate 11.9

Brigalow (*Acacia harpophylla* dominant and co-dominant) regrowth (>15 years) in survey area 7

Photo credit: Coffey

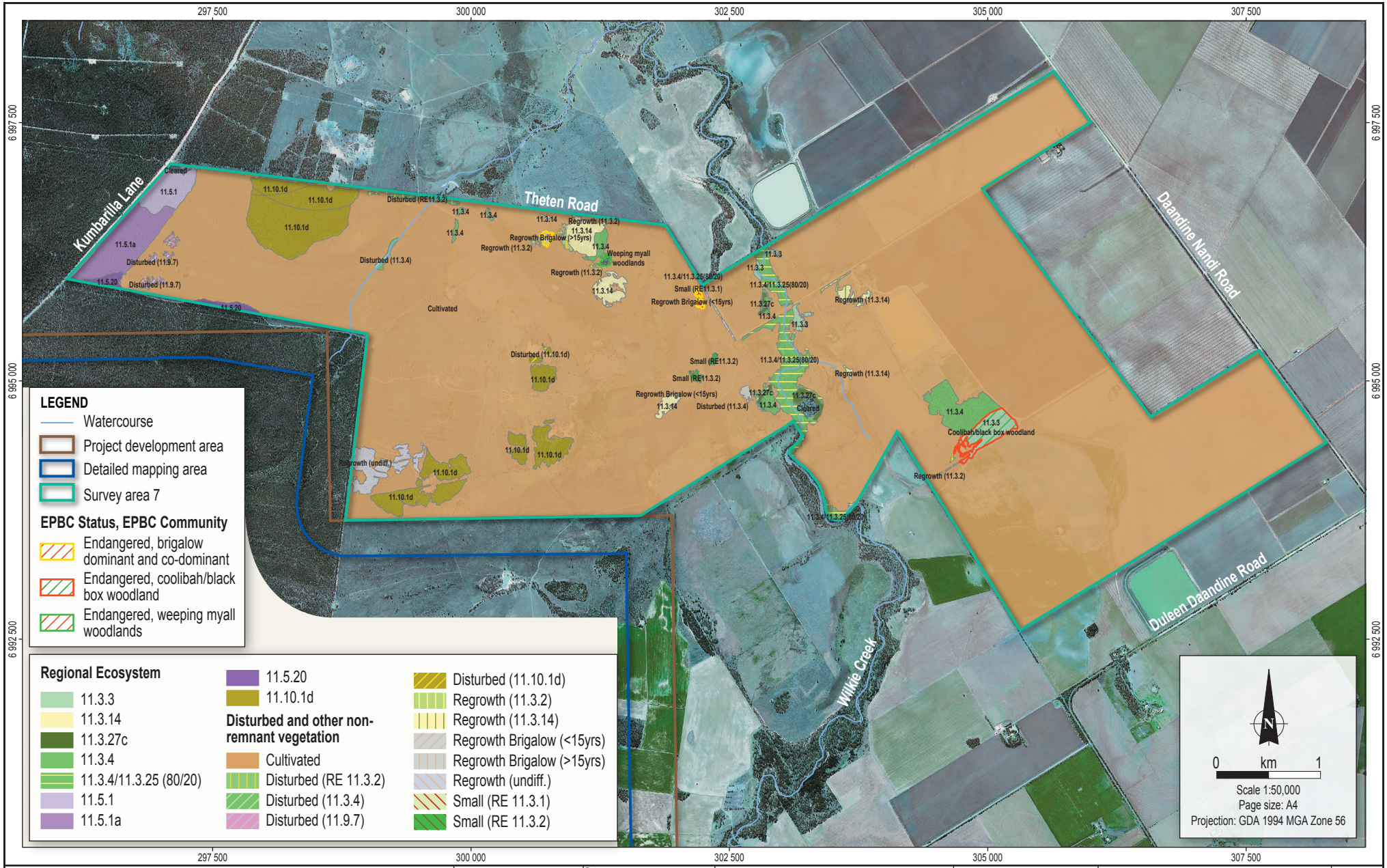
Plate 11.10

Weeping Myall Woodlands in survey area 7

Photo credit: 3D Environmental

Plate 11.11

Coolibah –Black Box Woodlands (RE11.3.3 (Biodiversity status of 'endangered')) in survey area 7



Source:
Place names and road names from DERM. Watercourses from Alluvium.
Project development area and survey areas from Arrow Energy.
Regional ecosystems within 3D detailed mapping area from 3D Environmental.
Aerial imagery from Fugro (June 2012).

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Date: 08.06.2013
MXD: 7040AE_12_GIS073_v1_3
File Name: 7040_12_F11.11_GIS_HB

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EPBC communities and regional ecosystems in survey area 7

Figure No: 11.11

Survey Area 8

Survey area 8 occurs within drainage area 8 and is located south of Lake Broadwater Conservation Park (see Figure 11.1). The western boundary of survey area 8 adjoins Kumbarilla State Forest, and Long Swamp enters the property on its northeastern boundary.

The survey area has an area of 9,222 ha of which more than 70% is cleared of vegetation. The majority of regrowth vegetation is currently not mapped as 'advanced regrowth', and is not protected under legislation, aside from a small patch of regrowth brigalow.

Vegetation in the area is highly fragmented as a result of historical agricultural activity in the east. In the west, vegetation is fragmented by clearings adjacent to the boundary with Kumbarilla State Forest.

Terrestrial ecology values of moderate to high sensitivity (known or potentially present) in survey area 8 are presented in Table 11.14.

Table 11.14 Summary of moderate to highly sensitive terrestrial ecology values in survey area 8

	Sensitivity	Occurrence	Core Habitat Known (ha)	Core Habitat Possible (ha)
EPBC Act Listed Community				
Brigalow (<15 years regrowth not assigned an RE)	High	Confirmed	Yes	-
RE (Biodiversity Status)				
11.3.4 ('of concern')	Moderate	Confirmed	Yes	-
Conservation Listed Flora Species (EPBC Act Status, NC Act Status)				
Acacia lauta (Tara wattle) (V,V)	Moderate	Possible	No	Yes
Bothriochloa biloba (lobed blue grass) (V, -)	Moderate	Possible	No	Yes
Peterostylis cobarensis (Cobar greenhood orchid) (V, -)	High	Possible	No	Yes
Philotheca sporadica (Kogan waxflower) (V,V)	Moderate	Possible	No	Yes
Eucalyptus curtisii (plunket mallee) (-, NT)	Moderate	Possible	No	Yes
Conservation Listed Fauna Species (EPBC Act status, NC Act status)				
Anomalopus mackayi (five-clawed worm-skink) * (*V, E)*	Extremely high	Possible	No	Yes
Cyclorana verrucosa (rough collared frog) (-, NT)	Moderate	Likely	Yes	Yes
Hemiaspis damelii (grey snake) * (-, E)	Moderate	Possible	No	Yes
Strophurus taenicauda (golden-tailed gecko) * (-, NT)	Moderate	Likely	Yes	Yes
Paradelma orientalis (brigalow scaly-foot) * (V,V)	Moderate	Possible	No	Yes
Furina dunmalli (Dunmall's snake) * (V, V)	Moderate	Possible	No	Yes

