

Surat Gas Project

Species Impact Management Plan

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Cover Page

EPBC Number: EPBC 2010/5344

Project Name: Surat Gas Expansion Project

Proponent and ABN: Arrow Energy Pty Ltd (ABN: 73 078 521 936)

Approved Action: To expand coal seam gas operations in the Surat Basin, Queensland, as described in the Referral provided under the EPBC on 2 February 2010; and as described in the Surat Gas Project Environmental Impact Statement (March 2012) and Supplementary Report to the Environmental Impact Statement (June 2013).

Location of the Action: The Project covers an area of approximately 6,100 km² and is located approximately 160 km west of Brisbane in Queensland's Surat Basin. The project development area extends from the township of Wandoan in the north towards Goondiwindi in the south.

Date of preparation of this Plan: 20 November 2018

Signed Declaration of Accuracy:

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or *Environment Protection and Biodiversity Conservation Regulation (2000)* (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have knowledge of that authorisation being revoked at the time of making this declaration.

Signed:



Full name:

Nathan Blundell

Organisation:

Arrow Energy Pty Ltd

Date: 20/11/2018

Executive Summary

Background and Purpose

- On 19 December 2013 Arrow Energy Pty Ltd (Arrow) received approval from the Australian Government to proceed with the Surat Gas Project (SGP) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC 2010/5344).
- On 29 March 2017 'Variation to Conditions Attached to Approval' was granted, whereby the more detailed Offset Management Plan is now required within 12 months of project commencement. On 29 May 2018 a second 'Variation to Conditions Attached to Approval' was granted, whereby maximum Stage 1 disturbance areas were refined and Stage 1 minimum offset areas were removed. On 31 October 2018 a third variation was granted to separate the SGP Species Impact Management Plan and the Stage 1 Offset Strategy.
- The purpose of this document is to satisfy Conditions 7 of the approval, whereby Arrow is submitting the EPBC Species Impact Management Plan (SIMP) for approval by the Minister prior to project commencement.

Key Elements

- This SIMP has been prepared by suitably qualified ecologists, with evidence of the authors' qualifications and experience provided in Appendix A.
- Arrow has undertaken comprehensive seasonal ecological surveys to gain a detailed understanding of EPBC listed threatened species and EPBC communities within the Project development area, and have modified our field development layout to avoid and minimise impacts to these national values.
- This SIMP details how Arrow will meet Condition 7A and 7B of the SGP approval conditions including describing the management measures and monitoring program that will be implemented to avoid, track and further minimise impacts to EPBC Act species and communities through the life of the SGP.
- As per Condition 7B, Arrow will not commence Project Phase 1 until this EPBC SIMP has been approved by the Minister in writing. Once approved Arrow will implement this SIMP.

Recommendation

That the Minister or delegate approves this Surat Gas Project EPBC Species Impact Management Plan.

Abbreviations and Acronyms

The following table provides a list of abbreviations and acronyms used throughout this report.

Abbreviations and Acronyms

Term	Definition
CSG	Coal Seam Gas
DotEE	Department of the Environment and Energy (Australia)
EA	Environmental Authority
DES	Department of Environment and Science (Queensland)
EIS	Environmental Impact Statement
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GIS	Geographic Information System
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
RE	Regional Ecosystem
ROW	Right of Way
SIMP	Species Impact Management Plan
SREIS	Supplementary Report to the Environmental Impact Statement
TEC	Threatened Ecological Community

1. Introduction

Arrow Energy is a Queensland based subsidiary of Arrow Energy Holdings Pty Ltd (Arrow), a 50:50 joint venture between Royal Dutch Shell (Shell) and PetroChina Company Ltd (PetroChina). Arrow is currently developing coal seam gas (CSG) resources in Queensland, including resources in the Surat Basin.

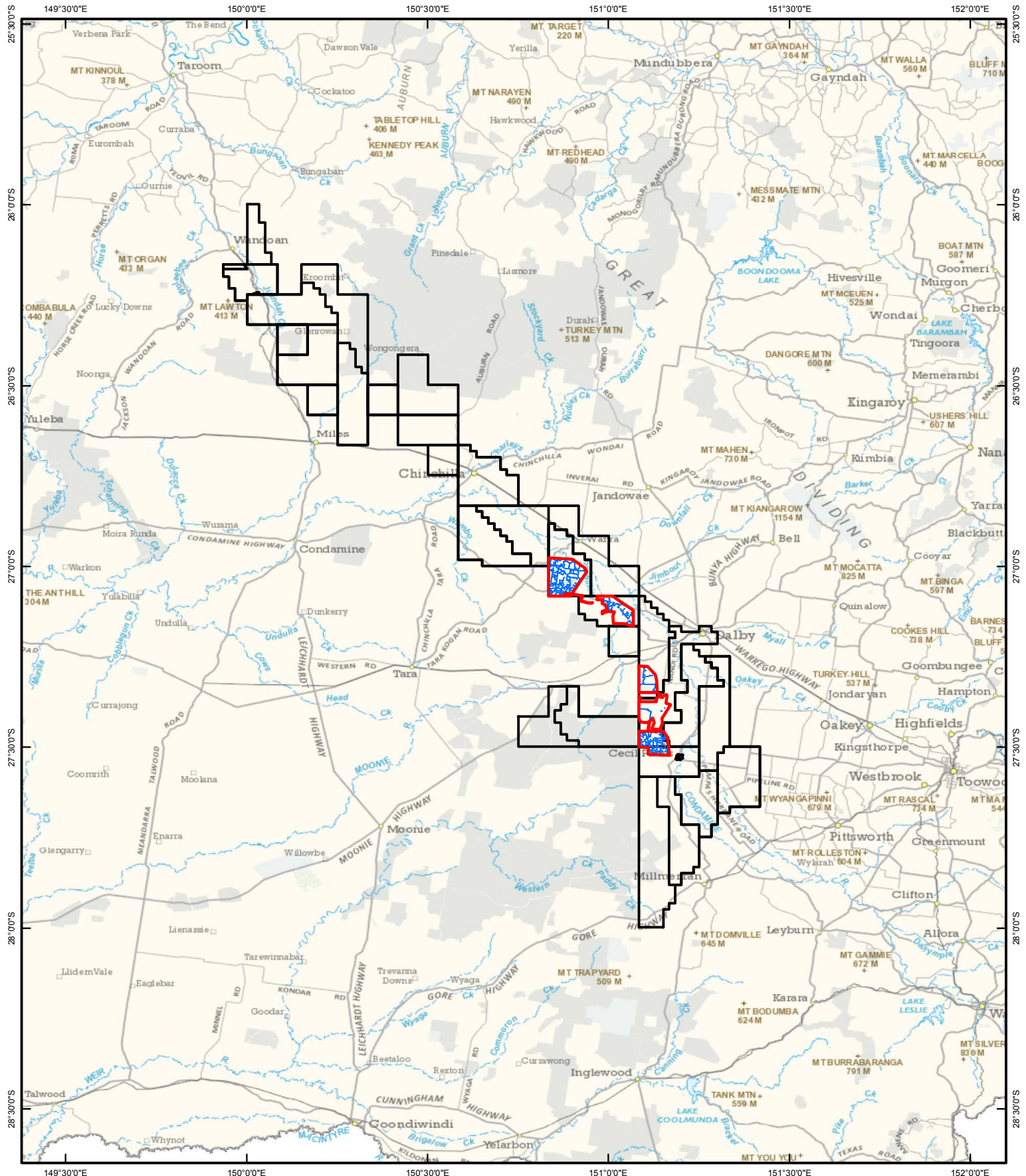
The Surat Gas Project (SGP) Environmental Impact Statement (EIS) for up to 6,500 coal seam gas production wells and associated infrastructure was granted approval from the Queensland Government in October 2013 and the Australian Government in December 2013. The Project covers an area of approximately 6,100 km², extending from the township of Wandoan in the north towards Millmerran in the south (see Figure 1.1).

The EPBC Act approval for the SGP (EPBC 2010/5344) specifies that “*prior to the commencement of Stage 1, the approval holder must prepare and submit an EPBC Species Impact Management Plan for the Minister’s written approval*” and that the plan must include a number of matters (Condition 7A (a) – (d) of the EPBC Act approval; refer Table 1.1 of this SIMP). The purpose of this SIMP is to satisfy these conditions.

The EPBC Act approval also identifies those EPBC Act listed species and communities (listed at the date of approval for the SGP) where a significant impact is likely, and specifies disturbance limits for each (Condition 5, Table 1 of the EPBC approval; shown in Table 1.2 of this SIMP; noting that MNES with ‘no disturbance’ limit is excluded from Table 1.2). This SIMP addresses all of these EPBC species and communities.

For completeness, this SIMP also addresses three listed EPBC Act species which have been identified as having the potential to be impacted by the SGP (i.e. *Phascolarctos cinereus* (Koala), *Petauroides volans* (Greater Glider) and *Grantiella picta* (Painted Honeyeater)). These three species were listed under the EPBC Act subsequent to the SGP’s EPBC Act approval. Although these species are discussed in this SIMP, they do not form part of the EPBC Act approval but are included by Arrow in the SGP Offset Strategy.

Table 1.1 identifies the sections within this SIMP that addresses each of the Condition 7 requirements.



Stage 1 SIMOP
 Stage 1 disturbance footprint
 Tenure

Based on or contains data provided by the State of Queensland (Department of Environment and Resource Management). In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.

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Issued To: M Ryan
Author: tstringer

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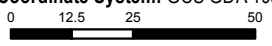
Note: The information shown on this map is a copyright of Arrow Energy Limited and, where applicable, its affiliates and co-venturers.

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

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Coordinate System: GCS GDA 1994



0 12.5 25 50
km

Figure 1.1
Surat Gas Project
Location in the Surat Region Context



Date: 8/01/2018

Uncontrolled (A) Confidential

Table 1.1 Cross-reference table for information requirements and SIMP section

Condition Number	Condition requirement	Section of this SIMP
7A	Prior to the commencement of Stage 1, the approval holder must prepare and submit an EPBC Species Impact Management Plan for the Minister's written approval. The EPBC Species Impact Management Plan must include:	
7(a)	Measures that will be taken to avoid, mitigate and manage impacts to EPBC listed threatened species and their habitat during clearance of vegetation, including the involvement of a suitably qualified ecologist at all times during clearance of vegetation	Section 3
7(b)	Measures that will be taken to avoid, mitigate and manage impacts to EPBC listed threatened species and their habitat and to EPBC communities during construction, operation and decommissioning of the action	Section 4
7(c)	A monitoring program to determine the success of impacts avoidance and mitigation measures and that will inform adaptive implementation of the action for the duration of this approval	Section 5
7(d)	A description of how measures proposed in the EPBC Species Impact Management Plan are consistent with the measures in relevant conservation advice, recovery plans and threat abatement plans	Section 6
7B	The approval holder must not commence Stage 1 until an EPBC Species Impact Management Plan has been approved by the Minister in writing. The approved EPBC Species Impact Management Plan must be implemented by the approval holder	Section 7

Table 1.2 Whole of project maximum disturbance limits (source: Table 1 of EPBC Act approval)

Matter of National Environmental Significance	Maximum disturbance (hectares) to core habitat
Terrestrial Species	
Curly-bark Wattle (<i>Acacia curranii</i>)	1,210
Hando's Wattle (<i>Acacia handonis</i>)	1,210
Belson's Panic (<i>Homopholis belsonii</i>)	140
Lobed Blue Grass (<i>Bothriochloa biloba</i>)	305
Kogan Waxflower (<i>Philothea sporadica</i>)	480
<i>Prostanthera</i> sp Dunmore	380
Small-leaved Denhamia (<i>Denhamia parvifolia</i>)	50
<i>Calytrix gurulmundensis</i>	1,210

SGP Species Impact Management Plan

Matter of National Environmental Significance	Maximum disturbance (hectares) to core habitat
Finger Panic Grass (<i>Digitaria australe</i>)	174
Austral Toadflax (<i>Thesium australe</i>)	160
<i>Acacia lauta</i>	990
Cobar Greenhood Orchid (<i>Pterostylis cobarensis</i>)	2,170
<i>Xerothamnella herbacea</i>	110
Hawkweed (<i>Picris evae</i>)	120
Austral Cornflower (<i>Rhaponticum australe</i>)	160
<i>Eucalyptus virens</i>	170
King Bluegrass (<i>Dichanthium queenslandicum</i>)	160
Queensland White-gum (<i>Eucalyptus argophloia</i>)	10
South-eastern Long-eared Bat (<i>Nyctophilus corbeni</i>)	4,080
Dunmall's Snale (<i>Furina dunmalli</i>)	4,400
Five-clawed Worm-skink (<i>Anomalopus mackayi</i>)	560
Squatter Pigeon (<i>Geophaps scripta scripta</i>)	3,261
Regent Honeyeater (<i>Anthochaera phrygia</i>)	20
Collared Delma (<i>Delma torquate</i>)	90
Yakka Skink (<i>Ergernia rugosa</i>)	310
Australian Painted Snipe (<i>Rostratula australis</i>)	5
EPBC Communities	
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	106
Coolibah-Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregion	8
Weeping Myall Woodlands	1

2. Management of EPBC Species and Communities

2.1 Management hierarchy

Coal Seam Gas developments apply an iterative process in terms of locating wells and gathering lines. This is required because there are several competing constraints when it comes to locating the infrastructure on the surface. These constraints include ecological values, landholder preferences, geological features, existing infrastructure and access tracks. Planning and management of surface activities and ground disturbance is undertaken utilising a set of hierarchical management principles used to avoid, minimise and mitigate impacts to ecological values. These principles are:

- **Avoid:** Arrow's first preference is to avoid EPBC Act listed threatened ecological communities and the habitat of EPBC listed threatened species
- **Minimise:** where other competing constraints or the scale / location of EPBC communities or species habitat dictate that avoidance is not possible (e.g. where there are long linear strips of Brigalow that need to be crossed or large areas of suitable habitat for wide ranging species such as the Squatter Pigeon), Arrow will preferentially locate infrastructure in a manner that minimises the impact to these values (e.g. cross the Brigalow at the narrowest or most degraded part or where practicable on the edge of suitable habitat for listed species so as not to bisect good quality habitat)
- **Mitigate:** implement mitigation measures to further minimise the direct and indirect impacts on ecological values
- **Remediate and rehabilitate:** actively remediate and rehabilitate impacted areas to promote and maintain long term recovery
- **Offset:** Arrow will offset unavoidable significant residual impacts to MNES as per the SGP Offset Strategy.

2.2 Application of the management hierarchy

Sections 3 and 4 of this document provide considerable detail of Arrow's commitments to avoid, minimise and mitigate impacts to MNES. The following steps will be undertaken to implement the above mentioned management hierarchy:

- Pre-clearance surveys
- Framing trade-offs
- On-site management and reporting
- Annual reporting.

Pre-clearance surveys

Arrow has already completed ecological surveys within the areas of proposed activities. However, additional pre-clearance surveys will be undertaken when the SGP activities proceed through the detailed design and planning phase and secondary approvals are required (e.g. an Environmental Authority, Clearing Permit or a landholder agreement).

At this point in time, a field inspection of the specified disturbance footprint will be undertaken by a suitably qualified ecologist. The pre-clearance survey will confirm the presence, absence and extent of environmental values (including EPBC Act species habitats and TECs) and these will be mapped in the field via GIS. The results of this step will be recorded within Geocortex (Arrow's GIS based mapping system) and the Arrow Sharepoint site (Arrow's data compilation software used by the Access and Approvals Team).

Framing trade-offs

Following the pre-clearance surveys, a framing trade-offs meeting will be held with the project engineers, planners, ecologists, land liaison officer and an archaeologist. The purpose of this meeting is for each specialist to discuss the proposed location of the infrastructure and the opportunities and constraints based on the findings of their field assessment. It is at this meeting where the ecologist will be reiterating Arrow's management hierarchy for MNES and aiming to avoid and minimise impacts to MNES. The outcome of the framing trade-offs meeting is an agreed location for the surface infrastructure after taking into consideration each competing constraint. The results of this step will be recorded within the Arrow Sharepoint database.

On-site management and reporting

Where the framing trade-offs meeting has identified that impacts to MNES are unavoidable, the following will be undertaken so that the actual area cleared will be surveyed to quantify the impacts (in addition to the detailed measures outlined in Table 3.1):

- Record GPS coordinates of the boundary of the MNES in relation to the proposed clearing boundaries and ensure the limits of the area to be cleared are clearly marked on the ground (e.g. high visibility flagging tape, hazard netting or similar).
- Complete a Habitat Quality Assessment as per the Queensland Government Department of Environment and Heritage Protection's *Guide to determining terrestrial habitat quality – A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy* (2017).
- Ensure a fauna spotter-catcher is present during clearing. The spotter-catcher will be a suitably qualified ecologist. The number of fauna spotter-catchers on site at the time of clearing will depend on the number of machines being used at any given time.
- Record the coordinates and total area of MNES habitats and communities cleared.
- Ensure the success of on-site mitigation measures by review and assurance against this EPBC Species Impact Management Plan and the accompanying SGP EPBC Phase 1 Offset Strategy.

Annual reporting

- The field data collected above will be provided to the Environment Team at the completion of site disturbance activities and tracked monthly against approved Stage 1 maximum disturbance limits.
- This data, together with other reporting requirements specified in this plan and the accompanying SGP EPBC Offset Strategy will be collated for annual compliance reporting as per Condition 28 of the SGP EPBC approval.

2.3 Supporting Arrow documents

Arrow has been installing and operating coal seam gas infrastructure since 2005. We have numerous guiding documents relevant to the monitoring of activities that may impact species and vegetation communities; namely:

- Operations Environmental Management Plan (ORG-ARW-AOP-PLA-00016) – this document identifies the relevant procedures and other control mechanisms that are used to minimise potential environmental impacts of production operations activities and ensures the requirements of relevant legislation are met.
- Biodiversity Standard (ORG-ARW-HSM-STA-00034) – the intent of this document is to ensure the protection of biodiversity (flora, fauna and natural habitats) in the areas in which Arrow operates in recognition of the value of healthy and functioning terrestrial and aquatic natural systems. The Standard places a responsibility on all Arrow line managers and contractors to monitor potential biodiversity impacts and controls.
- HSE Incident Management Standard (ORG-ARW-HSM-STA-00007) and the Incident Management Procedure (ORG-ARW-HSM-PRO-00089) – these documents specify the process for reporting, recording, classifying, notifying and investigating unplanned events and incidents that have resulted in damage to the environment.

Beyond the above mentioned overarching documents, two Arrow procedures are particularly relevant:

- Ecological Impact Assessment Procedure (ORG-ARW-HSM-PRO-00070) – this document provides the step by step process implemented for all Arrow development activities that involve significant disturbance to land, including the requirement to record the GPS coordinates and maps of all vegetated areas that have required clearing. Clearing extents will also be input into an Arrow database to track EPBC Act species and community disturbance against approved limits on a monthly basis.
- Fauna Management Procedure (ORG-ARW-HSM-PRO-00067) – this document informs all Arrow staff and contractors of their obligations to protect and manage native fauna whilst operating on Arrow controlled works sites. It includes the requirements to:
 - Record and report all interactions with fauna to the Arrow Ecologist (notification within 24 hours using the Fauna Incident Notification (FIN) form is required for listed

threatened (including EPBC Act listed species), near threatened and special least concern fauna).

- Record and report all interactions with fauna to the regulator, under their own permit, as required (but not before reporting to the Arrow Ecologist).
- Regularly monitor mitigation measures that have been constructed and/or implemented (e.g. fauna exclusion fences) and report their effectiveness to the Site Supervisor.
- Provide clear communications on any ongoing action requirements (e.g. monitoring and maintenance) during site handover processes, and these must be implemented, monitored and their effectiveness reported.

3. Mitigation measures

Condition 7A(a): measures that will be taken to avoid, mitigate and manage impacts to the EPBC listed threatened species and their habitat during clearance of vegetation, including the involvement of a suitably qualified ecologist at all times during clearance of vegetation.

Table 3.1 provides a description of the measures that will be implemented by Arrow to avoid, mitigate and manage impacts to the MNES.