Table 11.14 Summary of moderate to highly sensitive terrestrial ecology values in survey area 8 (cont'd)

	Sensitivity	Occurrence	Core Habitat Known (ha)	Core Habitat Possible (ha)
Conservation Listed Fauna Species (EPBC Act Status, NC Act Status) (cont'd)				
Nyctophilus corbeni (south-eastern long-eared bat) * (V, LC)	Moderate	Possible	No	Yes
Chalinolobus picatus (little pied bat) *(-, NT)	Moderate	Possible	No	Yes
Lophoictinia isura (square-tailed kite) (-,NT)	Moderate	Likely (transient)	Yes	Yes
Calyptorhynchus lathami (glossy black-cockatoo)* (-, NT)	Moderate	Likely	Yes	Yes
Melithreptus gularis (black-chinned honeyeater) (-, NT)	Moderate	Possible	No	Yes
EPBC Act Listed Migratory Species				
Merops ornatus (rainbow bee-eater)	N/A*	Confirmed	Listed migratory species have been assessed as being widespread throughout the project development area in suitable habitat – these species are wide ranging and associated with many different habitats. No important populations of listed migratory species were identified therefore no core habitat was assessed.	
Culturally Significant Species				
Tachyglossus aculeatus (short-beaked echidna)	N/A*	Likely	Not assessed**	
Phascolarctos cinereus (koala)	N/A*	Known	Not assessed**	
Additional Back-on-Track Species				
No additional back-on-track species (other than conservation listed species above) were recorded				
Bioregionally Significant Species				
Pyrrholaemus sagittatus (speckled warbler)	N/A*	Confirmed	Not assessed**	

* Back on Track species.

§ The significance assessment was not applied.

** Core habitat mapping was undertaken for species assessed under the significance assessment.

Confirmed = Species recorded in field surveys. Known = A species record exists in the survey area. Likely = A species record exists within close proximity to the survey area and suitable habitat is present. Possible = A record is not present within close proximity to the survey area however suitable habitat is present.

EPBC Act status: CE = Critically Endangered, E = Endangered, V = Vulnerable, - = Not Listed.

NC Act status: E = Endangered, V = Vulnerable, NT = Near Threatened, - = Not Listed.

The Brigalow (*Acacia harpophylla* dominant and co-dominant) community (listed under the EPBC Act) was identified during the targeted ecological surveys and is comprised of a small patch of advanced regrowth brigalow of approximately 2 ha. The patch is not included in the EHP mapping.

One moderately sensitive RE was recorded in field surveys at survey area 8 (RE 11.3.4 'Of Concern'). One 'endangered' RE is mapped in EHP mapping, but was not recorded in field surveys. An additional three REs (one 'of concern' and two 'no concern at present') are mapped in EHP mapping, but were not located in field surveys.

Field surveys confirmed the presence of two REs recorded in the EHP mapping for survey area 8. One additional RE was recorded in field surveys that was not mapped in EHP mapping. These REs have a biodiversity status of 'No Concern at Present' and are of low sensitivity. Some areas provide core habitat possible for EVNT species.

Extensive areas of non remnant habitat and cleared areas are present in the east of survey area 8. An area of derived grassland associated with Long Swamp and the floodplain of the Condamine River is present in the northeast of the area (Plate 11.12). These open areas show extensive evidence of weed infestation.

The EPBC Act listed ecological community and REs within survey area 8 are shown on Figure 11.12.

No EVNT flora species were identified at survey area 8. Five flora species of moderate or high sensitivity (listed under the EPBC Act and/or the NC Act) were mapped as having core habitat possible on the basis of previous records from the property or immediate adjacent area and the association with a particular RE or specific habitat features being present which are known to be favoured by the species. Areas of core habitat possible are predominantly associated with the loamy flats and low sandstone rises along the western margins of survey area 8. No core habitat known for EVNT flora species has been identified in the area.

No EVNT fauna species were identified at survey area 8. Four fauna species of moderate or high sensitivity (listed under the EPBC Act and/or the NC Act) were mapped as having core habitat known at survey area 8 on the basis database records from the property or immediate adjacent area and association with a particular RE or specific habitat features being present which are known to be favoured by the species. An additional seven fauna species of moderate or high sensitivity (listed under the EPBC Act and/or the NC Act) were mapped as having core habitat possible.

The majority of the core habitat for EVNT fauna species is associated with the areas of remnant vegetation in the east of survey area 8.

Eight 'Back on Track' species were identified as potentially being present in survey area 8. One bioregionally significant species, speckled warbler (*Pyrrholaemus sagittatus*) was confirmed as being present. One culturally significant species, the koala (*Phascolarctos cinereus*) was recorded from desktop studies. The short-beaked echidna (*Tachyglossus aculeatus*) is likely to occur at survey area 8.

One EPBC Act listed migratory species was observed within survey area 8, rainbow bee-eater (*Merops ornatus*). The habitat in this area is unlikely to support an important population of any EPBC Act listed migratory species.

Survey Area F

Survey area F occurs within drainage area 7 and is located northwest of Cecil Plains (see Figure 11.1). The survey area is 441 ha of which more than 50% is cleared of vegetation. Regrowth vegetation at survey area F is currently not mapped as 'advanced regrowth', and is not protected under legislation.

Photo credit: Coffey

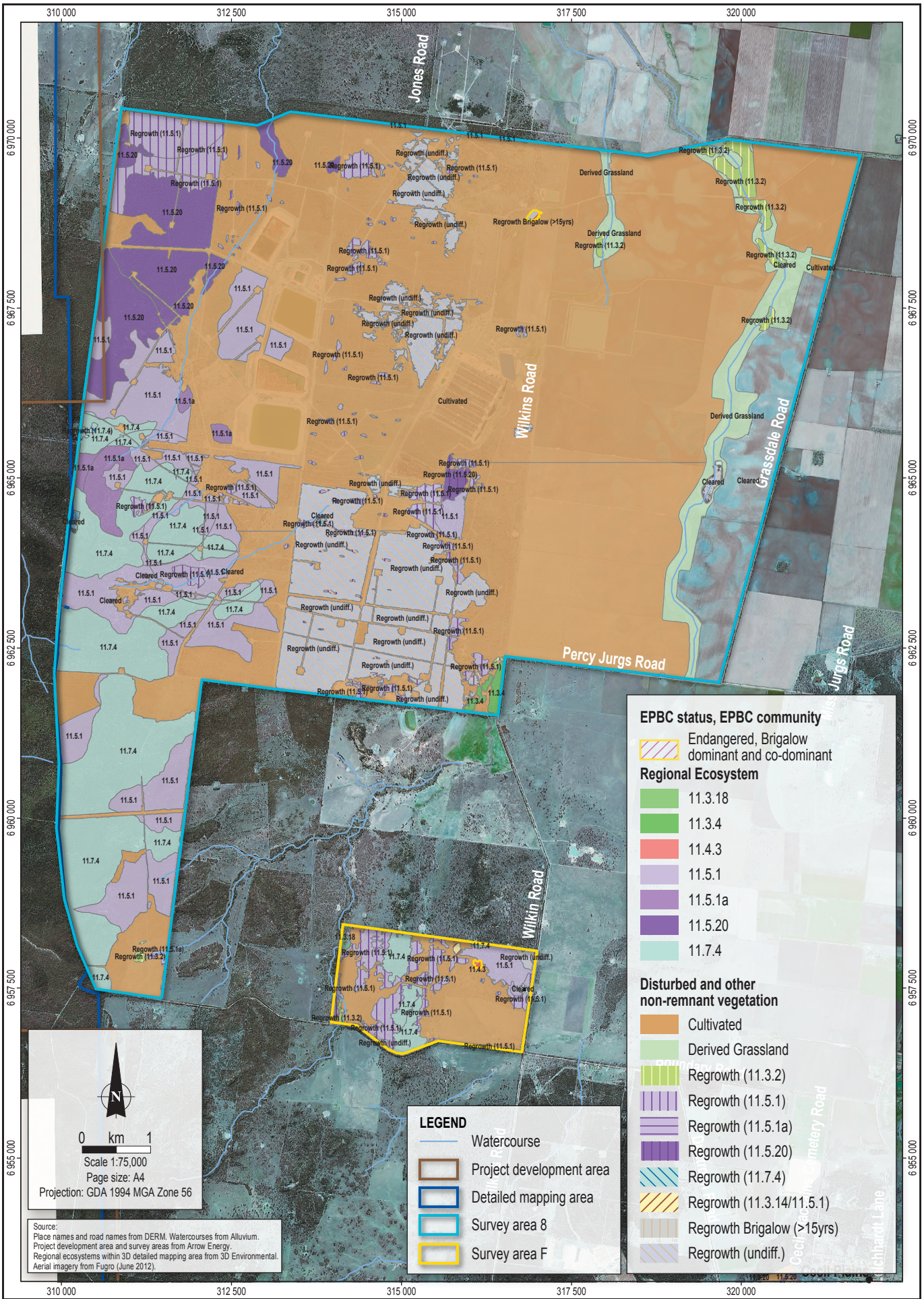
Plate 11.12

Coolibah –Black Box Woodlands (RE11.3.3 (Biodiversity status of 'endangered')) in survey area 7 Derived grasslands associated with Long Swamp in survey area 8

Photo credit: 3D Environmental

Plate 11.13

Brigalow (*Acacia harpophylla* dominant and co-dominant) (RE11.4.3, Biodiversity status of 'endangered')) in survey area F



coffey environments	Date: 08.06.2013 MXD: 7040AE_12_GIS074_v1_4 File Name: 7040_12_F11.12_GIS_HB	Arrow Energy Surat Gas Project	arrow energy go further	EPBC communities and regional ecosystems in survey areas 8 and F	Figure No: 11.12

Based on the survey results, habitats within survey area F contain few weeds. Survey area F shows evidence of extensive grazing and timber extraction, and EVNT taxa potentially present are likely to be adapted to open habitats.

Terrestrial ecology values of moderate to high sensitivity (known or potentially present) in survey area F are presented in Table 11.15.

Table 11.15 Summary of moderate to highly sensitive terrestrial ecology values in survey area F

	Sensitivity	Occurrence	Core Habitat Known (ha)	Core Habitat Possible (ha)
EPBC Act Listed Community				
Brigalow (*Acacia harpophylla* dominant and co-dominant) community (also mapped as RE 11.4.3 below)	High	Confirmed	Yes	-
RE (Biodiversity Status)				
11.4.3 ('endangered)	High	Confirmed	Yes	-
Conservation Listed Flora Species (EPBC Act Status, NC Act Status)				
*Eleocharis blakeana** (-, NT)	Moderate	Possible	No	Yes
*Homopholis belsonii (*Belson's panic*)* (V,V)	High	Possible	No	Yes
Xerothamnella herbaceae (Xerothamnella) (V, V)	High	Possible	No	Yes
Peterostylis cobarensis (Cobar greenhood orchid) (V,-)	High	Possible	No	Yes
Philotheca sporadica (Kogan waxflower) (V,V)	Moderate	Possible	No	Yes
Conservation Listed Fauna Species (EPBC Act status, NC Act Status)				
Cyclorana verrucosa (rough collared frog) (-, NT)	Moderate	Likely	No	Yes
Paradelma orientalis (brigalow scaly-foot) * (V,V)	Moderate	Possible	No	Yes
Nyctophilus corbeni (south-eastern long-eared bat) * (V, V)	Moderate	Known[#]	No	Yes
Chalinolobus picatus (little pied bat) * (-, NT)	Moderate	Possible	No	Yes
EPBC Act Listed Migratory Species				
Merops ornatus (rainbow bee-eater)	N/A[§]	Likely	Listed migratory species have been assessed as being widespread throughout the project development area in suitable habitat – these species are wide ranging and associated with many different habitats. No important populations of listed migratory species were identified therefore no core habitat was assessed.	

Table 11.15 Summary of moderate to highly sensitive terrestrial ecology values in survey area F (cont'd)

	Sensitivity	Occurrence	Core Habitat Known (ha)	Core Habitat Possible (ha)
Culturally Significant Species				
Tachyglossus aculeatus (short-beaked echidna)	N/A§	Confirmed	Not assessed**	
Additional Back-on-Track Species				
No additional back-on-track species (other than conservation listed species above) were recorded				
Bioregionally Significant Species				
Pyrrholaemus sagittatus (speckled warbler)	N/A§	Confirmed	Not assessed**	

* Back on Track species.

§ The significance assessment was not applied.

Reported to occur (Arrow pers. comm.) although location data not verified and not included in core habitat mapping. The mapping will be updated once verified.

** Core habitat mapping was undertaken for species assessed under the significance assessment.

Confirmed = Species recorded in field surveys. Known = A species record exists in the survey area. Likely = A species record exists within close proximity to the survey area and suitable habitat is present. Possible = A record is not present within close proximity to the survey area however suitable habitat is present

EPBC Act status: CE = Critically Endangered, E = Endangered, V = Vulnerable, - = Not Listed

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

The Brigalow (*Acacia harpophylla* dominant and co-dominant) community (listed under the EPBC Act) was identified during the targeted ecological surveys at survey area F and comprised a small patch of approximately 1 ha. This patch was not mapped in EHP mapping (Plate 11.13). This ecosystem is associated with RE 11.4.3 ('endangered') and is of high sensitivity.

Field surveys confirmed the presence of three REs recorded in the EHP mapping for survey area F. These REs have a biodiversity status of 'No Concern at Present' and are of low sensitivity, although some areas provide core habitat possible for EVNT species. An additional RE of this status and sensitivity was mapped by EHP at survey area F, but field surveys did not record this RE as being present.