Table 3.1 Description of mitigation measures / commitments

Mitigation	Commitment	Intended outcome	Responsible manager/s
Pre-construction clearance surveys / minimise clearing	<ul style="list-style-type: none"> • Minimise the disturbance footprint and vegetation clearing • Use existing roads and tracks, where practicable • Avoid unnecessary impervious surface coverings and reduce land footprint and vegetation clearing when designing facilities • Reduce the width of construction ROW within areas of sensitivity to the greatest extent practicable without compromising the safety of workers • Conduct preconstruction clearance surveys to identify any additional areas that may need to be avoided • Conduct preconstruction clearance surveys and include as a minimum: <ul style="list-style-type: none"> – Vegetation mapping at a scale suitable for site- specific planning – Identification of habitats and listed species – Identification of site-specific sensitive areas that require avoidance or buffer areas 	<ul style="list-style-type: none"> • To identify opportunities where the residual impacts to MNES matters can be further reduced 	<ul style="list-style-type: none"> • SGP Pre-execution (i.e. Planning) Manager (Arrow)
Construction activities as per plan (no-go areas)	<ul style="list-style-type: none"> • Ensure construction activities do not extend beyond the work site boundaries • Mark site boundaries clearly for site-specific sensitive areas that require avoidance • Demarcate buffers and inform workers and machinery operators of buffer locations when working within the vicinity of national- and state-listed species, communities and areas identified for avoidance • When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts • Retain habitat trees, where practicable • Construct production wells, gathering lines and access tracks within cleared areas, where practicable, with the aim of avoiding sensitive areas • 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 	<ul style="list-style-type: none"> • To ensure that no unplanned impacts occur on MNES as a result of construction activities 	<ul style="list-style-type: none"> • SGP Construction Manager (Arrow)

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Mitigation	Commitment	Intended outcome	Responsible manager/s
Clear Communication	<ul style="list-style-type: none"> • Inform relevant workers, including contract plant and machinery operators of the location of significant remnant vegetation and buffers and use qualified personnel to guide clearing activities • Prohibit disturbance or harassment of wildlife and the unauthorised collection of flora and forest products 	<ul style="list-style-type: none"> • To ensure that no unplanned impacts occur on MNES as a result of construction activities 	<ul style="list-style-type: none"> • SGP Construction Managers (Arrow and Third Party Contractor)
Fauna spotter catcher	<ul style="list-style-type: none"> • Assess trees prior to felling for potential nesting hollows. If identified, fell trees in the presence of a qualified fauna spotter-catcher (FSC) and roll them so that the hollows are facing upwards, allowing fauna to escape • Identify key koala trees (<i>Eucalyptus tereticornis</i> and <i>Eucalyptus populnea</i>), 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 • Use appropriately trained personnel or a FSC to capture injured wildlife, where possible. If further action is required, consult with a qualified vet to determine appropriate action • The FSC will be present during clearing. The FSC will be suitably qualified as per the definition provided in EPBC 2010/5344. The number of FSCs on site at the time of clearing will depend on the number of machines being used at any given time • Checks for identified EPBC Act fauna species breeding places will be undertaken immediately prior to commencing vegetation clearing • Potential breeding places will be clearly marked in the field with spray paint, coloured flagging tape (unless not permitted by land owners, e.g. some cattle properties), or by other suitable methods 	<ul style="list-style-type: none"> • To ensure that no unplanned impacts occur on the Koala, Dunmall's Snake, Greater Glider, South-eastern Long-eared Bat, Regent Honeyeater, Painted Honeyeater or Squatter Pigeon 	<ul style="list-style-type: none"> • SGP Construction Managers (Arrow and Third Party Contractor)
Appropriate rehabilitation	<ul style="list-style-type: none"> • Retain woody debris, logs and rocks for use in rehabilitation, spreading them over part or all of the corridor or, as a minimum, piled along the edge of the cleared corridor to provide refuge for crossing fauna • Translocate or propagate significant species where it is deemed necessary for use during rehabilitation or in offsets in accordance with relevant legislation • 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 	<ul style="list-style-type: none"> • To ensure that no unplanned impacts occur on MNES as a result of construction activities 	<ul style="list-style-type: none"> • SGP Construction Managers (Arrow and Third Party Contractor)

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Mitigation	Commitment	Intended outcome	Responsible manager/s
Reduce light spill	<ul style="list-style-type: none"> Reduce light spill resulting from project activities to reduce disturbance to nocturnal fauna 	<ul style="list-style-type: none"> To ensure that no unplanned impacts occur on the Koala, Dunmall's Snake, Greater Glider or South-eastern Long-eared Bat 	<ul style="list-style-type: none"> SGP Construction Managers (Arrow and Third Party Contractor)
Reduce project traffic speed	<ul style="list-style-type: none"> Implement speed limits on project-controlled roads to reduce the potential for vehicle collisions with wildlife Confine project traffic to designated roads and access tracks, where practicable 	<ul style="list-style-type: none"> To ensure that no unplanned impacts occur on the Koala, Dunmall's Snake, Collared Delma or Yakka Skink 	<ul style="list-style-type: none"> SGP Construction Managers (Arrow and Third Party Contractor)
Weed control	<ul style="list-style-type: none"> Inspect work sites and access routes for notifiable weeds and pest plants and animals prior to accessing the site Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites Advise all relevant personnel of the location and extent of weed infestations in the vicinity of the work areas and the risks involved in moving from one site or property to another Identify declared weeds [as per the Land Access Code 2016] during the preconstruction clearance survey 	<ul style="list-style-type: none"> To avoid degradation of the Brigalow, Coolibah-Black Box or Weeping Myall TEC To avoid reduction in the condition of listed threatened species habitat 	<ul style="list-style-type: none"> SGP Construction Managers (Arrow and Third Party Contractor)
Documentation	<ul style="list-style-type: none"> Develop management procedures, inclusive of buffers where required, for threatened communities and species as and when project activities are identified as likely to have an impact on these values Develop and implement a compensation framework to 'add value' rather than just compensating for impacts Where avoidance is not possible, and significant residual impacts remain to threatened species and communities, implement an offset strategy approved by a relevant government agency and comply with reporting conditions of an offset plan 	<ul style="list-style-type: none"> To ensure that the planned (and actual) impacts to MNES are accurately documented and offset 	<ul style="list-style-type: none"> Environment Manager (Arrow)

In addition to the mitigation measures listed in Table 3.1, Arrow's response to, and reporting of, injury or mortality of EPBC Act fauna is described in Sections 3.1 and 3.2.

3.1 Arrow response to fauna mortality and injury

In the case of animal mortality/injury, the suitably qualified ecologist/spotter/catcher would inspect the animal to determine the extent of injury and the following would occur:

- If injured, temporary first-aid shall be applied (e.g. stopping blood-flow or binding a wound or broken limb). For superficial scratch wounds, antibiotic ointment, spray or powder shall be applied prior to release.
- Sickness usually takes the form of cold stress during winter (this is alleviated during trapping by providing insulated material within any traps). An animal which appears to be suffering from cold-stress will be placed in a warm holding container in a quiet area until it recovers. Holding containers are always carried as part of the survey equipment and comprise tins or appropriate wooden or plastic boxes/ carriers.
- If successful recovery does not appear to be occurring, or the injury requires further treatment, the animal will be transported in a holding container to the nearest veterinarian or to a local wildlife carer.
- Fauna will not be contained for longer than four hours. If prolonged containment is necessary due to difficulty accessing storage facilities (i.e. veterinary surgery, wildlife carers premises), food and water shall be provided.
- The final aim of the response is to release the recovered animal back into the area where it was originally captured. Once assessed by a veterinary surgeon, injured or sick fauna shall be transported to an authorised wildlife carer if it is to be rehabilitated. If the fauna is to be released into the wild, the animal will be released in the location where it was originally captured.
- If it is necessary to euthanize an animal, humane procedures will be used. These procedures will be reliable, avoid distress and produce rapid loss of consciousness without pain until death occurs. It is important to recognise that whilst some physical methods of euthanasia (e.g. stunning followed by exsanguinations) are not aesthetically pleasant, they may be humane as they ensure immediate insensitivity to pain. The choice of technique will be made based on the sensibilities of the animal to be euthanized rather than the sensitivities of the observer or personnel involved.
- Spotter/catchers used by Arrow receive instruction of humane methods of euthanasia prior to entering the field. Should a situation arise where the spotter/catcher is not suitable or comfortable then works will stop and not proceed until assistance from another suitably qualified spotter/catcher can attend the site and deal with the situation. During this time no further works are permitted to occur.

- Animals that are euthanized or found dead will be disposed of humanely and at or near the site where they were found.

3.2 Reporting on fauna mortality and injury

Regular reporting for the SGP will be included in the annual report provided to the Department.

With regards to exceptional events, such as mortality to an EPBC listed species as a result of the SGP activities, the following information is collected:

- During vegetation clearing, information on all fauna impacted by the clearing works (i.e. instances that have involved the spotter/catcher) are recorded.
- Photographs of the fauna and habitat features will be communicated through various methods (e.g. posters, presentations, etc.) to assist site staff with the identification of fauna and their required habitats.
- Data/information must be provided to the Arrow permit holder or authorised representative and include the following:
 - Fauna sighted, relocated, injured and/or euthanized
 - Fauna breeding places identified and actions taken
 - Notable actions
 - GPS co-ordinates for any species that was captured, relocated or euthanized. The co-ordinate should be of the capture point and the release point, where relevant.

With regards to exceptional events, such as mortality to an EPBC listed species as a result of SGP activities, the following reporting to the Department will occur:

- Reporting of such an exceptional event will be carried out in writing to the Secretary of DotEE within a short period (e.g. 7 days) of Arrow becoming aware of the incident (contact details used will be as per the Department's webpage: <http://www.environment.gov.au/biodiversity/threatened/listed-species-and-ecological-communities-notification>).
- All such incidents will be reported on an Arrow incident report form and registered in an electronic database.
- The information provided to the Secretary will include the listed threatened species, the date on which the incident took place, the activity being undertaken at the time of the incident, and the immediate actions taken as a result of the death.

- Incidents will be assessed and tracked to ensure that the appropriate investigation, corrective actions and measures are taken to prevent the incident from reoccurring.
- Incidents will be reviewed by Arrow on a monthly and annual basis to determine incident trends, which will enable targeting of areas that require further adaptive management to assist in preventing future incidents. While the review of incidents will occur monthly, the reporting of such trends will be annual.

The annual reporting required by Condition 28 will also include information pertaining to mortalities of any listed threatened species.

4. Mitigation measures during construction, operation and decommissioning

Condition 7A(b): Measures that will be taken to avoid and mitigate impacts to EPBC listed threatened species and their habitat and to EPBC communities during construction, operation and decommissioning of the action.

Table 3.1 in the preceding section described the mitigation measures relevant to the construction phase and particularly in relation to clearing activities. This section does not repeat those measures but rather describes measures additional to those provided in Table 3.1.

Table 4.1 lists the mitigation measures that will be undertaken to avoid or reduce impacts to EPBC species and communities during construction, operation and decommissioning (these are consistent with relevant SGP EIS mitigation commitments).

Further to the commitments provided within the SGP EIS and reproduced below, a number of other mitigation measures included within the Arrow Energy Species Management Program for Tampering with Animal Breeding Places (which was developed for the State Department of Environment and Science (DES) in March 2018) are of relevance and have been included in the list below.

In addition to the mitigation measures listed in Table 4.1, Arrow's response to, and reporting of, injury or mortality of EPBC Act fauna during construction, operation and decommissioning is described in Sections 3.1 and 3.2.

Table 4.1 Description of additional mitigation measures / commitments

Mitigation	Commitment	Intended outcome	Responsible manager/s
Construction - clearing	<ul style="list-style-type: none"> See Table 3.1 		
Construction - Open trench management	<ul style="list-style-type: none"> Trenches will be inspected and monitored as per the APIA Code of Environmental Practice (B159) and will be checked within two hours of sunrise and trapped fauna released. Additional monitoring will be undertaken following rainfall events The time a trench is left open will be minimised. Fauna exit points will be incorporated when construction is within 1 km of native vegetation, using appropriate material. Fauna refuges, such as sawdust-filled bags, will be provided regularly through areas of high fauna activity As soon as practical following pipe laying, the trench will be backfilled with excavated material, compacted and topsoil replaced and erosion controls implemented 	<ul style="list-style-type: none"> To ensure that no unplanned impacts occur on Dunmall’s Snake, Koala, Collared Delma or Yakka Skink 	<ul style="list-style-type: none"> SGP Construction Managers (Arrow and Third Party Contractor)
Construction - Reduce light spill	<ul style="list-style-type: none"> Lighting will be designed in a manner that limits disruption on landscape character, views and visual amenity and lighting will be directed into the infrastructure siting rather than dispersed into native vegetation when sites are adjacent to intact habitat 	<ul style="list-style-type: none"> To ensure that no unplanned impacts occur on the Koala, South-eastern Long-eared Bat and Greater Glider 	<ul style="list-style-type: none"> SGP Construction Managers (Arrow and Third Party Contractor)
Construction - Reduce project traffic speed	<ul style="list-style-type: none"> Speed limits on Project controlled roads will be developed with due consideration to reduce the potential for vehicle collisions with wildlife 	<ul style="list-style-type: none"> To ensure that no unplanned impacts occur on Dunmall’s Snake, Squatter Pigeon, Koala or Yakka Skink 	<ul style="list-style-type: none"> SGP Construction Managers (Arrow and Third Party Contractor)
Construction - Bushfire	<ul style="list-style-type: none"> Fire management plans will be developed for production facilities Radiation exclusion zones around flares will be designed according to API standard Enclosed spaces where flammable gas may accumulate will be minimised Fire-fighting equipment will be installed, inspected and serviced in accordance with risk assessments and relevant legislation and standards Gathering lines will be buried at a minimum depth of 600 mm. Where gathering lines are present above the ground (at wellheads and at vents or drains), a clear area will be maintained. The size of the cleared area will be determined on a site-by-site basis with consideration of the site-specific risk of bushfire 	<ul style="list-style-type: none"> To avoid degradation of TECs To avoid reduction in the condition of listed threatened species habitat 	<ul style="list-style-type: none"> SGP Construction Managers (Arrow and Third Party Contractor)

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Mitigation	Commitment	Intended outcome	Responsible manager/s
	<ul style="list-style-type: none"> • Fire-safety equipment will be commissioned in the early phase of the construction period • All buildings and production facilities will be fitted with smoke or fire alarms • Fire and gas detection systems will be installed to shutdown compressors • Protocols will be developed for the control of operational activities during extreme fire danger periods, e.g., flaring or shutdowns • Regular patrols and inspections of pipeline easements will be conducted, including status of signposting subsidence and of fire breaks • Vegetation surrounding production facilities and wellheads will be maintained in a manner that limits the amount of combustible material in the area. The size of the cleared area will be determined on a site-by-site basis with consideration of the site-specific risk of bushfire • Access tracks to well sites will be kept clear of dry grass and combustible material wherever practicable and where there is a higher risk of bushfire (to minimise the risk of dry grass being ignited by hot components of vehicles accessing the sites) • Daily operations will be managed with consideration of the fire danger current at that time 		
Construction / Operation / Decommissioning - Weed control	<ul style="list-style-type: none"> • A detailed pest management plan will be developed to mitigate and manage the potential spread of pest flora and fauna species (B152). This plan will include requirements for machinery washdown procedures to be followed during all clearing activities • Weed monitoring and targeted weed control measures will be undertaken within sensitive EVNT habitats (particularly threatened communities such as Brigalow and native grasslands) (B158). Weed control methods within EVNT habitats will be selected on the basis of minimising the risk of adverse impacts on EVNT species or communities • In accordance with the Pest Management Plan regular inspections for pest flora and evidence of pest fauna will be undertaken within Project disturbed areas • Washdown facilities will be designed to ensure that runoff is contained on site and does not transfer weed seeds, spores or infected soils to adjacent areas • When sourcing maintenance materials, materials such as bedding sand, topsoil, straw bales and sand bags will be brought to site only after it is ascertained that the materials are not contaminated with weeds and plant or animal pathogens. A weed hygiene declaration form will be requested from the supplier where there is possible risk of 	<ul style="list-style-type: none"> • To avoid degradation of TECs • To avoid reduction in the condition of listed threatened species habitat • Successful implementation of Arrow's Vehicle and Machinery Hygiene Procedure (ORG-ARW-HSM-PRO-00138) and Weed Management Procedure (ORG-ARW-HSM-PRO-00139) 	<ul style="list-style-type: none"> • SGP Managers (Arrow and Third Party Contractor)

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Mitigation	Commitment	Intended outcome	Responsible manager/s
	<p>contamination in products</p> <ul style="list-style-type: none"> All relevant personnel will be made aware of the location and extent of weed infestations in the vicinity of the work area and the risks involved in moving from one site or property to another A declared weed and pest management plan will be developed in accordance with the Petroleum Industry – Pest Spread Minimisation Advisory Guide (Biosecurity Queensland, 2008). Species-specific management will be undertaken for identified key weed species at risk of spread through Project activities. Weed control efforts will be increased in areas particularly sensitive to invasion. The pest management plan will include, as a minimum, training, management of pest spread, management of pest infestations and monitoring effectiveness of control measures 		
Construction / Operation / Decommissioning – Pest control	<ul style="list-style-type: none"> Arrow will manage food, waste and other project activities to prevent or minimise the potential for these to transport or attract pest animals which may then impact MNES 	<ul style="list-style-type: none"> Successful implementation of Arrow’s Pest Management Procedure (ORG-ARW-HSM-PRO-00096) 	<ul style="list-style-type: none"> SGP Managers (Arrow and Third Party Contractor)
Operation - Grazing	<ul style="list-style-type: none"> Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites 	<ul style="list-style-type: none"> To avoid degradation of TECs To avoid reduction in the condition of listed threatened species habitat 	<ul style="list-style-type: none"> SGP Operations Managers (Arrow)
Operation / decommissioning - Appropriate rehabilitation	<ul style="list-style-type: none"> The cleared areas and stockpiles will be progressively rehabilitated through revegetation and/or mulching Areas will be cleared progressively and rehabilitation implemented as soon as practicable following construction and decommissioning activities Rehabilitation timeframes will be compliant with applicable Environmental Authority conditions and consider any landholder requirements/expectations Rehabilitation plans will be developed addressing ground preparation requirements, natural and constructed drainage patterns, soil erodibility, contamination, slope steepness and length, vegetation cover, land use and landowner requirements. Partial rehabilitation of gathering lines and other linear infrastructure will be undertaken to reduce edge effects (including weed invasion) and maintain movement rates Rehabilitation of available areas will be undertaken that is consistent with pre-clearance habitats, to increase the rate of recovery 	<ul style="list-style-type: none"> To ensure that no unplanned impacts occur on MNES as a result of construction activities To return the area to pre-disturbed condition (or better) as agreed with the landholder and as required by DES in order to grant progressive rehabilitation certification and EA surrender 	<ul style="list-style-type: none"> SGP Managers (Arrow and Third Party Contractor)

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

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Mitigation	Commitment	Intended outcome	Responsible manager/s
	<p>status, will be prepared and submitted to the appropriate authorities for approval where required</p> <ul style="list-style-type: none"> • The area disturbed within the pipeline corridor during the laying of the pipelines will be progressively rehabilitated as soon as practicable after completion of the pipeline installation. Fences, roads and tracks and other existing infrastructure impacted during construction of the pipeline will be repaired and/or replaced as required • At decommissioning, a suitable vegetation cover will be re-established to enable natural vegetation progression and minimal weed invasion • Final ground conditions will be rehabilitated to a state that is conducive to support further natural regeneration at project closure 		
Construction / Operation / Decommissioning - Documentation	<ul style="list-style-type: none"> • A Water Management Plan, Erosion and Sediment Control Plan, and Waste Management Plan will be designed to avoid or minimise the potential impacts of Project • Corrective actions will be undertaken in accordance with the outcomes of incident investigations, audits, monitoring results or advice given by the relevant regulatory authority • Arrow will develop emergency response plans in consultation with emergency services organisations that includes a list of required equipment, training and other resources, and foreseeable emergency and crisis situations. The plans will include safe evacuation procedures, communication protocols (internal and to emergency services, including the Petroleum and Gas Inspectorate), accounting for personnel and visitors, roles and responsibilities, and requirements for training • Any residual impacts to EPBC Act species and communities will be offset. A detailed SGP Phase 1 Offset Strategy and additional offset strategies for the subsequent phases will be developed and implemented to add value rather than just compensating for impact 	<ul style="list-style-type: none"> • To ensure that the planned (and actual) impacts to MNES are accurately documented and offset 	<ul style="list-style-type: none"> • Environment Manager (Arrow)
Construction / Operation / Decommissioning - Hazardous materials management	<ul style="list-style-type: none"> • Appropriate international, Australian and industry standards and codes of practice will be applied for the handling and storage of hazardous materials, such as chemicals, fuels and lubricants • Appropriate spill response equipment including containment and recovery equipment will be available onsite • Staff will be trained on appropriate handling, storage and containment practices for chemical, fuels and other potential chemicals as relevant 	<ul style="list-style-type: none"> • To avoid degradation of TECs • To avoid reduction in the condition of listed threatened species habitat 	<ul style="list-style-type: none"> • SGP Managers (Arrow and Third Party Contractor)

5. Monitoring program

Condition 7A(c): A monitoring program to determine the success of impacts avoidance and mitigation measures and that will inform adaptive implementation of the action for the duration of this approval.

Monitoring will be undertaken to determine the success of the mitigation and management measures identified within this SIMP and to identify whether the general objectives of the rehabilitation strategy are being met, and whether a sustainable and stable landform has been achieved. The monitoring program will focus on those sensitive ecological values at risk of a high level of residual impact and will be based on review and assurance of the environmental management plan active for the site. The plan will include reference to the relevant environmental impact management processes and procedures, assurance methods and incident response procedures.

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

Table 5.1 sets out the monitoring program which will be undertaken which relate specifically to EPBC Act species and communities. The table describes the location, methods and proposed timing as well as identifying responsible parties, reporting formats, trigger values for corrective actions to be initiated and describes adaptive management responses and / or how they will be determined.

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

Table 5.2 identifies the indicators of success and corrective actions that correlate to each of the mitigation measures identified in Tables 3.1 and 4.1.