The EPBC Act listed ecological community and REs within survey area F are shown on see Figure 11.12.

No EVNT flora species were identified at survey area F. Five flora species of moderate or high sensitivity (listed under the EPBC Act and/or the NC Act) were mapped as having core habitat possible at survey area F on the basis of association with a particular RE or specific habitat features being present which are known to be favoured by the species. Three of these species were associated with the remnant Brigalow (*Acacia harpophylla* dominant and co-dominant) community on this site. No core habitat known for EVNT flora species was identified in survey area F.

No EVNT fauna species were identified at survey area F. Four fauna species of moderate or high sensitivity (listed under the EPBC Act and/or the NC Act) were mapped as having core habitat possible at survey area F on the basis of association with a particular RE or specific habitat features being present which are known to be favoured by the species. These species are associated with the areas of remnant vegetation at survey area F. No core habitat known for EVNT fauna species was identified in survey area F.

Four 'Back on Track' species were identified as potentially being present as a result of desktop studies and targeted surveys. One bioregionally significant species, speckled warbler (*Pyrrholaemus sagittatus*) was confirmed as being present at survey area F. One culturally significant species, the echidna (*Tachyglossus aculeatus)* was also recorded in this area.

No EPBC Act listed migratory species were observed within survey area F, although rainbow bee-eater (*Merops ornatus*) is likely to occur. The habitat in survey area F is unlikely to support an important population of any EPBC Act listed migratory species.

11.5 Management Approach– Framework, Surveys and Buffers

Arrow's approach to managing potential project impacts on terrestrial ecology values is set out below. Measures to protect terrestrial ecology values at each of the five properties surveyed to inform the SREIS are also discussed.

11.5.1 Environmental Framework Approach

The environmental framework approach was developed by Arrow to manage the impacts of coal seam gas development where the location of infrastructure becomes progressively known over the life of the project. The identification of sites and routes for project infrastructure and activities is informed by the constraints imposed by environmental values of sites including habitat values and buffer requirements.

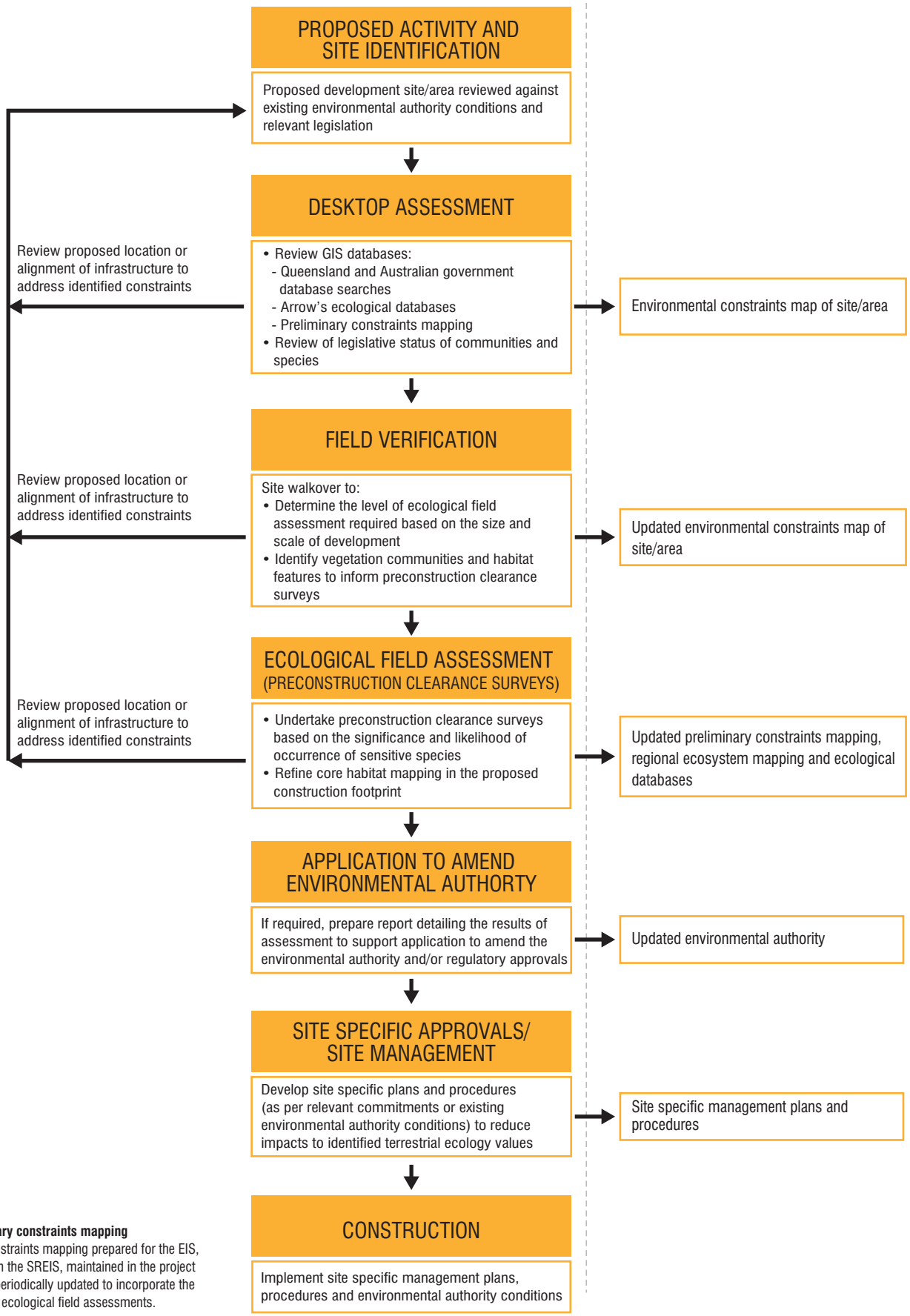
Constraints mapping, an integral part of the environmental framework, is informed by the findings of the EIS and SREIS. The mapping guides the site and route selection to avoid and reduce disturbance to sensitive vegetation communities and listed species in the design and layout of project infrastructure, thereby protecting the environmental values. The precise location of wells and gathering systems is relatively flexible, and will be informed by the findings of preconstruction clearance surveys. The siting of CGPFs will be informed by the findings of the targeted ecological assessments and surveys described above. Preconstruction clearance surveys will be undertaken to further refine 'core habitat possible'. Figure 11.13 outlines Arrow's approach to carrying out ecological surveys, identifying environmental values at proposed infrastructure sites, and implementing mitigation and management measures.

11.5.2 Ecological Surveys and Buffers

The environmental framework establishes the basis for detailed ecological surveys as the locations of project infrastructure are confirmed enabling site specific assessments of potential impacts. Consistent with the framework approach, ecological assessments were carried out in survey areas 2, 9, 7, 8, and F, the planned locations of project infrastructure. Preconstruction clearance surveys will be required once the exact location of project infrastructure is known to confirm the ecological assessment for the site, and to determine any additional (site specific) management measures required to protect identified listed species.

The assessments for the survey areas confirmed the findings of the EIS on terrestrial ecology (communities and species) that were expected at the sites and the mitigation measures set out in the EIS were confirmed as adequate to manage development at these sites.

Site validation process for terrestrial ecology values



Preliminary constraints mapping
is the constraints mapping prepared for the EIS, updated in the SREIS, maintained in the project GIS and periodically updated to incorporate the results of ecological field assessments.

coffey environments	Date: 24.06.2013	Arrow Energy	arrow energy go further	Overview of Arrow's approach to site validation of terrestrial ecology values	Figure No: 11.13
	File Name: 7040_12_F11.13_GL	Surat Gas Project			

Where necessary, buffers will be applied to protect significant environmental values, particularly where indirect impacts (e.g., edge effects, displacement) are likely. An example of regulated buffer distances for ESAs is proposed in the Model Conditions for Level 1 Environmental Authorities for Coal Seam Gas Activities (DERM, 2011d). This example was used to inform ecological assessments in the EIS and SREIS. It is noted that regulatory policy is evolving to an outcome-based approach.

The ecological assessments have confirmed that setback of project infrastructure from sensitive areas protects the associated environmental values. Impacts to sensitive areas will be avoided or reduced through environmental management controls that reflect the sensitivity of the environmental value. The need for buffers and buffer distances will be determined by legislative requirements at the time of development of a site or management measures set out in species-specific management procedures. Offsets will be required for unavoidable impacts to sensitive environmental values in accordance with relevant legislation (see below).

11.5.3 Management of Survey Areas 2, 9, 7, 8, and F

Commitments presented in the EIS are adequate to manage potential impacts to the identified terrestrial ecology values in all five of the survey areas assessed for the SREIS. No new mitigation measures are proposed for any of the survey areas.

The placement of infrastructure will consider the sensitivity of the terrestrial ecology values for flora (see Figures 11.9 to 11.12) and fauna (Figures 11.14 to 11.17).

11.6 Environmental Offsets

Arrow has developed a Draft Environmental Offset Strategic Management Plan (Attachment 6, Draft Environmental Offsets Strategic Management Plan) consistent with its Draft Environmental Offset Strategy. This plan:

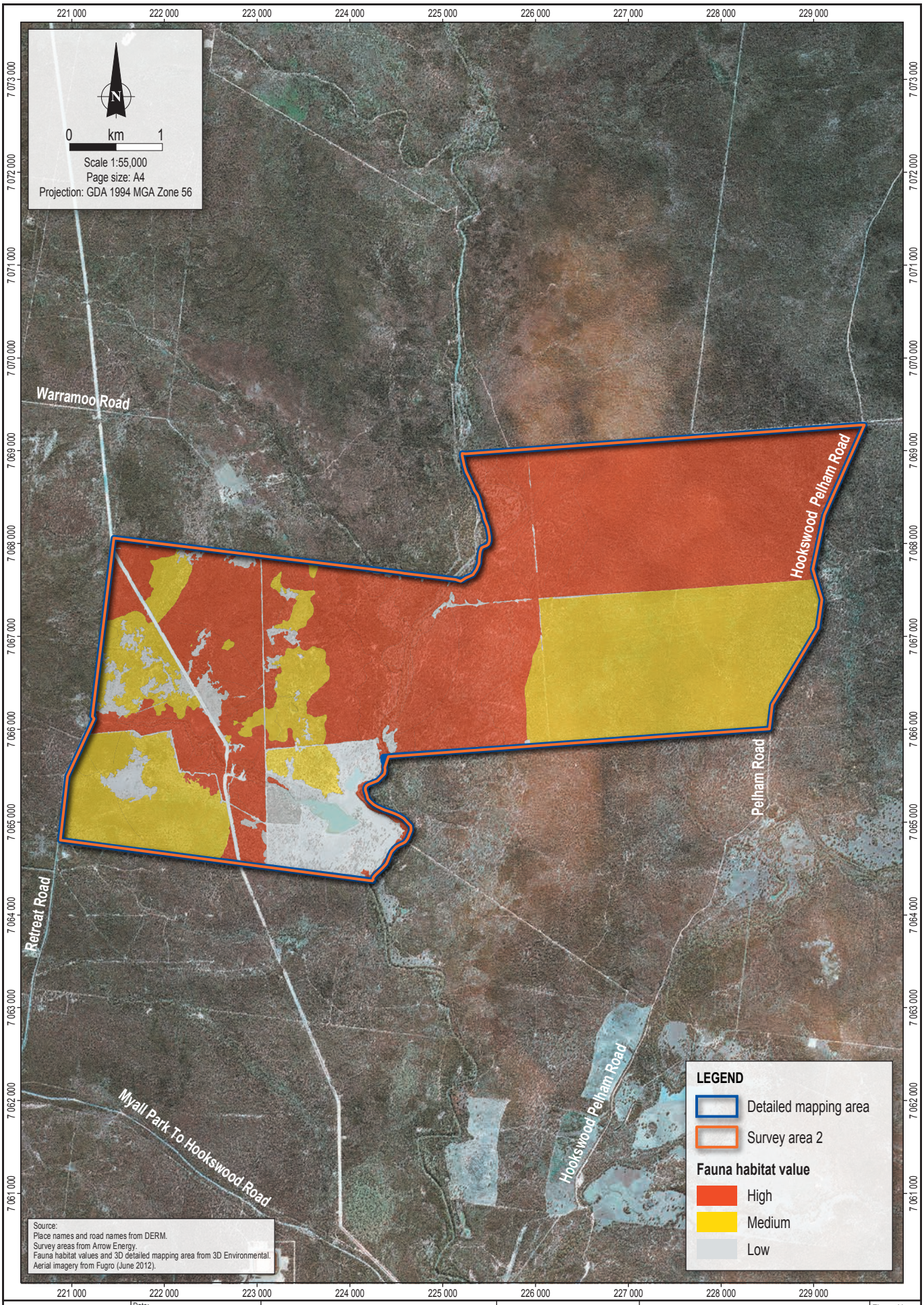
- Describes measures taken to avoid and reduce impacts.
- Identifies Arrow's likely offset requirements.
- Presents evidence that there are opportunities to achieve the required offsets.
- Sets out Arrow's preferred approach to the provision of environmental offsets.

The Draft Environmental Offsets Strategic Management Plan presents the results of GIS analysis involving the sequential application of filters to identify suitable patches/tracts of target regional ecosystems, to facilitate identification of potential offset sites.