Table 5.1 Monitoring program components for EPBC Act species and communities

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

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Monitoring Activities	Methods / commitments	Locations	Timing	Who	Reporting format	Corrective action trigger values	Adaptive management responses
	<ul style="list-style-type: none"> identification of site-specific sensitive areas (e.g. ESAs) that require avoidance or buffers. <p>Quantification will be based on field recording of GPS coordinates of the boundary of the habitat within proposed clearing boundaries. These surveys will also be used to ensure that the limits of the area to be cleared are clearly marked on the ground (i.e. high visibility flagging tape, hazard netting or similar) in accordance with the construction limits shown on construction drawings.</p>					communities including any residual significant impact to any of these that are not included in Table 1 of the EPBC approval.	to DotEE and Department of Environment and Science (DES). Approval for additional unavoidable residual significant impacts to any EPBC Act species or community (including any of these which were not in Table 1 of the EPBC approval) will be sought. Arrow also commits to providing offsets for any such additional residual significant impacts.
	Key Koala trees will be identified and visually inspected prior to clearing to ensure that they are free of Koalas.	Proposed vegetation clearing sites	Prior to vegetation clearing and daily during clearing works	Supervised by a suitably qualified person	Koala presence recorded within Geocortex and the Arrow Sharepoint database. Spotter-catcher daily activity records	Koalas located	Trees containing Koalas retained until the animals have moved on.
	Hollow-bearing tree locations and patches of vegetation with a distinct canopy and a dense cluttered shrub layer will be recorded.	Proposed vegetation clearing areas within habitat for MNES	Prior to vegetation clearing	Supervised by a suitably qualified person	Hollow-bearing trees and preferred habitat patches recorded within Geocortex and the Arrow Sharepoint database	Hollow-bearing tree and preferred habitat patches identified	Spotter-catcher present and search for this species in these areas during clearing.

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

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

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

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

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

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

Table 5.2 Description of mitigation measures, indicators of success and corrective actions

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

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

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

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

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Mitigation	Commitment	Indicator of success	Corrective action
Protection of topsoils	<ul style="list-style-type: none"> • Soil will be stripped according to designated profile depths, subject to further field investigations during stripping. • Where practicable, stripped material will be placed directly onto area to be rehabilitated and spread immediately (if rehabilitation sequences and weather conditions permit) to avoid the requirement for stockpiling. • Soils will be separated into windrows for later collection or re-spreading to minimise compression effects of heavy equipment. • Soil transported by dump trucks may be placed directly into storage. Soil transported by scrapers will be pushed to form stockpiles by other equipment (e.g. dozer) to avoid tracking over previously laid soil to minimise compaction. • Surface of soil stockpiles will be left in as coarsely structured a condition as possible to promote infiltration and minimise erosion until vegetation is established or suitable erosion controls have been applied, and to prevent anaerobic zones from forming. • Pipeline construction will be conducted in a manner that limits the duration of exposure of soils. Stripped and salvaged soil will be re-used within a short period of time (i.e. 28 days) in areas where rehabilitation immediately follows the installation of pipelines. • Erosion and Sediment Control Plans will be developed and maintained in accordance with the International Erosion Control Association (IECA) (2008) Best Practice Erosion and Sediment Control guidelines. All proposed erosion and sediment control measures will be implemented in advance of, or in conjunction with clearing activities. • Topsoil will be stripped, salvaged and stockpiled separately from subsoils. • Appropriate sediment and erosion control structures will be installed and maintained at work sites. • Best practice erosion and sediment control measures will be implement during decommissioning works in accordance with the requirements of the IECA (2008) Best Practice Erosion and Sediment Control manual. 	<ul style="list-style-type: none"> • Erosion and Sediment Control Plans (inclusive of topsoil management specifications) in place and implemented prior to all clearing activities. 	<ul style="list-style-type: none"> • Development and implementation of Plans
Open trench management	<ul style="list-style-type: none"> • Trenches will be inspected and monitored as per the APIA Code of Environmental Practice and will be checked within two hours of sunrise and trapped fauna released. Additional inspections will be undertaken following rainfall events. 	<ul style="list-style-type: none"> • Site records / photographs demonstrating compliance 	<ul style="list-style-type: none"> • Investigate the cause of non-conformance and amend the relevant processes / procedures to avoid future non-

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Mitigation	Commitment	Indicator of success	Corrective action
	<ul style="list-style-type: none"> The time a trench is left open will be minimised. Fauna exit points will be incorporated when construction is within 1 km of native vegetation, using appropriate material. Fauna refuges, such as sawdust-filled bags, will be provided regularly through areas of high fauna activity. Harm to fauna from entrapment during construction and operation of dams will be prevented. As soon as practical following pipe laying, the trench will be backfilled with excavated material, compacted and topsoil replaced and erosion controls implemented. 		conformance
Fauna spotter catcher	<ul style="list-style-type: none"> Suitably qualified fauna spotter-catcher (FSC) or ecologist will capture injured wildlife, where possible. Injured wildlife resultant from land clearing will be taken to a qualified veterinary surgeon or carer where practical (B153). The FSC will be at the site on the day of clearing. The FSC will be suitably qualified as per the definition provided in EPBC 2010/5344. The number of FSCs on site at the time of clearing will depend on the number of machines being used at any given time. Trees will be assessed for potential nesting hollows prior to felling. If hollows are identified, trees will be felled in the presence of a qualified FSC and rolled so that the hollows are facing upwards, allowing fauna to escape. Key Koala trees will be identified and visually inspect prior to clearing to ensure that they are free of Koalas. If Koalas are located, the tree will be retained until the animals have moved on, typically overnight. Checks for identified EPBC Act fauna species breeding places will be undertaken immediately prior to commencing vegetation clearing. Potential breeding places will be clearly marked in the field with spray paint, coloured flagging tape (unless not permitted by land owners, e.g. some cattle properties), or by other suitable methods. 	<ul style="list-style-type: none"> Review of spotter/catcher records / notes demonstrates compliance Potential breeding places are clearly marked in the field 	<ul style="list-style-type: none"> Reinforce the requirement to follow Arrow's Fauna Spotter/Catcher Work Instruction document (ORG-ARW-AND-WOI-00001) Investigate the cause of non-conformance and amend the relevant processes / procedures to avoid future non-conformance
Appropriate rehabilitation	<ul style="list-style-type: none"> The cleared areas and stockpiles will be progressively rehabilitated through revegetation and/or mulching. Areas will be cleared progressively and rehabilitation implemented as soon as practicable following construction and decommissioning activities. 	<ul style="list-style-type: none"> Inspection of site during and after installation of infrastructure demonstrates compliance That the area has been returned to pre-disturbed 	<ul style="list-style-type: none"> Early and clear communication with the construction crew if inspections are not demonstrating compliance

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Mitigation	Commitment	Indicator of success	Corrective action
	<ul style="list-style-type: none"> • Rehabilitation timeframes will be compliant with applicable Environmental Authority conditions and consider any landholder requirements/expectations. • Rehabilitation plans will be developed addressing ground preparation requirements, natural and constructed drainage patterns, soil erodibility, contamination, slope steepness and length, vegetation cover, land use and landowner requirements. Partial rehabilitation of gathering lines and other linear infrastructure will be undertaken to reduce edge effects (including weed invasion) and maintain movement rates. • Rehabilitation of available areas will be undertaken that is consistent with pre-clearance habitats, to increase the rate of recovery. • Woody debris, logs and rocks will be retained for use in rehabilitation. Where practical, these will be piled along the edge of the cleared corridor. Where possible these features will be spread over all or part of the corridor to provide refugia for crossing fauna. Systematic removal of surface debris will be avoided and cleared timber will never be burnt. • Data collection, particularly of EVNT species identified during pre-clearance surveys, during trench checking or in other Project related activities, will be ongoing until rehabilitation is complete. • Site planning, preparation and management requirements will be implemented in accordance with a decommissioning and rehabilitation plan. • After decommissioning, rehabilitation areas will be inspected for regrowth similar to the surrounding environment. • Regular monitoring of rehabilitation success will be carried out. • During rehabilitation works, care will be taken when moving stockpiled logs and vegetation to avoid fauna mortality. • Excavations, particularly pipeline trenches and drilling sumps, will be backfilled and rehabilitated. Backfilling will be conducted in a manner that will promote successful rehabilitation, including capping of exposed subsoil with topsoil and replacement of the land surface to preconstruction levels to reduce trench subsidence and concentration of flow. Soils will be mounded where required to allow for settling. However, in laser-levelled paddocks, this may not be practicable, and backfilling will be carried out in consultation with the landowner. 	<p>condition (or better) as agreed with the landholder and as required by DES in order to grant progressive rehabilitation certification and EA surrender.</p> <ul style="list-style-type: none"> • Progressive rehabilitation certification is granted by the Department of Environment and Science (DES) when requested. • The EA surrender application including the Final Rehabilitation Report and landholder signoff is granted by the DES. 	<ul style="list-style-type: none"> • Continued remediation and rehabilitation of the disturbed areas until the progressive rehabilitation certification is granted • Continued remediation and rehabilitation of the disturbed areas until the EA surrender application is granted

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Mitigation	Commitment	Indicator of success	Corrective action
	<ul style="list-style-type: none"> • A rehabilitation management plan for decommissioning will be developed and implemented which includes monitoring and maintenance of rehabilitated areas until rehabilitation sign off criteria are met. • Monitoring of the rehabilitated areas will be undertaken to identify whether the general objectives of the rehabilitation strategy are being met, and whether a sustainable and stable landform has been achieved. Monitoring will be conducted by suitably skilled and qualified persons at representative locations. Annual reviews of monitoring data will be conducted during operations, and post closure, to assess trends and performance. • A final rehabilitation report and a decommissioning plan, including a contaminated land assessment where required, landowner commitments and agreements, and rehabilitation status, will be prepared and submitted to the appropriate authorities for approval where required. • The area disturbed within the pipeline corridor during the laying of the pipelines will be progressively rehabilitated as soon as practicable after completion of the pipeline installation. Fences, roads and tracks and other existing infrastructure impacted during construction of the pipeline will be repaired and/or replaced as required. • At decommissioning, a suitable vegetation cover will be re-established to enable natural vegetation progression and minimal weed invasion. • Final ground conditions will be rehabilitated to a state that is conducive to support further natural regeneration at project closure. 		
Reduce light spill	<ul style="list-style-type: none"> • Lighting will be designed in a manner that limits disruption on landscape character, views and visual amenity and lighting will be directed into the infrastructure siting rather than dispersed into native vegetation when sites are adjacent to intact habitat. 	<ul style="list-style-type: none"> • No lighting directed towards intact MNES habitat 	<ul style="list-style-type: none"> • Lighting redirected or shielded away from intact habitat
Reduce project traffic speed	<ul style="list-style-type: none"> • Speed limits on Project controlled roads will be developed with due consideration to reduce the potential for vehicle collisions with wildlife. 	<ul style="list-style-type: none"> • Review reports generated from Arrow's In-Vehicle Monitoring System (IVMS) 	<ul style="list-style-type: none"> • Clear communication and warning for any IVMS breaches
Weed control	<ul style="list-style-type: none"> • A detailed pest management plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. This plan will include requirements for machinery washdown procedures to be followed during all clearing activities. 	<ul style="list-style-type: none"> • Inspection of site after installation of infrastructure demonstrates compliance • High risk weeds are managed as per Arrow's Weed 	<ul style="list-style-type: none"> • Reinforce the requirement to follow Arrow's Vehicle and Machinery Hygiene Procedure (ORG-ARW-

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Mitigation	Commitment	Indicator of success	Corrective action
	<ul style="list-style-type: none"> • Weed monitoring and targeted weed control measures will be undertaken within sensitive EVNT habitats (particularly threatened communities such as Brigalow and native grasslands). Weed control methods within EVNT habitats will be selected on the basis of minimising the risk of adverse impacts on EVNT species or communities. • In accordance with the Pest Management Plan regular inspections for pest flora and evidence of pest fauna will be undertaken within Project disturbed areas. • Washdown facilities will be designed to ensure that runoff is contained on site and does not transfer weed seeds, spores or infected soils to adjacent areas. • When sourcing maintenance materials, materials such as bedding sand, topsoil, straw bales and sand bags will be brought to site only after it is ascertained that the materials are not contaminated with weeds and plant or animal pathogens. A weed hygiene declaration form will be requested from the supplier where there is possible risk of contamination in products. • All relevant personnel will be made aware of the location and extent of weed infestations in the vicinity of the work area and the risks involved in moving from one site or property to another. • A declared weed and pest management plan will be developed in accordance with the Petroleum Industry – Pest Spread Minimisation Advisory Guide (Biosecurity Queensland, 2008). Species-specific management will be undertaken for identified key weed species at risk of spread through Project activities. Weed control efforts will be increased in areas particularly sensitive to invasion. The pest management plan will include, as a minimum, training, management of pest spread, management of pest infestations and monitoring effectiveness of control measures. 	<p>Management Procedure (ORG-ARW-HSM-PRO-00139)</p>	<p>HSM-PRO-00138) and Weed Management Procedure</p>
Grazing	<ul style="list-style-type: none"> • Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites. 	<ul style="list-style-type: none"> • Livestock absent from infrastructure sites 	<ul style="list-style-type: none"> • Reinstate integrity of exclusion fencing
Documentation	<ul style="list-style-type: none"> • A Water Management Plan, Erosion and Sediment Control Plan, and Waste Management Plan will be designed to avoid or minimise the potential impacts of Project. • Corrective actions will be undertaken in accordance with the outcomes of incident investigations, audits, monitoring results or advice given by the relevant regulatory authority. 	<ul style="list-style-type: none"> • Water Management Plan, Erosion and Sediment Control Plan, and Waste Management Plan in place for the Project and Offset Strategy in place for 	<ul style="list-style-type: none"> • Develop and implement required plans • Investigate the cause of non-conformance and amend the relevant

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Mitigation	Commitment	Indicator of success	Corrective action
	<ul style="list-style-type: none"> Arrow will develop emergency response plans in consultation with emergency services organisations that includes a list of required equipment, training and other resources, and foreseeable emergency and crisis situations (including escapes, blowouts, gas fire, bushfire, critical equipment failure, trapped or missing people, flooding, cyclones, power failure, security incidents and threats, and transport incidents). The plans will include safe evacuation procedures, communication protocols (internal and to emergency services, including the Petroleum and Gas Inspectorate), accounting for personnel and visitors, roles and responsibilities, and requirements for training. Any residual impacts to EPBC Act species and communities will be offset. A detailed SGP Phase 1 Offset Strategy and additional offset strategies for the subsequent phases will be developed and implemented to add value rather than just compensating for impact. 	relevant phase of the Project	processes / procedures to avoid future non-conformance
Hazardous materials management	<ul style="list-style-type: none"> Appropriate international, Australian and industry standards and codes of practice will be applied for the handling and storage of hazardous materials, such as chemicals, fuels and lubricants. Appropriate spill response equipment including containment and recovery equipment will be available onsite. Staff will be trained on appropriate handling, storage and containment practices for chemical, fuels and other potential chemicals as relevant. 	<ul style="list-style-type: none"> Records of training provided to construction crews demonstrating compliance 	<ul style="list-style-type: none"> Undertake and record evidence of such training Investigate the cause of non-conformance and amend the relevant processes / procedures to avoid future non-conformance
Bushfire	<ul style="list-style-type: none"> Fire management plans will be developed for production facilities. Radiation exclusion zones around flares will be designed according to API standard. Enclosed spaces where flammable gas may accumulate will be minimised. Fire-fighting equipment will be installed, inspected and serviced in accordance with risk assessments and relevant legislation and standards. Gathering lines will be buried at a minimum depth of 600 mm. Where gathering lines are present above the ground (at wellheads and at vents or drains), a clear area will be maintained. The size of the cleared area will be determined on a site-by-site basis with consideration of the site-specific risk of bushfire. Fire-safety equipment will be commissioned in the early phase of the construction period. 	<ul style="list-style-type: none"> Fire management plans in place and implemented prior for all production facilities 	<ul style="list-style-type: none"> Development and implementation of required plans Investigate the cause of non-conformance and amend the relevant processes / procedures to avoid future non-conformance

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Mitigation	Commitment	Indicator of success	Corrective action
	<ul style="list-style-type: none"> • All buildings and production facilities will be fitted with smoke or fire alarms. • Fire and gas detection systems will be installed to shutdown compressors. • Protocols will be developed for the control of operational activities during extreme fire danger periods, e.g., flaring or shutdowns. • Regular patrols and inspections of pipeline easements will be conducted, including status of signposting subsidence and of fire breaks. • Vegetation surrounding production facilities and wellheads will be maintained in a manner that limits the amount of combustible material in the area. The size of the cleared area will be determined on a site-by-site basis with consideration of the site-specific risk of bushfire. • Access tracks to well sites will be kept clear of dry grass and combustible material wherever practicable and where there is a higher risk of bushfire (to minimise the risk of dry grass being ignited by hot components of vehicles accessing the sites). • Project vehicles will not be driven or parked off-track in situations that are a high risk of igniting a grass fire. • Daily operations will be managed with consideration of the fire danger current at that time. 		

6. Consistencies with relevant documents

Condition 7A(d): A description of how measures proposed in the EPBC Species Impact Management Plan are consistent with the measures in relevant conservation advice, recovery plans and threat abatement plans.

Table 6.1 Relevant documents for each of the MNES addressed by this SIMP

MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
Terrestrial Species				
Curly-bark Wattle (<i>Acacia curranii</i>)	<ul style="list-style-type: none"> Advice dated 1 October 2008 Focuses on grazing and fire management 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> The main identified threats to Curly-bark Wattle are habitat erosion, grazing by feral goats, stock, rabbits and macropods; clearing of vegetation for fire trail widening 	<ul style="list-style-type: none"> Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites Fire management plans will be developed for production facilities Fire-fighting equipment will be installed, inspected and serviced in accordance with risk assessments and relevant legislation and standards
Hando’s Wattle (<i>Acacia handonis</i>)	<ul style="list-style-type: none"> Advice dated 1 October 2008 Focuses on inappropriate fire regimes 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Fire management plans will be developed for production facilities Fire-fighting equipment will be installed, inspected and serviced in accordance with risk assessments and relevant legislation and standards
Belson’s Panic (<i>Homopholis belsonii</i>)	<ul style="list-style-type: none"> Advice dated 1 October 2008 Focuses on loss of populations via habitat clearing for agriculture and mining; grazing and weed invasion 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites Inspect work sites and access routes for notifiable weeds and pest plants and animals prior to accessing the site Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites

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MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
Lobed Blue Grass (<i>Bothriochloa biloba</i>)	<ul style="list-style-type: none"> Advice dated 14 December 2013 No current known threats. Potential threats are grazing and weed invasion 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites Inspect work sites and access routes for notifiable weeds and pest plants and animals prior to accessing the site Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites
Kogan Waxflower (<i>Philotheca sporadica</i>)	<ul style="list-style-type: none"> Advice dated July 2008 Loss of large roadside populations is biggest risk due to insecure land tenure 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Pre-clearance surveys to avoid the species where possible Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries
<i>Prostanthera</i> sp <i>Dunmore</i>	<ul style="list-style-type: none"> Advice dated 1 October 2008 Main threats habitat degradation via timber harvesting; inappropriate fire regimes 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts Fire management plans will be developed for production facilities Fire-fighting equipment will be installed, inspected and serviced in accordance with risk assessments and relevant legislation and standards
Small-leaved Denhamia (<i>Denhamia parvifolia</i>)	<ul style="list-style-type: none"> Advice dated 16 December 2008 Main threats are the legacy of broad-scale clearing; changed fire regimes; grazing; weed 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Fire management plans will be developed for production facilities Fire-fighting equipment will be installed, inspected and serviced in accordance with risk assessments and relevant legislation and standards

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MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
	invasion			<ul style="list-style-type: none"> Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites Inspect work sites and access routes for notifiable weeds and pest plants and animals prior to accessing the site Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites
<i>Calytrix gurlmundensis</i>	<ul style="list-style-type: none"> Advice dated 1 October 2008 Main threats are clearing; fragmentation; changed fire regimes; quarrying; timber harvesting 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts Fire management plans will be developed for production facilities
Finger Panic Grass (<i>Digitaria australe</i>)	<ul style="list-style-type: none"> Advice dated 14 December 2013 Main threats are clearing for agriculture; fragmentation; fire; trampling by livestock 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts Fire management plans will be developed for production facilities Grazing activities will be excluded from all Arrow gas and water processing and well head

MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
				infrastructure sites
Austral Toadflax (<i>Thesium australe</i>)	<ul style="list-style-type: none"> Advice dated 17 December 2013 Main threats are lack of fire; grazing; clearing for development; weed invasion 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites Minimise the disturbance footprint and vegetation clearing Inspect work sites and access routes for notifiable weeds and pest plants and animals prior to accessing the site Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites
<i>Acacia lauta</i>	<ul style="list-style-type: none"> Advice dated 1 October 2008 Threats largely unknown. Susceptible to clearing for road widening and too frequent fire 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts Fire management plans will be developed for production facilities
Cobar Greenhood Orchid (<i>Pterostylis cobarensis</i>)	<ul style="list-style-type: none"> Advice dated 14 December 2013 Main threats are grazing by feral goats; broad-scale clearing; changed hydrology and salinity; weed invasion 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites Rehabilitation plans will be developed addressing ground preparation requirements, natural and constructed drainage patterns, soil erodibility, contamination, slope steepness and length,

MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
				<p>vegetation cover, land use and landowner requirements. Partial rehabilitation of gathering lines and other linear infrastructure will be undertaken to reduce edge effects (including weed invasion) and maintain movement rates</p> <ul style="list-style-type: none"> Rehabilitation of available areas will be undertaken that is consistent with pre-clearance habitats, to increase the rate of recovery
<i>Xerothamnella herbacea</i>	<ul style="list-style-type: none"> Advice dated 1 October 2008 Main threats competition from invasive plants; road widening; trampling 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites
Hawkweed (<i>Picris evae</i>)	<ul style="list-style-type: none"> Advice dated 1 October 2008 The main threats are weed invasion; inappropriate fire regimes; habitat fragmentation; clearing of vegetation for cropping and grazing 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites Fire management plans will be developed for production facilities Minimise the disturbance footprint and vegetation clearing
Austral Cornflower (<i>Rhaponticum australe</i>)	<ul style="list-style-type: none"> Advice dated 16 December 2008 The main threats include broad-scale vegetation clearing; invasion by exotic weeds; grazing pressure and road works 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites