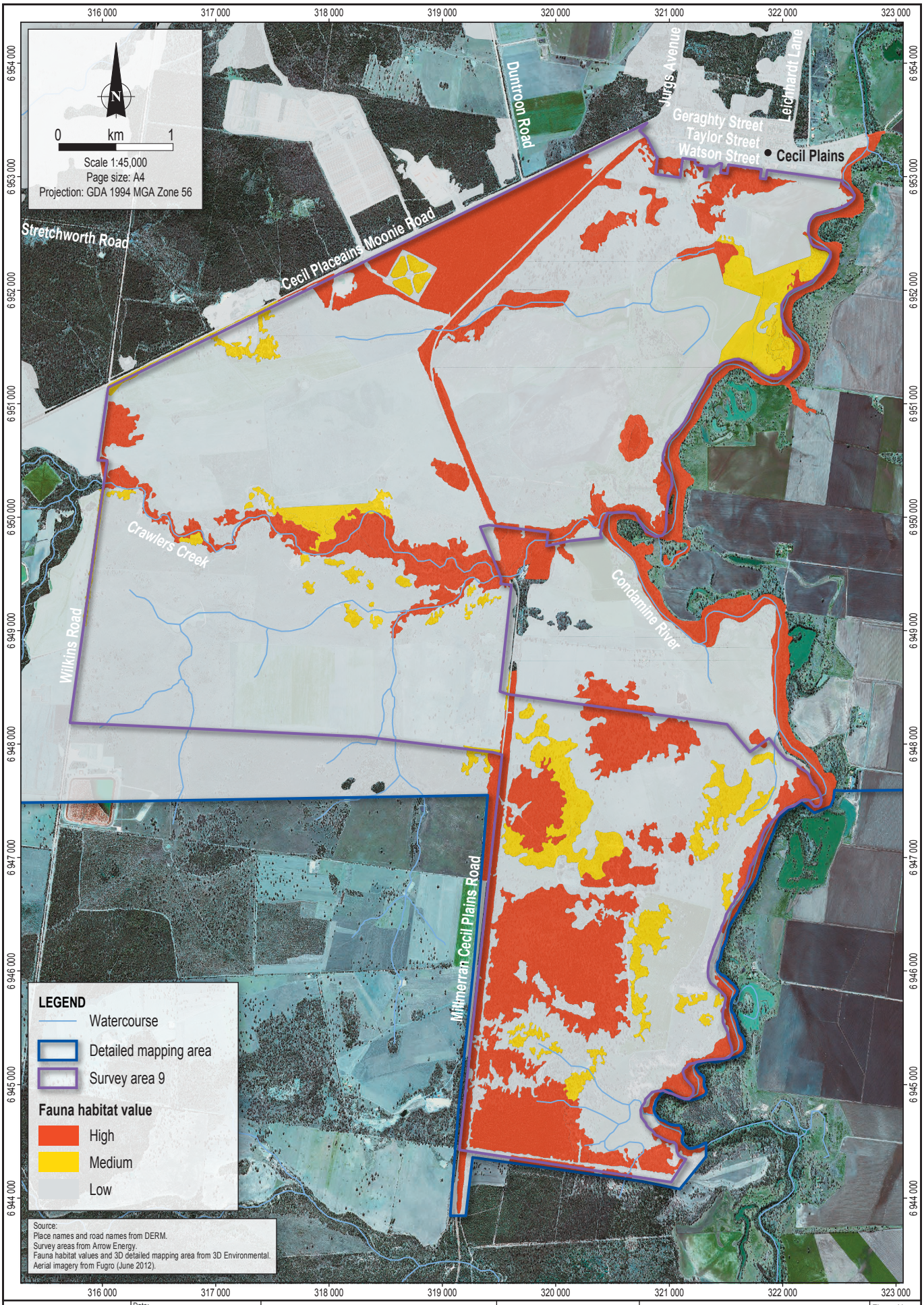
Arrow's principles for environmental offsets are:

- 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.
- Offsets will be implemented strategically and economically.

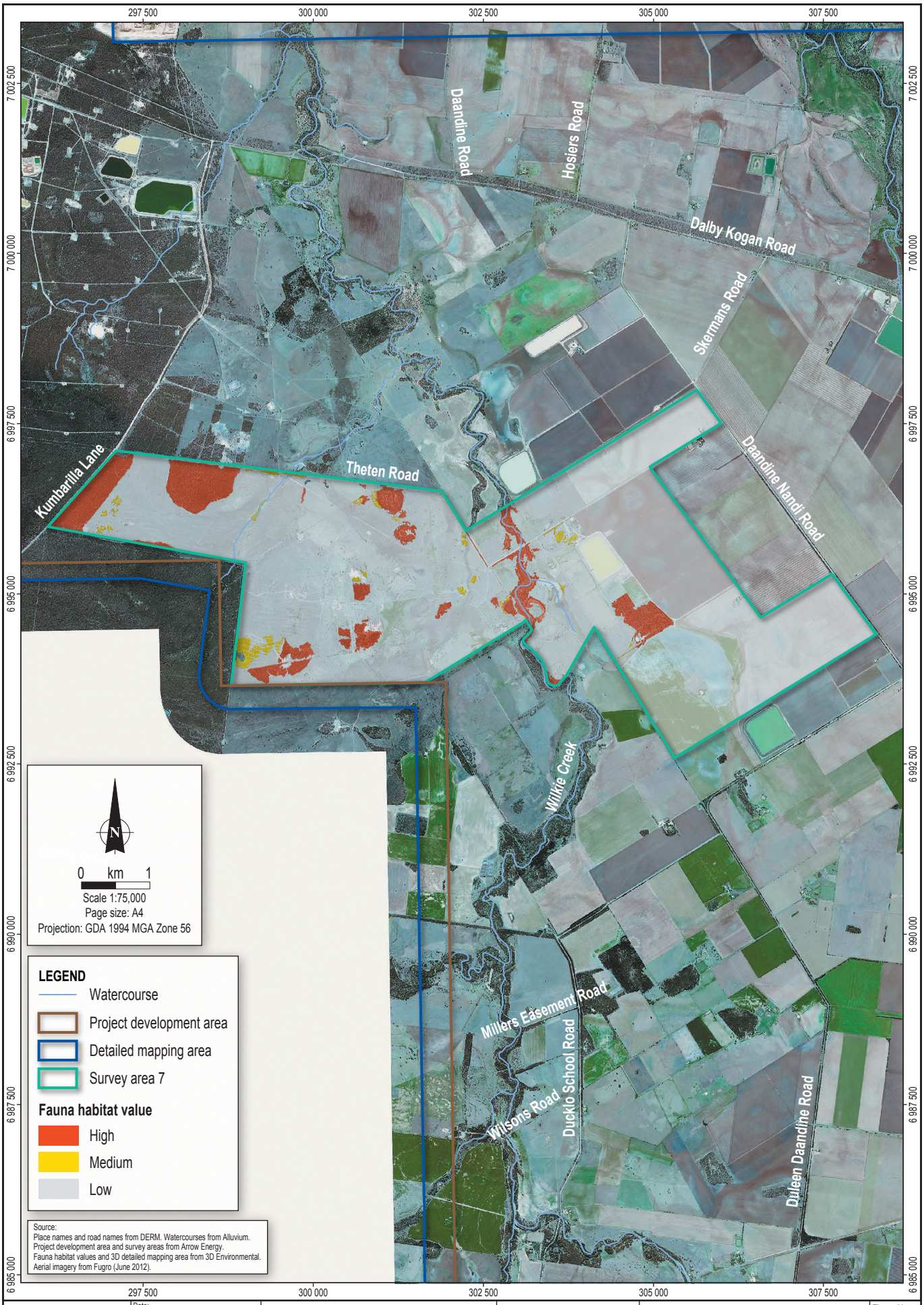
The regulatory framework for environmental offsets driving this strategy and subordinate plans is shown in Figure 11.18.



coffey environments	Date: 08.06.2013 MXD: 7040AE_12_GIS076_v1_2 File Name: 7040_12_F11.14_GIS_HB	Arrow Energy Surat Gas Project	arrow energy go further	Important fauna habitat areas in survey area 2	Figure No: 11.14



coffey environments	Date: 08.06.2013 MXD: 7040AE_12_GIS077_v1_3 File Name: 7040_12_F11.15_GIS_HB	Arrow Energy Surat Gas Project	arrow energy go further	Important fauna habitat areas in survey area 9	Figure No: 11.15



coffey environments

Date: 13.06.2013
MXD: 7040AE_12_GIS078_v1_3
File Name: 7040_12_F11.16_GIS_HB

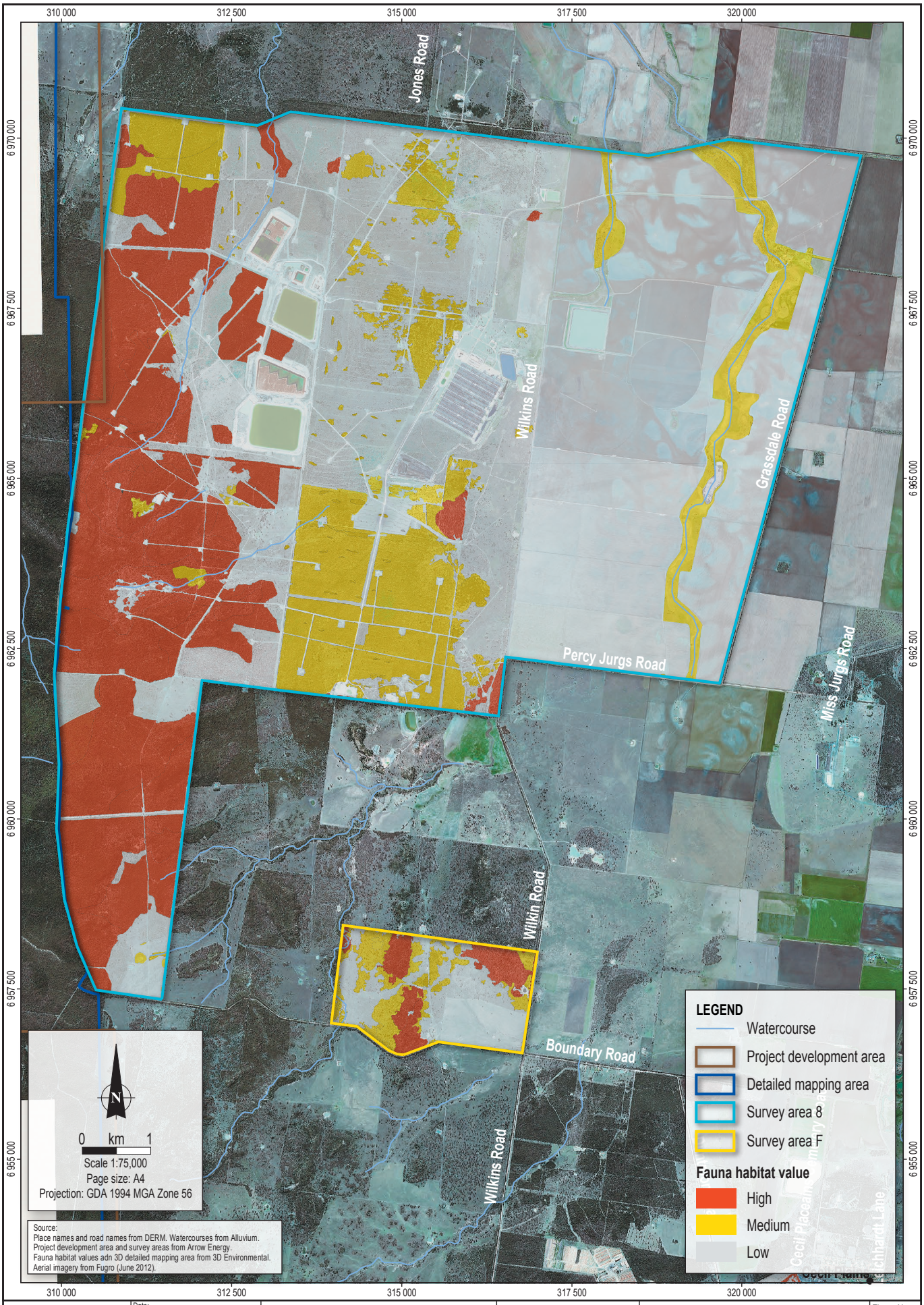
Arrow Energy

Surat Gas Project

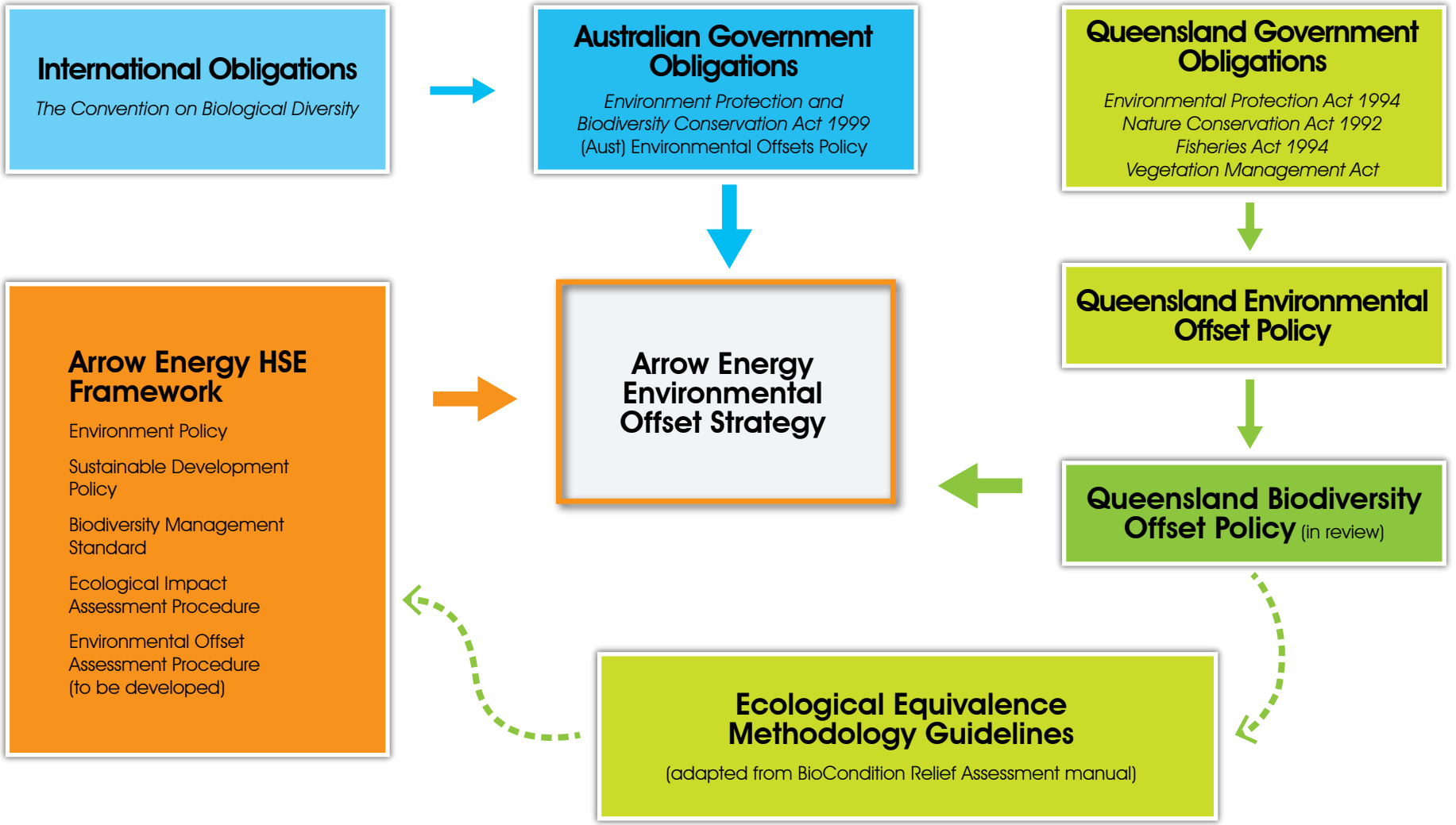
arrow energy go further

Important fauna habitat areas in survey area 7

Figure No: 11.16



coffey environments	Date: 08.06.2013 MXD: 7040AE_12_GIS079_v1_1 File Name: 7040_12_F11.17_GIS_HB	Arrow Energy Surat Gas Project	arrow energy go further	Important fauna habitat areas in survey areas 8 and F	Figure No: 11.17



	coffey environments	Date: 13.05.2013 File Name: 7040_12_F11.18_FT	Arrow Energy Surat Gas Project	arrow energy go further	Arrow's Environmental Offset Strategy – identifying the linkages to relevant policy frameworks	Figure No: 11.18

11.7 Conclusion

The terrestrial ecology values of the project development area are as presented in the EIS. The additional data and information obtained during the SREIS assessments enabled the assessment of sensitivity of the environmental values to be refined.

Ecological surveys of properties identified for development of CGPFs and a TWAF have confirmed the findings of the EIS, and allowed higher resolution mapping of vegetation communities and habitat, and allowed individuals and populations of listed species to be identified. This information has informed the update of constraints mapping which will guide the siting of the infrastructure on each property.

Species profiles prepared as part of the terrestrial ecology study have informed the habitat requirements for listed species. These requirements have been classified and mapped as 'core habitat known', 'core habitat possible' and 'general habitat'. Habitat mapping and information provided in the species profiles will inform the survey requirements for the ecological assessments prior to siting infrastructure and preconstruction clearance surveys prior to construction (and management of construction activities on the site).

The site-specific ecological surveys and assessments have confirmed that the impacts to terrestrial ecology values are as assessed in the EIS, and that the mitigation measures expressed as commitments in the EIS will be effective in protecting the values.

Arrow will develop a series of management plans that will include specific species and impact specific protection and mitigation measures. These plans will include the following:

- Species management plan (see C224), including translocation (C482).
- Pest management plan (see C188).
- Fire management plan (see C223).
- Decommissioning and rehabilitation plan (see C245, C250).

The proposed structure of a species management plan is provided in Attachment 2, Strategic Environmental Management Plan.