SGP Species Impact Management Plan

MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
<i>Eucalyptus virens</i>	<ul style="list-style-type: none"> Advice dated 16 December 2008 The main threats include timber harvesting; loss of habitat due to vegetation clearing 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries
King Bluegrass (<i>Dichanthium queenslandicum</i>)	<ul style="list-style-type: none"> Advice dated 30 January 2013 Focuses on habitat loss via agriculture and mining; grazing; weed invasion 	<ul style="list-style-type: none"> Recovery Plan is required 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites
Queensland White-gum (<i>Eucalyptus argophloia</i>)	<ul style="list-style-type: none"> Advice dated 1 October 2008 Main threat is habitat destruction for agriculture and grazing; timber harvesting; road widening 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts
South-eastern Long-eared Bat (<i>Nyctophilus corbeni</i>)	<ul style="list-style-type: none"> Advice dated October 2015 Protect known and potential habitat of key populations from habitat loss and 	<ul style="list-style-type: none"> Required – included on the ‘Commenced’ list Recovery objectives are to increase understanding of 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species Key threats are provided in the 	<ul style="list-style-type: none"> No clearing will occur in the Eena, Bracker or Barakula State Forests When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts

MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
	fragmentation (Eena SF, Bracker SF and Barakula SF in Qld)	basic ecology and to clarify distribution and abundance	conservation advice	
Dunmall’s Snale (<i>Furina dunmalli</i>)	<ul style="list-style-type: none"> Advice dated April 2014 Legacy of past broad scale land clearing for grazing and agriculture Manage disruptions to water flow and modifications to wetlands; investigate conservation arrangements 	<ul style="list-style-type: none"> Not required – see Conservation Advice 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species Key threats are provided in the conservation advice 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries Rehabilitation plans will be developed addressing ground preparation requirements, natural and constructed drainage patterns, soil erodibility, contamination, slope steepness and length, vegetation cover, land use and landowner requirements. Partial rehabilitation of gathering lines and other linear infrastructure will be undertaken to reduce edge effects (including weed invasion) and maintain movement rates Rehabilitation of available areas will be undertaken that is consistent with pre-clearance habitats, to increase the rate of recovery
Five-clawed Wormskink (<i>Anomalopus mackayi</i>)	<ul style="list-style-type: none"> Advice dated 26 March 2008 Main threat is habitat clearing for agriculture and development; overgrazing; predation from foxes and feral cats; soil and water pollution 	<ul style="list-style-type: none"> Not Required – included on the ‘Not Commenced’ list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites Arrow will manage food, waste and other project activities to prevent or minimise the potential for these to transport or attract pest animals which may then impact MNES Rehabilitation plans will be developed addressing ground preparation requirements, natural and

MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
				constructed drainage patterns, soil erodibility, contamination, slope steepness and length, vegetation cover, land use and landowner requirements. Partial rehabilitation of gathering lines and other linear infrastructure will be undertaken to reduce edge effects (including weed invasion) and maintain movement rates
Squatter Pigeon (<i>Geophaps scripta scripta</i>)	<ul style="list-style-type: none"> Advice dated Oct 2015 Nests on the ground Manage habitat loss and fragmentation, overgrazing by livestock and rabbits, weeds, inappropriate fire regimes, predation by feral cats and fox and illegal shooting 	<ul style="list-style-type: none"> Not required – see conservation advice 	<ul style="list-style-type: none"> The <i>Threat abatement plan for predation by cats</i> (DoE, 2015a) is identified as relevant The <i>threat abatement plan for competition and land degradation by rabbits</i> (DotEE, 2016) is identified as relevant The <i>Threat abatement plan for predation by European red fox</i> (DEWHA, 2008c) is identified as relevant Squatter Pigeon identified as a species being affected by rabbits 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites Arrow will manage food, waste and other project activities to prevent or minimise the potential for these to transport or attract pest animals which may then impact MNES Fire management plans will be developed for production facilities Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites

SGP Species Impact Management Plan

MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
			(through habitat degradation) and by feral cats (through predation).	
Regent Honeyeater (<i>Anthochaera phrygia</i>)	<ul style="list-style-type: none"> Advice dated 8 July 2015 Focuses on clearing of mature trees; fragmentation; inappropriate fire regimes 	<ul style="list-style-type: none"> Recovery Plan is required 	<ul style="list-style-type: none"> A broader plan targeting competition and land degradation from rabbits is linked to this species 	<ul style="list-style-type: none"> When clearing vegetation, seek to avoid clearing hollow-bearing trees, creating gaps in stands or patches or isolating parcels of remnant vegetation from more continuous tracts Fire management plans will be developed for production facilities Fire-fighting equipment will be installed, inspected and serviced in accordance with risk assessments and relevant legislation and standards
Collared Delma (<i>Delma torquata</i>)	<ul style="list-style-type: none"> Advice dated 3 July 2008 Main threats loss of habitat from urban and agricultural development; removal of surface rocks; weed invasion 	<ul style="list-style-type: none"> Not Required – included on the 'Not Commenced' list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries Rehabilitation plans will be developed addressing ground preparation requirements, retaining surface rocks, natural and constructed drainage patterns, soil erodibility, contamination, slope steepness and length, vegetation cover, land use and landowner requirements. Partial rehabilitation of gathering lines and other linear infrastructure will be undertaken to reduce edge effects (including weed invasion)
Yakka Skink (<i>Ergernia rugosa</i>)	<ul style="list-style-type: none"> Advice dated 29 April 2014 Main threats are legacy clearing; agricultural 	<ul style="list-style-type: none"> Not Required – included on the 'Not Commenced' list 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Rehabilitation plans will be developed addressing ground preparation requirements, retaining woody debris and surface rocks, natural and constructed drainage patterns, soil erodibility,

MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
	development; removal of wood debris; inappropriate roadside maintenance; predation by feral animals			contamination, slope steepness and length, vegetation cover, land use and landowner requirements. Partial rehabilitation of gathering lines and other linear infrastructure will be undertaken to reduce edge effects (including weed invasion) <ul style="list-style-type: none"> Arrow will manage food, waste and other project activities to prevent or minimise the potential for these to transport or attract pest animals which may then impact MNES
Australian Painted Snipe (<i>Rostratula australis</i>)	<ul style="list-style-type: none"> Advice dated 30 May 2013 Main threat is loss or degradation of wetlands; potential predation by foxes and cats 	<ul style="list-style-type: none"> Recovery Plan required 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> Avoid totally, or where not possible minimise the disturbance footprint and clearing of wetlands Rehabilitation of available areas will be undertaken that is consistent with pre-clearance habitats, to increase the rate of recovery Arrow will manage food, waste and other project activities to prevent or minimise the potential for these to transport or attract pest animals which may then impact MNES
Koala	<ul style="list-style-type: none"> Advice dated April 2012 Manage habitat loss and fragmentation, vehicle strike, disease and predation by dogs 	<ul style="list-style-type: none"> Multiple National and State-based plans 	<ul style="list-style-type: none"> Multiple National and State-based plans 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts Implement speed limits on project-controlled roads to reduce the potential for vehicle collisions with wildlife Arrow will manage food, waste and other project activities to prevent or minimise the potential for

SGP Species Impact Management Plan

MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
				these to transport or attract pest animals which may then impact MNES
Greater Glider	<ul style="list-style-type: none"> Advice dated May 2016 Cumulative effects of clearing and logging activities, current burning regimes and the impacts of climate change are a major threat to large hollow-bearing trees on which the species relies 	<ul style="list-style-type: none"> Recovery Plan required 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species Key threats are provided in the conservation advice 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing When clearing vegetation, seek to avoid clearing hollow-bearing trees, creating gaps in stands or patches or isolating parcels of remnant vegetation from more continuous tracts Fire management plans will be developed for production facilities Fire-fighting equipment will be installed, inspected and serviced in accordance with risk assessments and relevant legislation and standards
Painted Honeyeater	<ul style="list-style-type: none"> Advice dated July 2015 Habitat loss is the key threat to this species 	<ul style="list-style-type: none"> Recovery Plan required 	<ul style="list-style-type: none"> No Plan has been identified as being relevant for this species Key threats are provided in the conservation advice 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries
EPBC Communities				
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	<ul style="list-style-type: none"> Advice dated December 2013 Qld Government <i>Brigalow and Other Lands Development Act 1962</i> and <i>Brigalow Development Scheme</i> encouraged and funded the clearing of Brigalow 	<ul style="list-style-type: none"> Recovery Plan required 	<ul style="list-style-type: none"> No relevant Plan Links to the <i>Threat Abatement Plan for the biological effects</i> is provided on the DotEE webpage 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries Fire management plans will be developed for production facilities Fire-fighting equipment will be installed, inspected and serviced in accordance with risk

SGP Species Impact Management Plan

MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
	<p>to increase cattle stocking rates</p> <ul style="list-style-type: none"> • Key threats to remaining populations are clearing, fire, weeds, feral animals and grazing 			<p>assessments and relevant legislation and standards</p> <ul style="list-style-type: none"> • Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites • Arrow will manage food, waste and other project activities to prevent or minimise the potential for these to transport or attract pest animals which may then impact MNES • Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites
<p>Coolibah-Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregion</p>	<ul style="list-style-type: none"> • Advice dated 10 February 2011 • Main threats clearing and fragmentation; changes to hydrology; grazing; weed invasion 	<ul style="list-style-type: none"> • Recovery Plan required 	<ul style="list-style-type: none"> • No Plan has been identified as being relevant for this species 	<ul style="list-style-type: none"> • Minimise the disturbance footprint and vegetation clearing • Ensure construction activities do not extend beyond the work site boundaries • When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts • Rehabilitation plans will be developed addressing ground preparation requirements, natural and constructed drainage patterns, soil erodibility, contamination, slope steepness and length, vegetation cover, land use and landowner requirements. Partial rehabilitation of gathering lines and other linear infrastructure will be undertaken to reduce edge effects (including weed invasion) and maintain movement rates • Grazing activities will be excluded from all Arrow gas and water processing and well head infrastructure sites

SGP Species Impact Management Plan

MNES	Conservation Advice	Recovery Plan	Threat Abatement Plan	SIMP Consistency (Control measures included in Tables 3.1, 4.1 and 5.5 – the following are relevant to the particular MNES)
				<ul style="list-style-type: none"> Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites
Weeping Myall Woodlands	<ul style="list-style-type: none"> Advice dated December 2008 Manage clearing and degradation for agriculture and from overgrazing, weed invasion and herbivory by caterpillars of the Bag-shelter Moth 	<ul style="list-style-type: none"> Recovery Plan required 	<ul style="list-style-type: none"> The <i>Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads</i> (DSEWPAC, 2011) is identified as relevant 	<ul style="list-style-type: none"> Minimise the disturbance footprint and vegetation clearing Ensure construction activities do not extend beyond the work site boundaries When clearing vegetation, seek to avoid creating gaps in stands or patches and to avoid isolating parcels of remnant vegetation from more continuous tracts Wash down vehicles and equipment that have potentially been in contact with weeds before entering new work sites

7. Commencement of Stage 1

Condition 7B: The approval holder must not commence Stage 1 until an EPBC Species Impact Management Plan has been approved by the Minister in writing. The approved EPBC Species Impact Management Plan must be implemented by the approval holder.

Arrow provides the commitment that the Surat Gas Project will not commence until this EPBC Species Impact Management Plan has been approved by the Minister or delegate and that this EPBC Species Impact Management Plan will be implemented.

8. References

Arrow Energy (2012). Surat Gas Project Environmental Impact Statement.

Arrow Energy (2013). Supplementary Report to the Surat Gas Project Environmental Impact Statement.

Biosecurity Queensland (2008). Petroleum Industry (Including Coal Seam Methane Gas) Minimising Pet Spread Advisory Guidelines.

Department of Environment and Heritage Protection (2017). Queensland Environmental Offsets Policy. Version 1.4.

International Erosion Control Association (IECA) (2008). Best Practice Erosion and Sediment Control Guidelines.

9. Document Administration

This document has been created using ORG-ARW-IMT-TEM-00003 v4.0

Revision history

Revision	Revision Date	Revision Summary	Author
0.1	28 August 2017	Draft	M. Ryan
1.0	5 June 2018	Final	M. Ryan
2.0	27 July 2018	Revised Final	M. Ryan
3.0	15 October 2018	SIMP only Draft	M. Ryan
4.0	20 November 2018	Final SIMP	M. Ryan

Key document location

Confidential Project Pearl Drive

Related documents

Document Number	Document title

Acceptance and release

Author

Position	Incumbent
Manager Approvals	Michael Ryan

Contributors and reviewers

Position	Incumbent
Principal Ecologist	Paul Finn
Projects Environment Manager	Alison Way
Environment Manager	Scott Nairn
Manager Tenements and Overlapping Tenure	Suzanne Ferguson
SGP FEDM	Nathan Blundell
SGP Development Planning Lead	Taco Viets
Development Planner IFL	Chris Wicks

Approver(s)

Position	Incumbent
General Manager Surat Opportunities	Guy Young

APPENDIX A

Curriculum vitae of the suitably qualified ecologists that prepared the SIMP

Summary

Name	Qualifications	Years of Experience	Experience
Dr Michael Ryan (Author)	B. App. Sc; PhD (Ecology)	28	<ul style="list-style-type: none"> • 80 EIAs • 30 EPBC Referrals • 23 years of fauna field surveys
Dr Paul Finn (Technical Authority for SIMOP Review)	B. Sc (Hons); PhD (ecology)	19	<ul style="list-style-type: none"> • Detailed fauna and flora surveys • Targeted threatened species surveys and management plans • Migratory shorebird specialist
David Stanton (Flora surveys lead)	B. Sc (Hons)	24	<ul style="list-style-type: none"> • Professional and academic award winner • Extensive flora experience
Mark Sanders (Fauna surveys lead)	B. Sc (Hons)	20	<ul style="list-style-type: none"> • One of Australia's most respected field ecologists
Peter Hall (Future pre-clearance surveys)	B.Sc	20	<ul style="list-style-type: none"> • Flora surveys • Ecosystem assessment and validation • Habitat assessments • Land zone and soil classification



Dr Michael Ryan

Approvals Manager - Arrow Energy

Expertise

- Management of complex multi-disciplinary projects
- Advising and leading teams to deliver environmental impact and risk assessments
- Environmental legislation and approval processes

Summary

Dr Ryan is an experienced manager / director, having supervised and authored more than 80 environmental impact and risk assessments for development projects. Michael has an excellent working knowledge of Commonwealth and Queensland environmental approvals legislation for development projects (both primary and secondary approvals). For the last three years Michael has been the Approvals Manager for Arrow Energy and guest lecturer to post-graduate students at Bond University in Environmental Impact Assessment.

Michael sought and attained the collaboration of the Australian Government, the Queensland Government and the Western Australian Government in delivering joint half day pre-conference workshops on 'How to prepare a good EIS'. He is passionate about sharing knowledge and published the *Essentials Package for Successful Environmental Consulting*, a practical guidebook to assist practitioners on how to manage Environmental Impact Assessments, influence decision-makers and deliver agreed environmental outcomes.

He has excellent communication skills, both written and verbal, and has used these skills in negotiations and conflict resolution across all levels of government and non-government organizations.

Michael was selected by BHP Billiton to manage and author the Environmental Impact Statement (EIS) for the multi-billion dollar Olympic Dam mining and processing plant expansion in South Australia. He was also the Director and principal author for BHP Billiton's proposed Yeelirrie uranium mine in Western Australia. Michael was appointed as the Lead Environmental Consultant for Xstrata Copper (now Glencore) for the proposed Mount Isa Mines Open Pit Project in Queensland and the Tampakan Off Lease Linear Infrastructure Project in the Philippines.

Michael is innovative in his application of management standards to help organizations maximise socio-economic benefits, minimise impacts; comply with applicable laws and regulations; and develop frameworks for continual improvement via succinct guidelines, standards, management plans and monitoring programs.

Michael has extensive experience with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* having been an invited speaker on the EPBC Act for the Queensland Environmental Law Association, Environmental Protection Agency and the Queensland Resources Council. In October 2009, Michael was an invited speaker on achieving the balance between environmental legislation and company leadership at the China Mining 2010 Conference in Tianjin, China.

Qualifications

Bachelor of Applied Science, Queensland University of Technology, 1989
Doctor of Philosophy, Ecology, University of Queensland, 1996

**Projects as
Gamut Consulting**

Olympic Dam Expansion Investigation Phase Study Reports

Year: 2013 - 2014

Location: Semi-arid central South Australia (Roxby Downs)

Client: BHP Billiton

Main project features: BHP Billiton is re-investigating the mining and processing options for the previously approved expansion project.

Position held: Lead Environmental Consultant

Activities performed: Michael is assisting the BHP Billiton Environment Group with their Investigation Phase Study by developing the following:

- a Legal and Regulatory Approvals Register
- initial HSEC risk assessments and a Risk Register
- to document the likely process, scope and requirements of a future whole-of-project Environmental and Social Impact Assessment (ESIA)
- a global benchmarking study report on heap leach facilities
- a strategy for the timing, purpose and key messages for engagement with the Australian and South Australian governments in relation to five different water supply options.

Olympic Dam Mine Expansion Environmental and Social Impact Assessment

Year: 2004 - 2011

Location: Semi-arid central South Australia (Roxby Downs)

Client: BHP Billiton

Main project features: Major expansion of an existing mine to increase production from 200,000 tonnes/annum (tpa) copper cathodes to 350,000 tpa copper cathodes, 1.6 Mtpa copper concentrate, 1M ounces of silver, 270,000 ounces of gold and 17,000 tpa of uranium oxide. Also included 72 Mtpa of ore processing; 280 mega litre (ML)/day coastal desalination plant; 320 km water supply pipeline; 50 ML groundwater wellfield; 270 km electrical transmission line; 400 km gas pipeline; on-site 550 MW gas power station; 105 km rail line; airport, 90,000 t copper concentrate handling and ship loading facility; rail/road intermodal freight terminal; 10,000 person camp and 6,000 person expansion to existing township.

Position held: Manager and Author

Activities performed: I was a hands on manager of a core team of 20 people to deliver all environmental, social and cultural heritage assessments; developed the scope of works for 17 work packages; managed and understood technical inputs from more than 300 specialists from 75 different environmental and engineering companies; conducted stakeholder engagement and consultation; and authored the EIS and Supplementary EIS.

Projects as
Gamut Consulting

**Tampakan Copper-Gold Mine Development – Off-Lease Infrastructure
Environmental and Social Impact Assessment (ESIA)**

Year: 2011 - 2014

Location: Southern Island of Mindanao, the Philippines

Client: Xstrata Copper (now Glencore Xstrata)

Main project features: 105 km copper-gold concentrate pipeline; 100 km electrical transmission line; copper-gold concentrate filtration plant.

Position held: Manager and Author

Activities performed: Manager for all environmental, social and cultural heritage disciplines and author of the Supplementary Report to address the International Finance Corporation (IFC) requirements and Equator Principles for an international ESIA.

**415 MW Coal-fired Power Station and Copper Concentrate Loading Port Facility
ESIA**

Year: 2012 - 2013

Location: Southern Island of Mindanao, the Philippines

Client: Sagittarius Mines Inc. (SMI)

Main project features: 415 MW power station; coal unloading and copper concentrate loading port facilities.

Position held: Peer Reviewer and Advisor on Commercial Risk

Activities performed: Peer reviewer for an ESIA developed by in-country consultants to ensure it is developed in accordance with IFC requirements / Equator Principles; provision of advice regarding additional third party studies required to reduce commercial risk (and the subsequent scoping and management of air quality modelling, noise modelling and thermal plume modelling technical specialist studies). This project entailed liaison with SMI senior management regarding the outcomes of the commercial risk assessment to ensure SMI met their international and corporate responsibilities.

Mount Isa Open Pit Project (MIOP) Pre-Feasibility Study Environmental Studies

Year: 2011 - 2013

Location: Mount Isa, Queensland

Client: Xstrata Copper (now Glencore Xstrata)

Main project features: Major expansion of existing underground and small open pits into a single large open pit, expansion of copper, lead and zinc processing facilities and port facilities.

Position held: Lead Consultant, Manager, Peer Reviewer and Author

Activities performed: Authored the Pre-Feasibility Study environmental technical reports for the Project Description, Stakeholder Engagement Strategy, Surface Water, Closure and Environmental Design Criteria. Managed and peer reviewed technical reports from Amec (Ecology and Cultural Heritage), Klohn Crippen Berger (Groundwater and Geochemistry), SLR (Noise), PAEHolmes (Air Quality) and Arup (Traffic).

**Projects as
Gamut Consulting**

Yeelirrie Uranium Mine Environmental Review and Management Plan (ERMP)

Year: 2010 - 2011

Location: Perth, Western Australia

Client: BHP Billiton

Main project features: New greenfield uranium mine and associated infrastructure.

Position held: Lead Consultant, Project Director, Peer Reviewer and Author

Activities performed: Lead consultant to manage URS and SKM to a successful delivery of the ERMP for the proposed uranium mine in Western Australia. For this project, Michael was appointed the ERMP Project Director and Principal Author. In this role I reviewed all environmental, social and heritage technical reports and draft ERMP chapters and provided a technical review for the ERMP as Principal Author.

Essentials Package for Successful Environmental Consultants

Year: 2013

Location: Brisbane, Australia

Client: None – published to enhance general capacity building and skills

Main project features: Published practical guide to better influence key decisions and environmental outcomes for mining developments.

Positions held: Author / Publisher

Activities performed: I authored this publication to teach environmental practitioners and clients how to more efficiently manage an impact and risk assessment and put themselves and the mining company environmental representatives in a position to influence key decisions that promote better environmental outcomes. The book outlines the key steps in delivering an environmental and social assessment, and includes clear guidance on how to appropriately apply the two separate, but integrated, approaches to impact and risk assessments. The publication provides many of the management tools that I developed over the last 20 years to deliver projects on time and on budget.

Olympic Dam Closure Plan – Risk Assessment

Year: 2013

Location: Adelaide, South Australia

Client: BHP Billiton

Main project features: BHP Billiton reviews its Olympic Dam copper, gold, silver and uranium mine closure plan annually. For the current review, BHP Billiton has been requested by the South Australian Government to include a detailed environmental risk assessment for closure.

Positions held: Author/facilitator for the closure plan risk assessment

Activities performed: I have developed and authored the risk assessment component of the annual update to the Olympic Dam Closure Plan. This required liaison with numerous technical specialists from varying mining disciplines to identify and assess risk events/situations for the decommissioning and closure phase. Detailed tables were prepared for each risk event, identifying the source, pathway, receptor, initial risk rating, control / contingency measures and residual risk rating. Proposed closure outcomes, closure criteria and monitoring requirements were then identified for each risk event with a high or moderate residual risk rating.

**Projects as
Gamut Consulting**

Gladstone Steel Making Facility EIS

Year: 2012 - 2013

Location: Gladstone, Queensland

Client: Boulder Steel (CQG Consulting)

Main project features: 5 Mtpa integrated steel plant, 17 km private haul road, rail loop and import/export port facilities.

Positions held: Advice and chapter author

Activities performed: Gamut was commissioned by CQG Consulting on behalf of Boulder Steel to assist in the timely delivery of this EIS. We authored the executive summary, hazard and risk assessment, nature conservation, traffic impact assessment, environmental management framework and cumulative effects chapters and provided peer review on all other EIS chapters and technical appendices.

**Projects prior to
forming Gamut
Consulting**

Gateway Motorway EIS Project

Michael was appointed as the environmental advisor to the Queensland Government (Main Roads) to assist in the determination of the preferred Federal and State legislative process under which to develop an EIS for the \$1.6 billion Gateway Motorway Upgrade Project. Michael also developed the Initial Advice Statement to accompany the request for State Significant Project status and developed the Draft Terms of Reference for the EIS. Michael was also commissioned to undertake the technical review for the EIS and provide advice regarding the direction and compliance of the EIS as per Commonwealth and State legislation.

Enertrade North Queensland Gas Pipeline EIS Project

This was an EIS for a 400 km gas pipeline. This project was a controlled action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and a Project of State Significance under the Queensland Department of State Development's *State Development and Public Works Organisation Act 1971*. Michael completed the development of targeted ecological documents and presentations for the then Commonwealth Department of Environment and Heritage and the Queensland Environmental Protection Agency in relation to endangered ecological communities, threatened species and migratory species. Michael also successfully negotiated environmental approvals and compliance for the project.

Tamil Nadu Road Sector Project, India

Michael was the author of the physical (Climate, Geology and Soils, Land Use) and biological (fauna, flora, water quality, air quality, noise, heritage) environmental components of the Feasibility Study and Sectoral Environmental Assessment reports assessing the potential impacts associated with upgrading 3,328 km of roads in south-eastern India. Michael also authored the project's Environmental Management Plan. All deliverables were written under the guidelines of, and gained the approval of, the World Bank.

Reef Cove Resort, False Cape

Michael was the Manager of the environmental assessments for this major coastal development in Cairns. The site is adjacent to the Great Barrier Reef World Heritage Area, Fish Habitat Reserve and the ecologically significant Trinity Inlet. The project was deemed a controlled action under the EPBC Act and Michael negotiated the environmental approvals for the project under both Commonwealth and State legislation.

Projects prior to forming Gamut Consulting

Port of Brisbane Motorway - Environmental Review

Michael completed a review of all the environmental documentation compiled for the Port of Brisbane Motorway, undertaking a gap analysis with regards to recently introduced and amended environmental legislation, and providing reports to promote environmental compliance of this major road infrastructure project. Environmental approvals were gained for this project in a timely manner and as such avoided potential construction delays.

Cerito Road Review of Environmental Factors (REF) and EMP

Michael was the Manager and completed the legislative review and fauna assessment for the new 22 km road link between the Mt Coolon - Collinsville Road and the Glenden – Newlands Road. This project included the assessment of all environmental aspects and provided mitigation measures to minimise impacts on Commonwealth endangered ecological communities and State listed threatened species.

Brisbane City Council Ecological Corridors Project

Michael was appointed as an ecological specialist to assist Brisbane City Council and Chenoweth & Associates to identify appropriate civil structures to maintain fauna movement along corridors throughout Brisbane City. A detailed case study was also completed for fauna movement across the Logan Motorway for safe passage between the Greenbank Military Training Area and Karawatha Forest.

Federal Government Legislative Reviews

Michael was commissioned to negotiate the implications of the Federal Government's environmental protection legislation on behalf of the Queensland Department of Main Roads. Following presentations to the Main Roads Senior Management Group, he was commissioned to review all projects being constructed on state-controlled roads for the period 2000 - 2002 and in the Brisbane Metropolitan District from 2000 - 2005. This was more than 160 projects, resulting in presentations to DEWHA (then DEH) regarding referrals for 80 projects.

WMC Fertilizers Ltd

Michael completed the ecological assessment for the High Analysis Fertilizer Plant at Phosphate Hill, north-west Queensland. This assessment included comprehensive field surveys of fauna and flora to determine potential impacts on ecosystems and to provide appropriate mitigation strategies to ameliorate identified impacts.

Rockhampton Airport EIS and EMP

Michael was the Manager and author of the EIS for a proposed runway extension to the Rockhampton Airport. The risk of bird strikes was the key issue to be resolved for this project, given the surrounding environs being dominated by wetlands.

Rationalisation of Council and State Government Vegetation Mapping

Michael undertook an assessment of the methodology employed for vegetation mapping as a means of assigning State and local ecological significance to freehold, leasehold and state controlled land. This project enabled Dr Ryan to identify the 'building blocks' of both the EPA's Regional Ecosystem mapping and Local Government mapping and determined the advantages and disadvantages of each, with an objective of identifying appropriate mechanisms to identify and conserve significant vegetation communities.

**Projects /
employment prior
to forming Gamut
Consulting**

Road Corridor Environmental Assessment (RCEA)

Michael wrote the GIS compatible methodology that enabled the collection and storage of data on ecological assets and corridor management issues within the road reserve for the 33,500 km of Queensland State-controlled roads. Michael subsequently implemented this methodology via field surveys for more than 3,500 km of these roads.

Townsville Field Training Area (TFTA) EIS and EMP

Michael was the Manager and author of the EIS and EMP for a road upgrade, airstrip extension and two major creek crossings within the TFTA. Detailed investigations were completed at Keelbottom Creek and Star River.

Environmental Impact Assessments / Review of Environmental Factors

Michael has been the Manager and author of more than 20 additional linear infrastructure assessments including the following studies: Townsville Port Access, Ipswich Motorway, Mt Lindsay Highway, Smith Street Extension, Hope Island Road, Mt Tamborine - The Sentinel, Gregory Developmental Road, Kuralboo Creek and Gilmore Pipeline (Cheepie to Adavale).

PRINCIPAL ADVISOR (ENVIRONMENT AND PLANNING) QUEENSLAND DEPARTMENT OF MAIN ROADS (MAY 1999 TO NOVEMBER 2000)

Dr Ryan's principal role was to manage the \$1.2 M Technical Environment Program within the Department. This required the program management of over thirty-five road-related environmental projects, mentoring of graduate staff and direct project supervision of ten projects. Michael was also the Main Roads representative on several inter-government environmental committees including the Ministerial Committee on Net Gain 2010 and the Ministerial Committee that investigated the implications of the then soon to be enacted *Environment Protection and Biodiversity Conservation Act 1999*. Projects managed and/or supervised included:

Review of the Department's Road Project Environmental Management Processes Manual: This manual discusses the environmental documents to be prepared throughout the planning, design, construction and maintenance of a road project.

Compensatory Habitat Policy: Management of a project that identified the advantages and disadvantages of existing compensatory habitat policies so as to provide guidance to Main Road's Senior Management Group as to whether a similar policy should be adopted by Main Roads.

Revision of the Main Roads Environmental Legislation Register: This manual discusses all Commonwealth and State legislation relevant to road planning, design and construction. It provides a comprehensive reference guide for all legislative, permit and license requirements for Main Roads activities.

Revision of the Main Roads Cultural Heritage Manual: This manual discusses the preferred process for cultural heritage assessments for Main Roads. The revised manual was reviewed by the Environmental Protection Agency and accepted as appropriate for use by Main Roads in Queensland.

Waterways Guideline: This project aims to develop collaboration with the Department of Natural Resources in relation to permits under the *Water Act 2000*. Benchmarks were established so as to clearly identify and streamline the process for obtaining permits and licenses for construction activities.

**Projects /
employment prior
to forming Gamut
Consulting**

Review of the Main Roads Environmental Management Specification: This specification (MRS11.51) represents the standard environmental specification for all Main Roads construction projects. Michael managed the review of this specification in an attempt to refine contractor's costing of environmental works.

Road Drainage Manual: Michael was on the management and technical committees for the development of this manual. The aim of the manual is to design and construct cross and longitudinal drainage structures in a practical, cost effective and environmentally sustainable manner.

Road Planning and Design Manual: Michael was the author of the Environmental Considerations chapter of this manual and technically reviewed the engineering and design chapters to ensure consistent and effective environmental outcomes in road design.

KBR (FORMERLY KINHILL), BRISBANE (SEPTEMBER 1996 TO MAY 1999)

As the Brisbane office's specialist fauna ecologist, Dr Ryan was involved in the following projects:

Kopps Road - Smith Street Extension

Michael was the manager and author for the Review of Environmental Factors for the proposed construction of a major connecting road between Smith Street and Kopps Road to the west of the Pacific Motorway.

Vegetation and Ecological Assessments, Ipswich City Council

Manager for two projects that provide ecological assessments and recovery plans to guide future Council management practices and land acquisitions.

Brisbane Technology Park, Eight Miles Plains

Principal author of an environmental assessment and rehabilitation programme for the proposed Stage II of the Brisbane Technology Park.

Mary River Sand and Gravel Extraction, Maryborough

Investigating the potential impacts associated with sand and gravel extraction in the Mary River on fauna.

Snapper Creek Dredging

Investigating the potential impacts on wader bird species associated with dredging in Snapper Creek.

Donnybrook, Caboolture Shire, Environmental Management Plans

Developing Environmental Management Plans for a vulnerable amphibian species and mammal species to mitigate impacts of a proposed development in an ecologically sensitive location.

Coolum Ridges, Maroochy Shire, Queensland

Designing and conducting a complete fauna survey in an area of proposed private subdivision.

**Projects /
employment prior
to forming Gamut
Consulting**

Fauna Sensitive Road Design Publication

Michael was the author of the State Government publication: Fauna Sensitive Road Design - Volume 1 - Past and Existing Practices. This publication includes assessments of fauna movement pathways and provides recommendations to reduce highway impacts on native fauna.

PGT Pipeline, from south-central Queensland to North Brisbane

An extensive investigation of the proposed impact with respect to the environment associated with disturbance along a 480 km pipeline route.

CONSULTANT ECOLOGIST (1995 TO 1996)

Subconsultant for WBM Oceanics Australia on two projects. The first involved collation and review of existing information on and development of a sampling methodology for a Koala survey of the Buderim Mountain region. The second project involved mammal trapping and field identification of birds, mammals, reptiles and amphibians for a 4 week fauna survey of a site at Reedy Creek, Mudgeraba.

UNIVERSITY OF QUEENSLAND (1993 TO 1995)

Dr Ryan was employed as Research Assistant on the following projects:

Revegetation advice for mining operations (Dr Clive Bell, Dr David Mulligan, the then Agriculture Department – now Centre for Mined Land Rehabilitation): Advice for environmental officers of Queensland's coal and bauxite mining operations (Weipa and Bowen Basin) on procedures for maximising forest revegetation following above-ground mining.

Green vegetable bug (Dr Gimme Walter, Entomology Department): Planning, experimental design and analysis of research on the ecology of the bug. Also assisted with practical classes in ecology, behaviour and genetics.

Queensland rainforest mites (Dr David Walter, Entomology Department): Field research to assess the biodiversity of mites in rainforest.

SELECT PUBLICATIONS

Ryan, M.A. and G.H. Walter (1992) Sound communication in *Nezara viridula* (L.) (Heteroptera: Pentatomidae): further evidence that signal communication is substrate-borne. *Experientia* **48**: 1112-1115.

Ryan, M.A. (1994) Damage to papaw trees by the banana-spotting bug, *Amblypelta lutescens lutescens* (Distant) (Hemiptera: Coreida), in north Queensland. *International Journal of Pest Management* **40(3)**: 280-282.

Ryan, M.A., C.J. Moore and G.H. Walter (1995) Individual variation in pheromone composition in *Nezara viridula* (Hemiptera: Pentatomidae): how valid is the basis for designating "pheromone strains"? *Comparative Biochemistry and Physiology* **111B(2)**: 189-193.

Ryan, M.A., A. Cokl and G.H. Walter (1996) Differences in vibratory sound communication between a Slovenian and an Australian population of *Nezara viridula* (L.) (Heteroptera: Pentatomidae). *Behavioural Processes* **36(2)**: 183-193.

Ryan, M.A. (1996) An investigation of discontinuities in the sexual behaviour of green vegetable bugs, *Nezara viridula* (Linnaeus) (Heteroptera: Pentatomidae). Doctor of Philosophy Thesis. University of Queensland. Australia.

Kinhill (1997) Brisbane Technology Park Stage II: Environmental Assessment and Rehabilitation Programme. Prepared for Brisbane City Council. Principal Author: Dr Michael Ryan.

Kinhill (1998) Kopps Road – Smith Street Extension Review of Environmental Factors. Prepared for the Queensland Department of Main Roads. Principal Author: Dr Michael Ryan.

Queensland Department of Main Roads (1999) *Environmental Legislation Register – Version 2*. Principal Author: Dr Michael Ryan.

Queensland Department of Main Roads (2000) *Road Project Environmental Management Processes Manual – Version 2*. Principal Author: Dr Michael Ryan.

Queensland Department of Main Roads (2000) *Fauna Sensitive Road Design: Volume 1 – Past and Existing Practices*. Queensland Department of Main Roads, Technology and Environment Division. Brisbane. Principal Author: Dr Michael Ryan.

Kinhill (2001) Townsville Port Access Review of Environmental Factors. Prepared for the Queensland Department of Main Roads. Principal Author: Dr Michael Ryan.

Kinhill (2001) Ipswich Motorway Review of Environmental Factors. Prepared for the Queensland Department of Main Roads. Principal Author: Dr Michael Ryan

Kinhill (2001) Tamil Nadu Road Sector Project, India: Feasibility Study and Sectoral Environmental Assessment. Prepared for the Government of India under World Bank funding. Principal Author of the Climate, Geology, Soils, Land Use, Fauna, Flora, Water Quality, Air Quality, Noise and Heritage sections: Dr Michael Ryan

Kinhill (2002) Mt Lindsay Highway Review of Environmental Factors. Prepared for the Queensland Department of Main Roads. Principal Author: Dr Michael Ryan

HLA-Envirosciences (2002) Gregory Developmental Road Review of Environmental Factors. Prepared for the Queensland Department of Main Roads. Principal Author: Dr Michael Ryan

HLA-Envirosciences (2003) Smith Street Extension Review of Environmental Factors. Prepared for the Queensland Department of Main Roads. Principal Author: Dr Michael Ryan

HLA-Envirosciences (2003) Townsville Field Training Area (TFTA) Keelbottom Creek and Star River: Environmental Impact Statement and Environmental Management Plan. Prepared for the Department of Defence. Principal Author: Dr Michael Ryan

HLA-Envirosciences (2003) Rockhampton Airport Environmental Impact Statement and Environmental Management Plan. Prepared for the Rockhampton Regional Council. Principal Author: Dr Michael Ryan

HLA-Envirosciences (2004) Hope Island Road Review of Environmental Factors. Prepared for the Queensland Department of Main Roads. Principal Author: Dr Michael Ryan

HLA-Envirosciences (2004) Mt Tamborine - The Sentinel Review of Environmental Factors. Prepared for the Queensland Department of Main Roads. Principal Author: Dr Michael Ryan

BHP Billiton (2009) Olympic Dam Expansion: Draft Environmental Impact Statement. Principal Author: Dr Michael Ryan

Ryan, M.A. (2009) Environmental Protection Through Leadership and Law. Presentation. China Mining 2010 Conference. Tianjin. China.

Ryan, M.A. (2010) The Expanding Role of an EIS Project Manager. Presentation. EIS For Resource Projects Conference. Brisbane. Queensland.

Wilkinson, L. and M.A. Ryan (2010) What Makes a Good Environmental Impact Statement: A Government Perspective / A Consultant's Perspective. Presentation. Environment Institute of Australia and New Zealand Conference. Wellington. New Zealand.

BHP Billiton (2011) Olympic Dam Expansion: Supplementary Environmental Impact Statement. Principal Author: Dr Michael Ryan

Ryan, M.A. (2011) Managing Environmental Impact Assessment Requirements. Presentation and Pre-conference Workshop. Environmental Management in Resources Conference. Perth. Western Australia.

BHP Billiton (2011) Proposed Yeelirrie Development: Environmental Review and Management Programme. Draft. Principal Author: Dr Michael Ryan

Gamut Consulting (2012) Uranium Projects Approval Process Guideline. Prepared for BHP Billiton. Principal Author: Dr Michael Ryan

Gamut Consulting (2012) Olympic Dam EPBC Act Assessment Report – Pre-commitments. Prepared for BHP Billiton. Principal Author: Dr Michael Ryan

Gamut Consulting (2012) Mount Isa Open Pit Pre-Feasibility Study: Environment Stakeholder Engagement Strategy. Prepared for Xstrata Copper. Principal Author: Dr Michael Ryan

Gamut Consulting (2012) Mount Isa Open Pit Pre-Feasibility Study: Environmental Design Criteria. Prepared for Xstrata Copper. Principal Author: Dr Michael Ryan

Gamut Consulting (2012) Draft Terms of Reference for the Mount Isa Open Pit Project Environmental Impact Statement. Prepared for Xstrata Copper. Principal Author: Dr Michael Ryan

Sagittarius Mines Incorporated and Gamut Consulting (2012) Tampakan Off-Lease Linear Infrastructure Project: Environmental and Social Impact Assessment. Prepared for Xstrata Copper. Principal Author: Dr Michael Ryan

CQG Environmental (2013) Environmental Impact Statement: Gladstone Steel Plant Project. Prepared for Boulder Steel Limited. Principal Author of the Executive Summary, Hazard and Risk Assessment, Nature Conservation, Traffic Impact Assessment, Environmental Management Framework and Cumulative Effects chapters: Dr Michael Ryan

Ryan, M.A. (2013) *Essentials Package for Successful Environmental Consulting*. ISBN (hardcopy): 978-0-9874942-1-4. ISBN (electronic copy): 978-0-9874942-0-7

Ryan, M.A. (2013) How to Develop and Effective EIS. Presentation and Pre-Conference Workshop. Permit Approvals Queensland Conference. Brisbane. Queensland.

Gamut Consulting (2013) Olympic Dam Expansion Investigation Phase Study: Environmental Inputs. Prepared for BHP Billiton. Principal Author: Dr Michael Ryan

Gamut Consulting (2013) Tampakan Copper-Gold Mine Off-Lease Infrastructure (OLI) Project: Addressing International Environmental and Social Sustainability Standards. Prepared for Xstrata Copper. Principal Author: Dr Michael Ryan

Gamut Consulting (2014) Olympic Dam Heap Leach Processing Environmental Benchmarking Study. Prepared for BHP Billiton. Principal Author: Dr Michael Ryan

Gamut Consulting (2014) Olympic Dam Water Supply Government Engagement Strategy. Prepared for BHP Billiton. Principal Author: Dr Michael Ryan

Paul Gerard Finn

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ACADEMIC QUALIFICATIONS

Doctor of Philosophy (2009)

Griffith School of Environment and Centre for Innovative Conservation Strategies
Griffith University
Scholarship: Strategic Partnerships with Industry, Research and Training (SPIRT); funded by Griffith University and The Federal Government (Environment Australia).

Bachelor of Science with First Class Honours (1996)

Australian School of Environmental Studies
Griffith University
Undergraduate major: Ecology and its Applications.

EMPLOYMENT HISTORY and WORK EXPERIENCE

Paul is a CEnvP (Ecology Specialist) with over 18 years' experience in project management, community consultation, research, environmental monitoring, experimental and statistical design, data management, analysis and interpretation, ecological and biodiversity assessment, fauna and flora surveys, and GIS mapping.

Paul has a background in ornithological research, obtaining his PhD in 2009, and has published a number of refereed and popular articles (including a chapter in a CSIRO book on shorebird feeding ecology and habitat selection), and presented his research at local and international conferences, workshops and public lectures. Paul has collaborated on many research projects, taking responsibility for experimental design, field work, data analysis and publishing on a diverse range of projects incorporating population biology, community ecology and conservation of birds.

Paul's consulting experience includes targeted threatened species surveys, significant species management plans, ecological impact assessment, legislation and environmental authority interpretation and negotiation with government agencies. He is a skilled consultant and field ecologist, and is experienced in leading teams to undertake fauna and flora surveys. Paul has a particular interest in natural resource management, conservation, terrestrial and coastal ecology, coastal management, animal behaviour, and ornithology.