Offsets for unavoidable impacts on listed ecological communities and species (and their habitat) will be provided in accordance with relevant Queensland and Australian government legislation and policies, as set out in Arrow's Draft Environmental Offsets Strategic Management Plan (Attachment 6).

11.8 Issues Raised in Submissions

Submissions on the EIS raised a range of issues relating to terrestrial ecology. The issues fall in broad topics which are listed below:

- Study method.
- Site-specific assessment for facility and infrastructure locations.
- Potential impacts to communities and species.
- Environmentally sensitive areas.
- Vegetation corridors and faunal movement.
- Estimates of disturbance.
- Avoidance, mitigation and management measures for terrestrial environmental values.
- Buffer distances from sensitive communities and habitats.
- Weed and pest management Commitments made by Arrow.

- Environmental offsets.
- Inspection and monitoring.

This list reflects the types of issues that have been raised in relation to terrestrial ecology and for which responses have been provided under the heading 'Terrestrial Ecology' in (Part B, Chapter 19, Submission Responses; Part B, Response to DERM Submission, Chapter 20; Part B, Response to SEWPaC Submission, Chapter 21).

11.9 Commitments Update

One new management measure (commitment) relevant to terrestrial ecology has been identified in the course of the study and is presented in Table 11.16. Four commitments have been updated to reflect the relinquishment of sub-blocks of Arrow tenements and current legislative requirements. The full list of commitments, including those that remain unchanged from the EIS and details on those that have changed, is included in Attachment 4, Commitments Update.

Table 11.16 Commitments update: terrestrial ecology

No.	Commitment	Revised / New
C557	Design infrastructure to avoid disturbance of state significant vegetation and other high value ecological corridors where practicable.	New
C217	Avoid the following areas: • 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, 11.8.2a), including three natural grassland road reserves (Dalby Kogan, Dalby Cecil Plains and Dalby St George Road).	Updated as Bendidee National Park is no longer within the project development area.
C218	Aim to avoid: • 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.	Updated as Bendidee State Forest is no longer within the project development area.
C227	Manage potential impacts to Category A, B and C ESAs through implementation of buffers in accordance with legislative requirements at the time.	Changed to reflect legislative requirements.
C157	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.	Changed to reflect legislative requirements.

Commitments C249 and C523 (presented in the EIS) for the protection of the bulloak jewel butterfly (*Hypochrysops piceata*) are no longer required as Bendidee State Forest will not be affected by project related activities due to the relinquishment of sub-blocks of Arrow tenements. As suitable habitat for the bulloak jewel butterfly (*Hypochrysops piceata*) was found in survey area 9, Commitment C224 will require Arrow to develop threatened species management procedures for this species, if the species is confirmed as present during preconstruction clearance surveys and project activities are likely to impact on the species.