Currently Paul is working as a biodiversity technical advisor and ecology subject matter expert in the coal seam gas industry, managing ecological assessments, providing clarity on federal and state legislated species impact management and offsets, and delivering reports to support various approvals.

Principal Ecologist, Arrow Energy Pty Ltd (June 2013–present)

Employed by Arrow as a Principal Ecologist, I am accountable for the delivery of technical advice and maintaining ecology standards in order to service exploration and appraisal, well delivery and the production of domestic gas. This position involves the management of ecology resources (internal staff and external contractors) across Arrow's tenements within both the Surat and Bowen Basins to deliver compliance and best practice ecology standards and work practices. The responsibilities of this position include:

- Promoting Health, Safety and Environment (HSE) standards;
- Managing a team by planning, coordinating and scheduling work to be completed;
- Recruiting, mentoring, training and developing personnel, and associated performance management;
- Providing technical advice, appropriate ecological survey methods, work scopes and reporting to solve compliance issues;
- Liaising and engaging with leadership personnel, external clients, contractors, and government regulators; and,
- Developing lean initiatives to increase quality and productivity of the ecology function, and improve profitability of projects.

Senior Ecologist, Sinclair Knight Merz (May 2012–May 2013)

Employed by Sinclair Knight Merz (SKM) as a Senior Ecologist and Project Manager, I delivered projects for clients in both the private and government sectors, related to infrastructure, energy and resources, environment and urban growth. This role included leading teams of ecologists in the field and actively training and mentoring junior staff in the field and the office, to ensure professional outcomes and effective project delivery. Key skill areas include: project management, stakeholder engagement, research, environmental monitoring, experimental and statistical design, data management, analysis and interpretation, review of scientific papers and reports, ecological and biodiversity assessment, fauna and flora surveys, significant species management and interpreting government legislation.

Selected project experience:

- **New Acland Coal Mine Stage 3 Expansion (New Hope Group)** – Targeted Koala (*Phascolarctos cinereus*) surveys for EPBC Act advice/referral including habitat assessments and Spot Assessment Technique (SAT), groundtruthing of threatened flora (*Bothriochloa biloba*, *Digitaria porrecta*, *Homopholis belsonii*, and *Stemmacantha australis*).
- **Surat Pipeline Header (Arrow Energy Pty Ltd)** – Detailed ecological assessment including fauna trapping, nocturnal fauna surveys including harp trapping for bats, bird surveys, targeted threatened species searches and micro-habitat assessments.
- **Nathan Dam Ecological Assessment (SunWater)** – Targeted Koala (*Phascolarctos cinereus*) surveys for EPBC Act advice/referral including habitat assessments, line-transect searches and SAT, groundtruthing of a threatened ecological community (Coolibah - Black Box Woodlands), and wetland assessments.
- **New Parallel Runway (Brisbane Airport Corporation)** – Project management, monitoring birdlife and associated habitat use, data analysis and interpretation, environmental management.

- **Pumicestone Road Interchange Upgrade (Department of Transport and Main Roads)** – Environmental assessment, ecological advice on detailed design, environmental management plan, and significant species management plan.
- **Roma Flood Levee (Maranoa Regional Council)** – Groundtruthing of EPBC Act MNES and NC Act listed species and breeding places, detailed assessment of a threatened ecological community (Weeping Myall Woodlands), regional ecosystems and high value regrowth verification, and EPBC Act referral advice.
- **Sibelco Taragoora Limestone Project (Sibelco Australia Limited)** – Property vegetation management plan (PVMP), and negotiation with the Queensland Department of Environment and Heritage Protection (DEHP).

Technical Advisor, Holcim Australia Pty Ltd (July 2005–February 2013)

Employed by Holcim as a Shorebird Expert on the Technical Advisory Panel (TAP) for a sand extraction operation at Donnybrook, Queensland. The formation and use of the TAP (consisting of three experts in their fields) was a requirement of the operation, triggered by the *Environment Protection and Biodiversity Conservation Act 1999* and imposed by the Department of the Environment. The main aim of the TAP is to ensure the maintenance of Ramsar wetland values and includes:

- Assisting with the design and implementation of intertidal wetland monitoring programs; and,
- Reviewing subsequent data collected by independent environmental consultants.

Senior Ecologist, RPS Group (February 2010–April 2012)

Employed by RPS Australia East Pty Ltd as a Senior Ecologist and Project Manager, I delivered projects for clients in both the private and government sectors, related to infrastructure, energy and resources, environment and urban growth. This role included leading teams of ecologists in the field and actively training and mentoring junior staff in the field and the office, to ensure professional outcomes and effective project delivery. Key skill areas include: project management, stakeholder engagement, research, environmental monitoring, experimental and statistical design, data management, analysis and interpretation, review of scientific papers and reports, ecological and biodiversity assessment, fauna and flora surveys, vegetation offsets, landscape rehabilitation, bushfire management, interpreting government legislation and GIS mapping.

Selected project experience:

- **Coal Seam Gas Exploration Gunnedah Basin (Santos)** – Detailed ecological assessment including fauna trapping, nocturnal surveys, habitat assessments and bird surveys, targeted threatened species searches, EPBC Act referral for a threatened ecological community (Box Gum Woodland).
- **Ecological Scouting in South-west QLD (Origin Energy)** – Undertaking pre-clearance ecological surveys for future coal seam gas infrastructure in cooperation with other team members including surveyors, cultural heritage monitors, geologists and Origin Energy staff.
- **New Parallel Runway (Brisbane Airport Corporation)** – Project management, monitoring birdlife and associated habitat use, data analysis and interpretation, environmental management.

- **GLNG Facility, Curtis Island, Gladstone (Bechtel)** – Significant species management plan including spotter-catcher procedures for the construction phase.
- **Queensland to South Australia / New South Wales Link Gas Pipeline (QSN Link) Looping Project (Epic Energy Queensland Pty Ltd)** – Targeted surveys for weeds of national significance and other declared pest plants.
- **QCLNG Pipeline, Curtis Island (Queensland Gas Company)** – Targeted Water Mouse (*Xeromys myoides*) surveys for EPBC Act clearance including habitat assessment, diurnal searches and nocturnal trapping.
- **Moranbah to Peak Downs and Goonyella Mines, Transmission and Water Lines (BMA – BHP-Mitsubishi Alliance Coal Operations Pty Ltd)** – Regional ecosystems verification, targeted threatened species searches, tertiary vegetation assessment, vegetation offset calculations and EPBC Act advice.
- **Pinkenba Review of Environmental Factors (Port of Brisbane Pty Ltd)** – Project management, ecological assessment, detailed fauna and flora surveys, regional ecosystems verification, vegetation mapping.
- **Sewage Pipeline (Redlands Water and Waste)** – Vegetation assessment and management plan, development approvals processing, consultation.
- **Bald Hills Quarry (Nielsen’s Quality Gravels Pty Ltd)** – Ecological impact assessment, detailed fauna survey, vegetation survey and management plan, riparian condition assessments, rehabilitation planning, GIS mapping, consultation.
- **Redlands land developments (Harridan Pty Ltd and Sentinel Pty Ltd)** – Field surveys of Koala habitat including identification of food trees and SAT, desktop assessments of corridor connectivity and SPRP Koala habitat mapping, GIS mapping, reporting in regards to legislative requirements, environmental management plans, bushfire management plans.
- **Brisbane north shore development, Hamilton (Urban Land Development Authority)** – Project management, marine vegetation management plan, consultation.
- **Ipswich land developments ‘Paradise Waters’ (Stocklands Developments)** – Project management, environmental assessment, property map of assessable vegetation (PMAV), vegetation management plan, detailed tree survey, targeted searches for threatened species, GIS mapping.
- **Benaraby landfill expansion (Gladstone Regional Council)** – Species management plan, detailed fauna and flora surveys, GIS mapping.
- **The Village at Redcliffe (Hardev Property Development)** – Environmental offsets, habitat offset packaging, rehabilitation planning, GIS mapping.
- **Deception Bay land development ‘Brolga Lakes’ (Erneve Pty Ltd)** – Monitoring birdlife and associated habitat use, data analysis and interpretation, environmental management.
- **Willawong land development (Maximus Industrial Pty Ltd)** – Vegetation management plan, detailed tree survey, rehabilitation planning, GIS mapping, environmental approvals processing.
- **Murrarie land development (Incitec Pivot Limited)** – Due diligence environmental assessment, fauna and flora surveys, GIS mapping.

Conservation Officer / Program Coordinator, Seagrass-Watch, Moreton Bay Marine Park (October 2002–December 2009)

Employed by the Department of Environment and Resource Management's, Queensland Parks and Wildlife Service, the Wildlife Preservation Society of Queensland and the Queensland Conservation Council to set up and coordinate 'Seagrass-Watch', a community-based habitat monitoring program, in Moreton Bay.

The responsibilities of this position included:

- assisting with writing grant applications;
- establishing and maintaining effective volunteer involvement;
- locating suitable survey sites and coordinating the collection, collation, evaluation, analysis and interpretation of data;
- preparing a range of multi-media extension material including newsletters, public presentations, technical and administrative reports, and scientific conference and journal papers;
- training new volunteers (on-site and through workshops) and assisting volunteers with field work;
- maintaining and servicing equipment used in the sampling program;
- liaison, consultation and negotiation with government agencies, local stakeholders and interest groups;
- working with various legislative documents including, but not limited to: the *Nature Conservation Act 1992*, *Environmental Protection Act 1994*, *Coastal Protection and Management Act 1995*, *Environment Protection and Biodiversity Conservation Act 1999* and *Marine Parks Act 2004*;
- managing staff and university students on industrial placement; and,
- undertaking various administrative, budgeting and financial duties.

Doctor of Philosophy Candidate, Consultant Ecologist, Research Assistant and Tutor, Griffith University (January 1994–December 2009)

- **Doctor of Philosophy Candidate:** My research covered many aspects of habitat selection and feeding ecology with Eastern Curlews (*Numenius madagascariensis*) in Moreton Bay, Queensland. The aim of my research was to identify characteristics of important habitats for conservation of the Eastern Curlew on its non-breeding grounds. During my PhD I gained skills in many areas including: project management, logistical planning, working within a budget (approx. \$30,000), experimental design, data management, statistical analyses and targeted dissemination of results through scientific reports, conference papers, journal articles and community consultation. I developed good analytical and practical ecological skills and employed various ecological methods including: population census, behavioural observations of focal individuals, benthic invertebrate sampling and GIS mapping.
- **Consultant Ecologist:** Employed to conduct monthly surveys of all birds at the Luggage Point wetland reserve for the Brisbane City Council (May 2001–April 2003) and at the Fisherman Islands reclamation area for the Port of Brisbane Corporation (March 2001–June 2002). The focus of these consultancies was to assess and monitor the habitat use by shorebirds. Thereby facilitating the ecologically sustainable management of the focal areas by identifying threats to the birds' long term survival and making recommendations for their long term protection and management.

- **Research Assistant:** I have collaborated on many research projects, assisting with experimental design, field work, data analysis and publishing on a diverse range of projects incorporating population biology, community ecology and conservation of birds, and biodiversity assessments of remnant vegetation. My collaborators included but were not limited to: Prof. Carla Catterall, Dr. Peter Driscoll, Prof. Jane Hughes, Dr. Darryl Jones, Prof. Roger Kitching, Dr. Jeff Miller, Mr. Clive Minton and Dr. Kees Hulsman. Projects included: **Shorebird ecology** (surveying, cannon netting, banding and biometrics) in Moreton Bay, The Great Sandy Strait, Mackay and the Swaines Reefs; **Landscape ecology** (distribution, abundance and dynamics of mixed species foraging flocks within a large habitat matrix) of birds in south-east Queensland, involving mist-netting, banding, seasonal surveys and behavioural observations; **Population assessment and monitoring** of seabird breeding colonies over five years on all coral cays throughout the Capricorn and Bunker Island groups; **Biodiversity** studies at Eungella National Park, north Queensland, incorporating vegetation survey and invertebrate sampling techniques; and, Seabird research on Raine and neighbouring Islands as the 1995 recipient of the **Brian R. King Research Award** for seabird research (administered by the Raine Island Corporation).
- **Tutor:** Employed as an avian ecology tutor by Griffith University for a 3rd-year field course in tropical ecology conducted in Danum Valley, Borneo (2 weeks in January 2007). Also employed as an ecology tutor by Griffith University for 1st-3rd year field and laboratory courses (1994–2002).

PUBLICATIONS

Journal Articles

1. **Finn, P.G.** and Catterall, C.P. Does foraging success explain choice of feeding sites by a deep-probing shorebird on its non-breeding grounds? Manuscript in preparation.
2. **Finn, P.G.**, Udy, N.S., Baltais, S.J., Price, K. and Coles, L. 2010. Assessing the quality of seagrass data collected by community volunteers in Moreton Bay Marine Park, Australia. Environmental Conservation. 37, 83-89.
3. **Finn, P.G.**, Catterall, C.P. and Driscoll, P.V. 2008. Prey versus substrate as determinants of habitat choice in a feeding shorebird. Estuarine, Coastal and Shelf Science. 80, 381-390.
4. **Finn, P.G.**, Catterall, C.P. and Driscoll, P.V. 2007. Determinants of preferred intertidal feeding habitat for Eastern Curlew: A study at two spatial scales. Austral Ecology. 32, 131-144.
5. **Finn, P.G.**, Driscoll, P.V. and Catterall, C.P. 2002. Eastern Curlew numbers at high tide roosts versus low tide feeding grounds: a comparison at three spatial scales. Emu. 102, 233-239.
6. **Finn, P.G.**, Catterall, C.P. and Driscoll, P.V. 2001. The low tide distribution of Eastern Curlew on feeding grounds in Moreton Bay, Queensland. Stilt. 38, 9-17.
7. **Finn, P.G.** and Hughes, J.M. 2001. Helping Behaviour in Australian Magpies, *Gymnorhina tibicen*. Emu. 101, 57-63.
8. Jones, N.D. and **Finn, P.G.** 1999. Translocation of aggressive Australian Magpies: a preliminary assessment of a potential management action. Wildlife Research. 26, 271-279.

Book Chapter

9. **Finn, P.G.** 2007. Feeding ecology and habitat selection. Pp. 51-59 in Geering, A., Agnew, L. and Harding, S. (eds.) Shorebirds of Australia. CSIRO Publishing, Victoria.

Theses

10. **Finn, P.G.** 2009. Habitat selection, foraging ecology and conservation of Eastern Curlews on their non-breeding grounds. PhD Thesis. Griffith University, Brisbane.
11. **Finn, P.G.** 1996. Why do helpers help, in cooperatively breeding Australian Magpies?: a test of the indirect fitness benefits hypothesis using microsatellite DNA. BSc (Honours) Thesis. Griffith University, Brisbane.

Major Reports

12. **Finn, P.G.**, Catterall, C.P. and Driscoll, P.V. 2002. Key habitats for conservation of the Eastern Curlew on its feeding grounds. PhD report prepared for the Wetlands Unit, Biodiversity Group, Environment Australia (Commonwealth of Australia, Department of the Environment), Canberra. 100 pp.
13. Jones, D.N. and **Finn, P.G.** 1998. Translocation of Aggressive Australian Magpies as a Potential Management Option: A Preliminary Assessment. Report prepared for the Suburban Wildlife Research Group, Australian School of Environmental Studies, Griffith University, Brisbane. 35 pp.

CONFERENCE PRESENTATIONS

1. **Finn, P.G.** and Catterall, C.P. 2009. Choice of feeding sites by Eastern Curlews (*Numenius madagascariensis*) on their non-breeding grounds. Australasian Shorebird Conference, Hobart, September. (Spoken).
2. **Finn, P.G.** and Catterall, C.P. 2009. Choice of feeding sites by a global migrant shorebird on its austral wintering grounds. International Congress of Ecology, Brisbane, August. (Spoken).
3. **Finn, P.**, Udy, N., Baltais, S., Price, K. and Maxwell, P. 2007. Distribution and status of seagrasses in Moreton Bay and an evaluation of community based monitoring (Seagrass-Watch). Queensland Coastal Conference, Bundaberg, September. (Poster).
4. **Finn, P.**, Udy, N., Baltais, S., Price, K. and Maxwell, P. 2007. Seagrass-Watch Moreton Bay: Community based monitoring of seagrass resources. Australian Marine Sciences Association Conference, Melbourne, July. (Spoken).
5. **Finn, P.G.**, Catterall, C.P. and Driscoll, P.V. 2005. Relationship between Eastern Curlew predation and intertidal prey availability on wintering grounds in subtropical eastern Australia. Ecological Society of Australia Conference, Brisbane, December. (Spoken).
6. **Finn, P.G.**, Catterall, C.P. and Driscoll, P.V. 2002. Characteristics of key feeding habitat for Eastern Curlew at two spatial scales in subtropical eastern Australia. Ecological Society of Australia Conference, Cairns, December. (Spoken).
7. **Finn, P.G.**, Catterall, C.P. and Driscoll, P.V. 2000. Feeding Distribution of Eastern Curlew in Moreton Bay. Griffith University Ecology and Evolution Postgraduate Symposium, Brisbane, October. (Spoken).
8. **Finn, P.G.**, Catterall, C.P. and Driscoll, P.V. 2000. Distribution and site selection in Eastern Curlew at feeding grounds in Moreton Bay. Southern Hemisphere

- Ornithological Congress and Australasian Shorebird Conference, Brisbane, July. (Spoken).
9. **Finn, P.G.**, Driscoll, P.V. and Catterall, C.P. 1999. The low tide distribution of Eastern Curlew at feeding grounds in Moreton Bay. Griffith University Ecology and Evolution Postgraduate Symposium, Brisbane, October. (Spoken).
 10. **Finn, P.G.**, Driscoll, P.V. and Catterall, C.P. 1999. The low tide distribution of Eastern Curlew at feeding grounds in Moreton Bay. Australasian Shorebird Conference, Victoria, June. (Spoken).
 11. **Finn, P.G.** and Hughes, J.M. 1996. Do Australian Magpie ‘Helpers’ Gain Indirect Benefits? Griffith University Ecological Review Postgraduate Symposium, Brisbane, November. (Spoken).
 12. **Finn, P.G.** and Hughes, J.M. 1996. Helping Behaviour in the Australian Magpie (*Gymnorhina tibicen*). Australasian Society for the Study of Animal Behaviour Conference, Canberra, September. (Spoken).
 13. **Finn, P.G.** and Hughes, J.M. 1995. Relationship of Helpers to Offspring in the Australian Magpie (*Gymnorhina tibicen*). Australasian Society for the Study of Animal Behaviour Conference, Brisbane, April. (Poster).

LICENCES and ATTAINMENTS

- Manual C- and R-class open driver’s and recreational shipmaster’s licences.
- Construction Industry White Card.
- GIQ Coal (Standard 11) and Coal Board Medical.
- Origin Energy Modules 0 and 1 HSE Leadership Programs.
- Arrow Energy, Epic Energy, Santos, Queensland Gas Company, BHP-Mitsubishi Alliance, Macarthur Coal and New Hope Coal safety inductions for contractors.
- APPEA Introduction to the Petroleum Industry.
- ASIC authority for working airside at the Brisbane Airport.
- Fauna Handling (Spotter/Catcher) and Venomous Snake Handling training.
- National accreditations include: ‘SAIEMS604A - Conduct and Environmental Management Systems Audit’; ‘SAIEMS605A - Evaluate an Organisation’s Environmental Management Systems Audit’; and, ‘AHCFAU301A - Respond to Wildlife Emergencies’.
- Australian Bat Lyssavirus vaccination.
- QLD Herbarium training courses including: Vegetation Structure; Regional Ecosystems; Plant Identification; and, BioCondition Version 2.1.
- Department of Environment and Heritage Protection approved suitably qualified person under the *Flora Survey Guideline – Protected Plants*.
- Senior First Aid and Remote Area First Aid qualifications.
- Defensive four-wheel driving qualifications including: ‘PMASUP236B - Operate vehicles in the field’; ‘RIIVEH201B - Operate light vehicle’; and, ‘AHCMOM211 - Operate side by side utility vehicles’.

- ‘Elements of Shipboard Safety’ qualification and the accrual of a total of 21 ‘days at sea’ as a ‘deckhand’ operating various commercial vessels from 5 to 12 m in length and 37 to 232 kW in power, within ‘smooth’ and ‘partially smooth’ waters of Moreton Bay.

PROFESSIONAL MEMBERSHIPS

- Certified Environmental Practitioner (CEnvP) Scheme: Ecology Specialist since 2014.
- Environment Institute of Australia and New Zealand: member since 2012.
- Ecological Society of Australia: member since 2000.
- BirdLife Australia and Threatened Bird Network: member since 1999, on the management committee of BirdLife Australia Southern Queensland from 2010-2012.
- Australasian Wader Studies Group: member since 1999.
- Queensland Wader Study Group: member since 1993, on the management committee from 1996-2005 and 2015-present.

ADDITIONAL SKILLS

Bird banding: I hold a current A-class bird banding authority with the Australian Bird and Bat Banding Scheme and have had experience banding all types of birds from small passerines to large seabirds and using various catching techniques (trapping, mist- and cannon-netting).

Field skills: I have well-developed skills in animal identification, trapping and handling. I am experienced in a wide range of sampling/trapping techniques for both plants and animals. I have very good field knowledge of birds, particularly shorebirds. I have extensive experience working in urban and rural landscapes, forests, coral cays and intertidal wetlands.

Computer skills: I have developed a high level of computer literacy, using computers extensively for data analyses, word processing and desktop publishing during the writing of scientific papers, presentations, theses and reports. Additionally, I am skilled in the application of computers for data management and a wide range of statistical analyses. I am familiar with several statistical packages including SAS, PATN, SPSS and PRIMER, and GIS programs such as ‘ArcMap’ and ‘MapInfo’.

Laboratory skills: I have experience sorting and identifying benthic marine fauna and flora. I have a good understanding of, and practical experience in, a wide range of genetic techniques, especially allozyme electrophoresis and mini- and micro-satellite DNA analysis. I am proficient in general laboratory and equipment maintenance.

REFEREES

Available on request.

Curriculum Vitae- David James Stanton

Date of Birth: 10/ 04/ 1970

Business Address:

44 Henzell Terrace, Greenslopes, Qld, 4120.

Mob: 044 7822119

Email: davidstanton@3denvironmental.com.au

CURRENT POSITION

Principal Landscape Ecologist - 3D Environmental

ACADEMIC QUALIFICATIONS

BSc Hons: Geology / Biology/ Geomorphology (Hons Class 1-Geology) completed at James Cook University, 1993.

PROFESSIONAL CERTIFICATIONS

MEIANZ: Certified Environmental Practitioner – Ecology Specialist (Certification Number: 0906E)

PROFESSIONAL AWARDS

Planning Institute of Australia, Queensland Division (2005) '*Award of Excellence*' for the Caboolture Shire Councils Bushfire and Hazard Assessment Study. The award was given in the categories of Disaster Mitigation and Biodiversity Conservation and Planning in recognition of work completed in the Caboolture Shire Vegetation Mapping Project, 2004.

Planning Institute of Australia, National Division (2006) '*National Award of Excellence*' for the Caboolture Shire Councils Vegetation Mapping Project. National winner in the category of 'Biodiversity and Conservation Planning'

ACADEMIC AWARDS

Geological Society of Australia Gold Medallion (1993) for outstanding academic achievement in studies of earth science.

PROFESSIONAL SUMMARY

David has a professional career that spans 24 years, which including 3 years' working as regional exploration geologist in the Louisiade Archipelago of PNG, He has extensive experience in the disciplines of resource mapping (geology and geomorphology), floristic assessment, groundwater and dependent ecosystems, conservation planning and impact and ecological risk assessment. His expertise has been utilised across several industry sectors which include mining, infrastructure as well as a consultant to government and indigenous organisations throughout Queensland, the Northern Territory, north-Western Australia and Papua New Guinea. David has particular expertise in landscape scale ecology and ecological processes including the relationships between vegetation geology, geomorphology, hydrology and hydrogeology. David has published vegetation mapping for the Wet Tropics World Heritage area and the Torres Strait Island's on behalf of the Australian Government and has worked extensively on the management of terrestrial biodiversity in northern Australia, co-authoring a number of technical papers on issues relating to landscape ecology and fire management.

PROJECT SUMMARY

ENVIRONMENTAL IMPACT ASSESSMENT FOR LINEAR INFRASTRUCTURE AND WATER

- Northern Australia – Northern Territory
 - PNG to Queensland Gas Pipeline Project, Weipa to Gove Pipeline Lateral Biophysical Assessment: Preparation of floristic mapping (1:25 000 scale), landform and geomorphic analysis and threatened flora assessment of the proposed Weipa (Qld) to Gove (NT) Lateral sections of the proposed pipeline. Included assessment of several pipeline landfall options in the Gove Peninsula / Nhulunbuy region of the Northern Territory. Enesar 2006.

- **AGL Petronas Corporation –PNG to Queensland Gas Pipeline Project:** Provision of botanical and landform assessments along sections of the proposed pipeline easement. Large sections were completed using helicopter survey with foot survey at selected localities. The subsequent reports for these sections provided the information necessary for incorporation into a broader environmental impact assessment. Enesar, 2005, 2006. Sections investigated included:
 - Landfall on Cape York to the Jardine River
 - Charters Towers to Muttaburra.
 - Stonehenge to Windorah
 - South-west of Windorah to Cameron's Corner on the QLD/ SA / NT junction.
- **TRIP Weir Project, Flinders River:** Floristic surveys over the 200 km² TRIP Weir Project inundation area and associated pipelines. Flinders River in the Gulf Plains Bioregional Area. Studies included assessment of potential threatened flora, review of RE Mapping and general floristic survey for the purpose of Environmental Impact Assessment. Stanbroke Holdings Ltd, November 2014 to May 2015.
- **Copperstring EIS:** Comprehensive floristic mapping (regional ecosystems and threatened ecological communities) at 1:40 000 scale of a 150 km² section of the Copperstring Powerline in the Mt Isa, Cloncurry and Selwyn Ranges sections of the proposed 1km wide study easement. Survey also included a flora and mapping survey of the Charters Towers, Pentland, Hughendon and Cloncurry sections of the proposed powerline alignment.
- **Wet Tropics – North-east Queensland**
 - **Ella Bay Integrated Resort Development:** Floristic baseline assessment of the proposed Ella Bay Integrated Resort development site within the Wet Tropics World Heritage Area.
 - **False Cape Development:** A detailed aerial photographic interpretation and classification of vegetation communities and regional ecosystems, including rare and threatened species search on the False Cape development site to the east of Cairns. HLA Envirosciences Pty Ltd, 2004.
 - **Powerlink –Cardstone Powerline Easement Study:** In conjunction with Peter Stanton, carried out an ecological and botanical assessment of the Cardstone – Kareeya powerline easement to determine the environmental impact of a proposed powerline upgrade. The study included a detailed aerial photographic interpretation and map at 1:25 000 scale. This formed part of a broader impact assessment commissioned by Powerlink through C&B Consultants. 2003.
 - **Main Roads Southern Access Planning:** Alongside Peter Stanton, mapped in detail the vegetation communities within the proposed access corridor south of Cairns using 1:7500 scale aerial photographs. The project assessed the presence of rare and threatened plant species and vegetation communities. Sub-contracted to Sinclair Knight Merz, 1997, 1998.
 - **Chevron Asiatic Gas Pipeline Project:** An aerial photographic interpretation of the botany of the Northern Cape York region. The project assisted in the location of a route for a proposed gas pipeline. Sub contracted to NSR consulting group through Peter Stanton. NSR Consulting Pty Ltd, 1997.
- **Central Queensland**
 - **Queensland Nitrates Pipeline Project:** Floristic survey along the 18 km length of the proposed Queensland Nitrates Gas Pipeline near Moura, southern Bowen Basin. Survey focused specifically on assessment of EPBC Act significance of vegetation communities encountered along the pipeline route as well as intensive searches for Protected Plants (following Protected Plants Survey Guidelines) within the project impact area. Contracted to Queensland Nitrates Pty Ltd (September 2014).
 - **Connors River Dam and Pipelines Environmental Impact Assessment:** Provision 1:20 000 scale vegetation mapping, baseline floristic assessment and environmental impact assessment of the proposed Connors River Dam inundation area and proposed pipelines. Brigalow Belt North Bioregion. Contracted to Sunwater, 2009-2012.
- **South-east Queensland**
 - **Gateway Motorway Assets and Expansion Project:** Floristic mapping and assessment of habitats potentially impacted by the Gateway Expansion Project, Brisbane, over a 12 km stretch of road alignment (September 2014).
 - **Traveston Crossing Dam –Terrestrial Flora Survey:** Provision of baseline floristic assessment and supplementary 1:10 000 scale vegetation mapping for the purpose of assessment of environmental impact. Queensland Water, 2006-2009.
 - **Wyaralong Dam –Terrestrial Flora Survey:** Provision of baseline floristic assessment and supplementary 1:10 000 scale vegetation mapping for the purpose of assessment of environmental impact. Sub-contracted to BAAM Pty Ltd on behalf of Queensland Water, 2006-2009.
 - **Emu Swamp Dam and Pipelines – Terrestrial Flora Survey:** Terrestrial floristic assessment of the proposed inundation area and pipeline routes. Emu Swamp on the Severne River, Stanthorpe.

ENVIRONMENTAL IMPACT ASSESSMENT AND CONSTRAINTS PLANNING FOR MINING

- **Northern Australia / Northern Territory**
 - **Ergon Energy – Mua Island Floristic Analysis:** Preparation of dossiers for 18 threatened flora species recorded on Mua Island (Torres Strait) to assist infrastructure planning and facilitate protected plant surveys. The report required comprehensive review of databases, compilation of ecological information and species photographs (contracted to Ergon Energy, 2016).
 - **MMG Century – Phantom Hills Prospect Floristic Baseline Survey:** Baseline floristic survey and vegetation mapping over the 150 km² Phantom Hills Prospect. North-west Highlands Bioregion (2014 Ongoing), 50 km east of the Queensland / Northern Territory border. Prepared for MMG Century.

- **Brigalow Belt**
 - **Arrow Surat Basin Advanced Exploration Project – Ecological Surveys:** Intensive floristic and vegetation mapping surveys over Arrow Energy's advanced project tenements in the region between Miles and Cecil Plains. Assessments were undertaken over a 2500 km² assessment area (contracted to Arrow Energy, 2016 – 2017).
 - **Arrow Bowen Basin Advanced Development Project – Ecological Surveys:** Intensive floristic and vegetation mapping surveys over Arrow Energy's advanced project tenements to the north of Moranbah. Detailed surveys were completed over a 450 km study area including the Roy's Hill and Lancewood gasfield development areas which are contiguous with the North Goonyella Mine ML boundary. Survey included comprehensive desktop assessments as well as the provision of both dry season and wet season survey reports. Contracted to Aecom Pty Ltd and GHD Pty Ltd on behalf of Arrow Energy (November 2014 to June 2015).
 - **Arrow Energy – Daandine Lease (PL230):** An assessment of EPBC values as they relate to flora and threatened ecological communities for Arrow's Daandine Lease (PL230) in the Surat Basin. Sub-contracted to Ecosmart Ecology 2014.
 - **Arrow –Surat Gas Project Supplementary EIS Study:** Preparation of a supplementary terrestrial ecology study including bio-condition assessments at selected sites and habitat mapping for the 80 flora and fauna species listed under state and federal legislation. Habitat mapping was undertaken for the purpose of biodiversity offset planning. Prepared for Coffey Environments, June 2013.
 - **Supplementary EIS Assessment of Arrow Energy's LNG Facility Site, Curtis Island (SEQ):** Review of EIS chapter and terrestrial ecology assessment of the proposed site facility to inform requests for supplementary information. Included assessment of terrestrial flora and fauna on mainland and island portions of the project. Prepared for Coffey Environments, June 2013.
 - **Acacia Coal / EPC1230:** Floristic baseline survey, preparation of 1:50 000 scale regional ecosystem and EIS assessment of the EPC 890 Resource Area to the south of Blackwater. Mapping was undertaken to accurately identify the distribution of regional ecosystems across the EPC to inform requirements for ecological offset (October 2013).
 - **Coffey Environments / Moultrie ESA Mapping:** Preparation of 1:50 000 scale regional ecosystem mapping over the Hillalong Resource Area, north-west of Nebo. Mapping was undertaken to accurately identify the distribution of Environmentally Sensitive Areas over the Mineral Development Lease (Coal). Revised mapping facilitated ecologically sensitive planning for a forthcoming exploratory drilling project (August 2013).
 - **Arrow Bowen Gas Project:** Floristic impact assessment including detailed baseline ecological assessment of the Arrow Energy's 7800 km² petroleum lease and exploration tenements in the Northern Brigalow Belt, Queensland. The project involved revision of regional ecosystem mapping over a selected 1 000 km² area at a scale of 1: 40 000 for the purposes of constraint analysis. Contracted to Arrow Energy, 2012.
 - **Surat Gas Project EIS - Arrow Energy:** Floristic impact assessment including detailed baseline ecological survey of the Arrow Energy's 8200 km² petroleum lease and exploration tenements in the Southern Brigalow Belt, Queensland. The project involved revision of regional ecosystem mapping over a selected 1 800 km² area at a scale of 1: 40 000 for the purposes of constraint analysis. Contracted to Coffey Environments, 2009 -2013.
 - **Byerwen Coal:** Floristic survey and mapping assessment of the Byerwen Coal exploration lease including project 1:50 000 scale revision of mapping over the 60km² site. Byerwen Property in the Northern Brigalow Belt. Unidel 2010, 2012.

- **Curragh North Coal Development Project:** Provision of baseline floristic assessment, 1: 25 000 scale vegetation mapping and environmental impact assessment of the proposed Jellinbah development area (November, 2011).
- **MCG Resources:** Floristic survey and mapping assessment of the MCG Groups MLA's in the Blackwater area, the Brigalow Belt South Bioregion of central Queensland. The study area covered approximately 25 km² as smaller sections of the larger MDL 152 (Curragh Extended and Curragh South). Contracted to Tecsol (2012).
- **Papua New Guinea**
 - **PNG Biomass Project:** Assessment of the 250km² PNG Biomass (Markham Valley- Morobe Province) project for the purpose of forestry plantation. Assessment included detail floristic analysis, vegetation mapping and assessment of impacts against IFC Standards (BAAM P/L, Aligned Energy)
 - **Wafi-Golpu Gold-Copper Mine Project Terrestrial Flora and Fauna Assessment:** Floristic baseline assessment and environmental impact assessment for the Wafi-Golpu advanced exploration project. Contracted to BAAM Pty Ltd on behalf of Morobe Mining JV (February 2015 ongoing).
 - **Marengo PNG – Yandera Prospect Floristic Environmental Impact Assessment:** Ecological baseline study and Environmental Impact Assessment of habitats and species affected by development of the proposed Yandera Prospect, Bismarck Ranges, Marengo Province PNG. Included comprehensive analysis of ethnobotanical and faunal resources. Coffey Environments, 2012.
 - **Kantobo to Mubi River Road Project:** A survey of significant floristic values along an 11km section of proposed road alignment. The survey required assessment of floristic values associated with virgin lowland rainforest in the Southern Highlands/ Gulf Province, Papua New Guinea. Subcontracted to Coffey Environments, 2010.
 - **Solwara Project – East New Britain PNG:** Habitat assessment, floristic analysis and mapping of the 80km² lease area on the East New Britain Coast-Papua New Guinea. Included comprehensive analysis of ethnobotanical and faunal resources. Contracted to Coffey Natural Systems, 2008.
- **Central Queensland Coast**
 - **McFarlane Oil Shale Project-Central Queensland:** Detailed baseline botanical assessment and environmental impact assessment of the 252km² mineral lease area in the central Queensland Coast Bioregion. The project included 1:40 000 scale aerial photographic interpretation of regional ecosystems and vegetation communities. Contracted to URS Australia (2008 – 2009).
 - **Supplementary EIS Assessment of Arrow Energy's LNG Facility Site, Curtis Island (SEQ):** Review of EIS chapter and terrestrial ecology assessment of the proposed site facility to inform requests for supplementary information. Included assessment of terrestrial flora and fauna on mainland and island portions of the project. Prepared for Coffey Environments, June 2013.
 - **Stuart Oil Shale Floristic Impact Assessment:** Baseline floristic assessment, vegetation community/ regional ecosystem mapping and floristic impact assessment of the Stuart Oil Shale Project Area, Gladstone. Revision of RE mapping undertaken over a 120 km² area at 1:25 000 scale. Queensland Energy Resources (QER), 2012.
 - **Red Mud Dams Vegetation Assessment:** Completion of an RE and vegetation community assessment of the Red Mud Dams area, Boyne Island. The map and complementary report was an aid to planning for future tailings disposal in the area. QAL (sub-contracted through BAAM Pty Ltd), 2005.
- **Desert Uplands**
 - **Eromanga Basin / Desert Uplands vegetation and floristic constraints analysis:** Provision of floristic and landform constraints analysis and mapping over a 5000km² ATP area to assist sensitive location of a proposed comprehensive seismic survey (500km of proposed survey line). Galilee Energy, 2010.

BIODIVERSITY OFFSET PLANNING AND ASSESSMENT

- **MMG Century – Lawn Hill Station Biodiversity Offsets Project:** Habitat biocondition and vegetation mapping assessment of a 6km stretch of river frontage on Lawn Hill Creek contiguous with Lawn Hill National Park on the Queensland / Northern Territory border. The assessment provided baseline information to assist preparation of a biodiversity offset plan for Lawn Hill Station (July 2014).
- **Exco Resources Biodiversity Offsets Project:** Habitat bio-condition, ecological equivalence assessment, vegetation mapping and general floristic survey of a 42 km² portion of Lawn Hill Station to identify suitable habitat for Purple-necked Rock Wallaby.

MINESITE REHABILITATION MONITORING AND ASSESSMENT

- **MMG Century Rehabilitation Monitoring Project:** Implementation of a baseline monitoring program to assess rehabilitation progress on stabilised waste rock dumps. Prepared to identify trends in vegetation development toward the meeting of mine closure criteria. North-West Highlands (March 2014 ongoing).
- **Arrow Energy - Review of Environmental Authority Conditions for Rehabilitation, ATP 676:** A review of EA conditions for ATP 676 to assess the achievability of current EA requirements for vegetation rehabilitation. The review report was utilised for internal Arrow Energy purposes. Prepared with assistance from Vegetation Management Science (March 2014).

CONSERVATION PLANNING

- **North-eastern Australia**

- **Wet Tropics Management Authority Vegetation Mapping Project:** A 1: 25 000 scale aerial photographic interpretation and complementary 1:50 000 map of the structural characteristics, vegetation communities and geology of the Wet Tropics Bioregion, an area of over 30 000 km². The project required the detailed classification of both remnant and non- remnant vegetation communities and the completion of 38 resource management reports for various regions within the project area. During this time, expert advice was provided to the authority in regard to management aspects of the World Heritage Reserve. The completed mapping product forms the basis for RE mapping and assessment within the Wet Tropics Bioregion (incorporated into Version 5.2 digital RE data produced by EPA). (1997 – 2012, work is ongoing to date of publication expected in August 2012)
- **Upper Bridge Creek Conservation Area Timber Assessment Report:** Provided an assessment of timber resources within the 160 km² Upper Bridge Creek Conservation Area to the north of Hopevale. Project facilitated negotiations between Traditional Owners and the Queensland Government to agree to terms of transfer to Conservation Reserve. Contracted to DATSIMA (Old Govt, April 2015).
- **Mandingalbay Yidinji Lands Biodiversity Planning and Management Project:** Development of biodiversity and land management profile for the Mandingalbay – Yidinji Lands, Wet Tropics World Heritage Area. Biodiversity profile has been applied to guide land management programs for the 'Working on Country' ranger program. Contracted to Djunbunji Ltd. June 2013 ongoing.
- **Torres Strait Island Biodiversity Planning Project:** Development of biodiversity and land management profiles for 14 selected islands in the Torres Strait, Northern Australia. Biodiversity profiles are being applied to guide land management programs for the 'Working on Country' ranger program. Contracted to Torres Strait Regional Authority, Australian Government). November 2010 to December 2012.
- **Torres Strait Islands Regional Ecosystem and Vegetation Community Mapping:** A 1:25 000 aerial photographic interpretation of the vegetation, structural associations and regional ecosystems of the islands of the Torres Strait. Spatial data produced during the vegetation survey has been successfully incorporated into the Version 6.0 RE digital database produced by DERM. The survey and mapping project assessed a total land area of 860 km² within the Cape York Peninsula Bioregion (Contracted to Torres Strait Regional Authority, Australian Government).
- **Queensland Herbarium – Wet Tropics Bioregion Regional Ecosystems Classification:** Expert advice provided to the Queensland Herbarium concerning descriptions and classification of regional ecosystems in the Wet Tropics Bioregion. Advice was specific to the release of revised regional ecosystem mapping throughout the state relevant to the implementation of Queensland's "Vegetation Management Act". Queensland Herbarium, 2009.
- **Queensland Herbarium Non Remnant Vegetation Classification:** An assessment of the remnant status of highly disturbed vegetation communities within the Wet Tropics Bioregional zone, relevant to the implementation of Queensland's "Vegetation Management Act" EPA, 2004- 2005.
- **Wet Tropics Management Authority Timber Resource Assessment Project (2004):** A resource and timber assessment of freehold tenure within the World Heritage area to provide a means to adequately assess landowner compensation claims. Wet Tropics Management Authority, 2004.
- **Dawnvale Station Vegetation Mapping Project:** A land management report and detailed aerial photographic interpretation of vegetation within the Dawnvale Grazing Leasehold. The study was commissioned to assist traditional owners in their application for leasehold renewal. Centre for Appropriate Technology, 2001.
- **Mt Molloy Vegetation and Land Systems Mapping:** Report on the environs of the Mt Molloy Wetlands including a 1:25 000 aerial photographic interpretation of landform, geomorphology and vegetation. Mitchell River Catchment Management Group, 1999.

- **Brigalow Belt / Central Queensland**
 - **Newlands Nature Refuge / Wollumbi Brigalow Conservation Reserve ecological assessment:** Detailed vegetation mapping and floristic analysis of vegetation communities and regional ecosystems on the Newland Nature Refuge and Wollumbi Brigalow Conservation Reserve, Brigalow Belt North Bioregion (total area of 100km²). The study was commissioned for compliance with EPBC offset requirements. XStrata Coal / Footprints Ecology, 2009.
- **South-east Queensland**
 - **Seqwater Advanced Offsets Project:** Identification of suitable advanced habitat offsets within Seqwater's water infrastructure estate in south-east Queensland. Assessment included the identification habitats suitable for offset at Ewan Maddock, North Pine and Hinze Dam sites to the north and south of Brisbane (contracted to GHD, 2017).
 - **Caboorture Shire Council Vegetation Mapping Project:** Detailed 1:25 000 scale and 1:10 000 scale mapping of vegetation communities, land zones, and regional ecosystems of the Caboorture Shire Council (SEQ) using aerial photograph analysis. Total project area of 1200 km². The project included detailed floristic sampling of all intact communities identified and the development of a classification scheme to allow assessment of highly disturbed vegetation types. Contracted to Rob Friend and Associates, 2004.
 - **Reedy Creek Conservation Area (Agnes Waters):** Detailed 1:10 000 scale aerial photographic interpretation and map of the vegetation communities in the Reedy Creek Conservation Area relevant to conservation and fire management with a proposed eco-development site (Bush Heritage Trust, 2005).

FIRE / ECOLOGICAL MONITORING PROJECTS

- **Mandingalbay Yidinji / Djunbunji Aboriginal Corporation Fire Monitoring Project:** Implementation of a fire monitoring program to assess the ecological impacts of both wildfire and traditional burning practice on MY Lands. Wet Tropics Bioregion, Yarrabah, Cairns (January 2014 ongoing).
- **East Trinity Monitoring / Wetlands Rehabilitation Project:** Completion of a detailed mapping and flora survey on reclaimed estuarine wetland, including mapping and categorisation of secondary vegetation communities. The study was based aerial photograph interpretation (1:10 000 scale aerial photography). Department of Environment and Resource Management (DERM), 2002 to 2009.
- **Wet Tropics Phytophthora Mapping / Monitoring Project:** Contracted to map rainforest die back resulting from Phytophthora outbreak within the wet tropics rainforest communities. The study was completed with detailed 1:25000 aerial photographic interpretation over 'at risk' areas. James Cook University/Rainforest CRC (1999 - 2001).

FIRE PLANNING PROJECTS

- **Mandingalbay Yidinji / Djunbunji Aboriginal Corporation Fire Management Planning:** Development of a fire management strategy for Mandingalbay Yidinji Lands within the Wet Tropics World Heritage Area. Prepared for the purpose of engaging traditional owners in the on ground management of traditional lands (October 2013 ongoing) and direct ecologically sensitive application of fire to the landscape.
- **Reedy Creek Conservation Reserve Fire Management:** Five-year review of the endorsed fire plan for the Reedy Creek Conservation Reserve, Agnes Water. Included recommendations to accommodate changes in the surrounding urban landscape whilst considering the results and lessons from the previous management period. Bush Heritage Trust 2014.
- **Torres Strait Island Fire Management Project:** Development of fire management plans for biodiversity conservation on Badu, Mua, Saibai, Boigu, Dauan, Mabuig, Mer and Erub Islands in the Torres Strait. Work was completed in conjunction with Peter Stanton. Contracted to Torres Strait Regional Authority (2012 -2013).
- **Cape York Fire Project:** A fire scar and floristic structural mapping project to assess changes in vegetation communities that have resulted from shifting fire regimes over the past 30 years. Project utilised current and historical aerial photography for interpretation. Balkanu Cape York Land Development Agency (April to June 2003).

GROUNDWATER DEPENDENT ECOSYSTEMS / GAS MIGRATION ASSESSMENT AND MONITORING

- **GDE Site Characterisation – Arrow Surat Gas Project:** Implementation of GDE assessment execution plan involving characterisation of chosen GDE localities through drilling and bore construction (Sonic), isotope analysis of soil and xylem water and leaf water potential. Arrow Energy 2017 / 2018.

- **GDE Study Execution Plan – Arrow Surat Gas Project:** Execution plan for detailed characterisation of GDE's throughout the Surat Gas Project Area including plans for groundwater assessment, ecological characterisation, leaf, soil and groundwater sampling.
- **Groundwater Dependent Ecosystem (GDE) Assessment – Arrow Energy Surat Gas Project:** Detailed description, characterisation and mapping of GDEs throughout the Surat Gas Project assessment area. Study was commissioned to assist development of the Water Monitoring and Management Plan (WWMP). Contracted to Arrow Energy 2016 and 2017.
- **Banksia Beach Borefield – Groundwater Dependent Ecosystem (GDE) Monitoring:** Monitoring of wet coastal heath to detect impacts of groundwater drawdown on vegetation composition, structure and ecology. Biannual reporting includes an analysis of NDVI datasets to support assessments of vegetation condition. Seqwater (2016 ongoing).
- **Condamine River Gas Seeps Vegetation Monitoring:** Assessment of the impacts of gas migration into soil on the health and vigour of intact riparian vegetation on the Condamine River frontage. Required assessment of the current condition and status of vegetation as well as implementation of a long-term vegetation monitoring program.
- **Groundwater Dependent Ecosystem (GDE) Assessment – Arrow Energy Surat Gas Project:** An assessment of the potential groundwater dependency of ecosystems in Arrow Energy's Surat Project tenements to inform federal requirements for a Groundwater and GDE Management Plan . The project required detailed assessment and integration of groundwater, geology and ecological databases, spring characterisation and recommendations for an ongoing monitoring program (Arrow Energy 2016 ongoing).
- **Groundwater Dependent Ecosystem (GDE) Assessment – Arrow Energy Bowen Gas Project Development Area:** An assessment of the potential groundwater dependency of ecosystems in Arrow Energy's Bowen Gas Project tenements to inform federal requirements for a Groundwater and GDE Management Plan . The assessment focused on the potential groundwater dependency of ecosystems in areas contiguous with the North Goonyella, Suraji, Newlands and Suttor Creek Mining Lease areas with the focus on developing an ecological assessment program to monitor the effects of groundwater drawdown on vegetation condition (Coffey Environments 2015).
- **Sunshine Coast Regional Airport – GDE Assessment:** Assessment of the effects of altered groundwater hydrology on the ecology of wet heath and associated populations of the Endangered *Allocasuarina emuina*. Preliminary review of environmental conditions for the Sunshine Coast Airport Upgrade. Sub-contracted to BMT – WBM (June 2010).

LANDFORM / SOIL AND GEOMORPHOLOGY PROJECTS AND ASSESSMENTS

- **Mornington Wildlife Sanctuary Landform, Geology and Vegetation Community Mapping Project:** A 1: 50 000 aerial photograph interpretation and descriptive landform, soils geological and floristic mapping assessment of the Mornington Wildlife Sanctuary, Kimberley Region, North Western Australia. The report and complementary map provided a baseline study into the factors influencing the area's ecology and diversity. Assisted with preparation of vegetation maps for the property as well as preparation of a floristic inventory. Total survey and mapping area of 3 200 km². Contracted to Australian Wildlife Conservancy (2004).
- **Mt Zero Wildlife Sanctuary Landform and Geological Mapping Project:** A 1:25 000 scale aerial photographic interpretation, map, and descriptive report on land systems soils and geology of the Mt Zero/Taravale Wildlife Sanctuary, North Queensland. Total survey and mapping project area of 650 km².
- **Agnes Water Geomorphic and Land Zone analysis:** Provision of a geomorphic and soil assessment of a 300ha site south of Agnes Water. The study formed the basis for appraisal of regional ecosystems in the study area. EPA certified regional ecosystem mapping was successfully challenged. Mariner Awaken/ Midell Joint Venture, September 2009.
- **Geomorphological assessments on major river crossings on the proposed PNG to Queensland gas pipeline for the purpose of assessing crossing stability.**

GENERAL ECOLOGY, REHABILITATION AND VEGETATION MANAGEMENT ASSESSMENTS FOR DEVELOPMENT

- **Property Map of Assessable Vegetation:** Preparation of and application for a PMAV over the 250km² Burdekin Downs property in the Einasleigh Uplands. Includes detailed field site survey, historical aerial photographic interpretation, preparation of supporting material and submission to DNRM. Burdekin Downs Pastoral Ltd, Charters Towers, 2017.
- **Ecological Assessment Report – Seton College, Brisbane:** Assessment of development impacts on the ecology of remnant woodland mapped as having High Ecological Sensitivity. Response to an information request by Brisbane City Council.

- **Vegetation Management Plan – Rehabilitation Plan, Hymix Concrete Batching Site, North Pine River:** Vegetation and Rehabilitation Management Plan for the 250 Bald Hills Road, a 10 ha former industrial site adjacent to the North Pine River to be rehabilitated under court order. Duggan and Hede Pty Ltd for Hymix Australia.
- **Ecological Assessment Report – Yandina Waste Disposal Facility (Sunshine Coast Regional Council):** Floristic survey and assessment of vegetation condition at proposed waste disposal facility, Yandina on the Sunshine Coast. Prepared for Sunshine Coast Regional Council on behalf of Duggan and Hede Pty Ltd (August 2014).
- **Ecological Assessment Report – Warwick Landfill:** Floristic survey and general ecological assessment of the proposed extension of the Warwick Landfill Site. Prepared for Duggan and Hede Pty Ltd (November 2013).
- **Wooyung Developments, NSW –** Ecological assessment of a proposed Eco-Tourism Facility at Wooyung Beach, Northern NSW. Assessment of a 100ha development site including mapping and assessment of Critically Endangered Littoral Rainforest communities, listed under the Federal and State (NSW) legislation.

WATERWAYS MANAGEMENT PROJECTS

- **Redlands Waterways Reach Management and Riparian Condition Assessment:** A reach and catchment characterisation including riparian habitat assessment, for waterways in the Redland Shire Council area (SEQ). The project involved aerial photograph classification of reach, and field assessment of riparian habitats (Hydrobiology, 2011).
- **Caboolture Waterways Management Project:** Provided a reach and catchment characterisation, including riparian habitat assessment, for waterways in the Caboolture Shire area (SEQ). The project involved aerial photograph classification of reach, and field assessment of riparian habitats (Natural Systems, 2006 - 2007).

EXPERT WITNESS

- Provision of expert advice to Rob Friend and Associates / Iwasaki Resorts in regard to charged breaches against the Vegetation Management Act. Evidence was presented for the defence in Queensland Planning and Environment Court Proceedings.
- Expert witness duties for the case of Queensland Government versus Strathmore Station in regard to charged breaches against the Vegetation Management Act. Contracted to Preston Law, Cairns. Trial is ongoing.

OTHER RELEVANT PROFESSIONAL EXPERIENCE

Feb. 1995 - August 1997

Regional Exploration Geologist – Louisade Archipelago P.N.G: The position required the development of remote epithermal gold prospects on Placer Dome's (now Barrick Gold Corporation) exploration tenements on Misima Island and regional areas. Major tasks included detailed geological mapping, remote sensing and reconnaissance drilling (diamond core). The supervision of exploratory drilling on advanced gold prospects, including resource delineation drilling in the mine vicinity, was also required on a regular basis.

Feb. 1994 - February 1995

Exploration Geologist - Osborne Gold Mine: The major task was to supervise the Osborne regional exploration program during the construction phase of the Osborne Cu-Au Mine (Mt Isa Inlier). Project requirements included the planning and implementation of exploratory drilling programs to test geophysical targets, supervision of RC and Diamond Core drilling rigs, logging of RC chips and diamond core. Project management tasks included the planning of a regional exploration program around a budget of \$350K.

PEER REVIEWED PUBLICATIONS

Stanton J. P., Stanton D.J., Stott M. & Parsons M. (2014). Fire Exclusion and the Changing Landscape of Queensland's Wet Tropics Bioregion 1. The Extent and Pattern of Transition. Australian Forestry V77 No.1 51 – 57.

Stanton J. P., Parsons M., Stanton D.J.& Stott M. (2014). Fire Exclusion and the Changing Landscape of Queensland's Wet Tropics Bioregion 2. The Dynamics of Transition Forests and Implications for Management. Australian Forestry V77 No.1 58 – 68.

Fell D.G., Stanton D. J (2015). Vegetation and Flora of Mabuyag Island, Torres Strait, Queensland. Memoirs of the Queensland Museum, Volume 8, Part 1.

Stephenson PJ, Burch AT, Stanton DJ & Whitehead PW (1998). *Three long lava flows in north Queensland*. *Journal of Geophysical Research-Space Physics*, 103, 27359 – 27370.

SPECIALIST TECHNICAL TRAINING

Australian Groundwater School: Four-day intensive training course dealing with technical and management aspects of groundwater in an Australian context. Flinders University, Canberra, 2017.

PUBLISHED VEGETATION MAPPING

Stanton J. P and Stanton D. J (2005) '*Vegetation of the Wet Tropical Bioregion of North Queensland*', published at 1:50 000 scale in co-operation with the Wet Tropics Management Authority, Cairns, Queensland.

Stanton D.J, Fell D. F, Gooding D. O (2009). '*Vegetation of the Torres Strait and Kaurareg Islands*': 1:25 000 scale vegetation mapping produced in co-operation with Torres Strait Regional Authority, Australian Government.

PRESENTATIONS

IAVCEI (International Association of Volcanology and Chemistry of the Earths Interior) conference, Canberra 1993, "*Using Remote Sensing to Detect Geochemical Heterogeneity within the Kinrara Lava Flow, McBride Lava Province, N.Q.*"

EIANZ conference '*Achieving Real Biodiversity Outcomes during the EIS Process*', April 2010. The presentation was titled '*The Importance of Accurate Regional Ecosystem and Vegetation Mapping in the Assessment of Impact to Biodiversity*'.

ADDITIONAL RELEVANT SKILLS, INTERESTS and CERTIFICATIONS

- Proficient in the Tok Pisin PNG language
- Professional experience as a Lifeguard for Queensland Surf Life Saving Association;
- Former Queensland representative swimmer and current record holder for the Magnetic Island to Townsville swimming race.
- Senior First Aid Certificate Current.
- Above Ground Coal Core and Coal Seam Gas inductions
- Advanced 4wd training certification current.

REFERENCES

Steven Goosem: Principal Scientist, Wet Tropics Management Authority. Ph: 07 4052 0563: Email: steve.goosem@wetma.qld.gov.au

Barton Napier: Principal - Coffey Environments. Trenerry Crescent, Melbourne. Ph: 03 9473 1450. Email: Barton.Napier@coffey.com

Dale Mundraby: CEO Mandingalbay Yidinji Aboriginal Corporation. Ph: 07 4056 8283. Email: dale@djunbunji.com.au

MARK SANDERS

Position: Director/Principal Ecologist, EcoSmart Ecology Pty Ltd
Qualifications: Bachelor of Advanced Science (Zoology) (First Class Honours)

Areas of Expertise

- Environmental planning and constraints analysis
- Vertebrate fauna survey and identification
- Rapid assessment of terrestrial habitats
- Design and implementation of research projects, particularly monitoring programs
- Threatened species survey and assessment
- Wildlife management
- Biodiversity planning and offset management
- Scientific communication

Overview

Mark Sanders is a highly respected and well known ecologist with over 20 years field expertise and first-hand knowledge of more than 1600 of Australia's terrestrial vertebrate species. His enthusiasm for natural history has led to surveys in every state and territory within the Australian continent from across a vast range of habitats.

Mark combines his ecological knowledge and experience with strong industry understanding and management skills. His project-related experience has included linear infrastructure (roadways, rail corridors, transmission lines etc), mining (inc metalliferous and coal), oil and gas, energy and transport projects, and small and large scale infrastructure (town development, master plan projects, airports etc). He has also prepared management plans for threatened species and offset areas, and provided detailed assessment for regulatory review. His broad industry experience enables him to evaluate ecological resources and make effective strategy recommendations based on scientific understanding and industry knowledge.

Marks recent work has included a large-scale airport development located on the Sunshine Coast of Queensland. The work involved rapid ecological assessment to identify potential ecological constraints, targeted long-term (12+ months) research on high conservation taxa, and baseline (inventory) surveys. Multidisciplinary understanding has been fundamental in developing environmentally sustainable solutions, which has included evaluation and identification of offset priorities and targets. Due to the sensitive location and nature of the works, Mark has been required to regularly liaise with government bodies, research institutions and community groups, often requiring the communication of complex ecological issues.

Mark has extensive experience in remote area work, four-wheel drive training and maintenance skills and has worked with traditional land owners. His photography skills are renown, and his highly sort after images have been used in a variety of publications.

Professional History

2009 - present	Director/Principal Ecologist EcoSmart Ecology Pty Ltd
2008	Principal Ecologist Matrixplus Consulting Pty Ltd
2005 - 2008	Senior Ecologist BAAM Pty Ltd
2001 – 2005	Senior Ecologist Australasian Resource Consultants Pty Ltd, Brisbane Qld.
2000	Environmental Scientist Blue Mountains Wilderness Trust, Sydney NSW.

Selected Project Experience

- Baseline (seasonal) inventory survey of terrestrial fauna at MMG Century, located near Lawn Hill National Park in north-west QLD, 2013-14,
- Fauna assessment and community fauna awareness project within the Mandingalby Yidinji IPA, Yarrabah, Cairns. Surveys involved teaching survey methods and sharing information with local Traditional Owners, 2013-14.
- Baseline (seasonal) inventory survey for terrestrial fauna on Curtis Island for Arrow Energy CSG, 2012/13. Works included the survey of mangrove communities, intertidal communities, headlands and coastal dune vegetation (e.g., littoral rainforest),
- Baseline terrestrial fauna survey at Pisolite Hills, north of Weipa, QLD, 2012-2013
- Baseline vertebrate assessment of the Red Mud Dam area, Boyne Island for QAL (2005). Works included coastal dune complex with littoral rainforest.
- Team leader for the (fauna) assessment of Arrow Energies Surat basin CSG tenements. Works included high-level assessment to establish areas of primary conservation value, and the development of a risk-based approach to infrastructure planning. 2010 to present
- Fauna survey for South Murrin Murrin mining operations, WA. 2012.
- Pest Management Action Plan – Feral Pig and Red Fox. Action Plan prepared for Redland Shire Council. June 2005.
- Team Leader for two successive flora and fauna surveys (2001 and 2003) for the North Curragh Coal Project, Central Queensland. The project included assessing and managing impacts on three Nationally Vulnerable species along a proposed transport corridor.
- A 6 day (5 night) survey in a remote area for Matrix Metals near Kajabbi in far north-west Queensland. The survey found several threatened species and added small range extensions for several common species.
- Project Manager and Team Leader for a comprehensive survey and assessment of environmental values of Tarong State Forest in south-eastern Queensland.
- Flora and fauna assessment of coastal vegetation in north-eastern NSW. The survey located eight threatened fauna species.
- Survey of flora and fauna species on a 400ha site near Mt Glorious, south-east Queensland. Habitats surveyed include rainforest, wet sclerophyll forest and dry sclerophyll forest.
- Team Leader for an intensive 10-day survey of an area north of Clermont, Central Queensland. Confirmed the presence of several Endangered Regional Ecosystems and Threatened species.
- An extensive 8 day baseline survey study for Selwyn Mines in the Selwyn Ranges. During the study, *Pseudantechinus mimulus* was discovered. This species has been seen on the mainland of Australia only five times since its description in 1906.

Targeted Surveys

- Ground Parrot Research (2012-2014 and 2017) at the Sunshine Coast Airport. Monthly works to establish habitat use and population size,
- Targeted Purple-necked Rock-wallaby research and monitoring; MMG Dugald River. Ongoing works,
- Targeted survey, including trapping and active searches, for the vulnerable Water Mouse (*Xeromys myoides*) around Port Curtis (Gladstone) including Curtis Island (2012). The works located a number of nesting holes and increased local knowledge/distribution of the species.
- Targeted survey and assessment of the distribution of the Brigalow Scalyfoot on Boyne Island (for Queensland Alumina) (2006).
- Targeted survey and management plan for the federally Vulnerable Black-breasted Button-quail, Boyne Island Gladstone (QAL, 2006). This work was commissioned following baseline surveys which rediscovered the species within littoral rainforest on coastal dunes. Prior to the discovery the species had only been known in the local area from records in the early 1900's.

- Team leader for the survey of threatened wallum frogs (particularly Wallum Sedgefrog) near Caloundra, south-east Queensland (2012 – ongoing). Work included sampling tadpoles and water parameters to evaluate breeding success across a variety of pools located in a variegated and disturbed landscape.
- Assistant to field ecologist on a study into the population, distribution and abundance of Plains Wanderers (*Pedionomus torquatus*) in grasslands of southern central NSW.
- Field Team Leader in the assessment of the presence and extent of Black-breasted Button-quails (*Turnix melanogaster*) in Tarong State Forest, south-east Queensland.
- Microchiropteran bat fauna of Clermont Coal Project north of Emerald. The survey was designed to determine the presence/absence and distribution of the Little Pied Bat (*Chalinolobus picatus*) and Greater Long-eared Bat (*Nyctophilus timoriensis*).
- Team Leader for an assessment of the presence/absence of the Threatened *Delma torquata* in south-east Queensland.

Research and Monitoring

- Carpentarian Pseudantechinus (*Pseudantechinus mimulus*) research to establish best survey methods and evaluate their distribution. Co-supervisory role with the University of Sunshine Coast.
- Team leader for the twelve month monitoring to determine area of occupancy and habitat preference of the vulnerable Ground Parrot, Sunshine Coast Airport, Marcoola.
- Research into the methods of habitat utilisation and differentiation between four sympatric species of low-foliage gleaning bird species (White-browed Scrubwren, Superb and Variegated Fairy Wren and the Southern Emu-wren).
- Leader of the team that developed a biannual monitoring program for Pacific Coal's Kestrel Project in central Queensland. The aims of the program are to determine the affect of cattle grazing and subsidence on biodiversity values of natural grasslands and riparian ecosystems. The program was specifically designed so that later publication of results would be possible.
- Design and implementation of biannual monitoring program to document the success of rehabilitation strategies at Peak Downs Coal Mine.
- Comprehensive 8 day fauna study for the Ernest Henry Copper/Gold Mine as part of their yearly monitoring program. Aims of the program are to statistically show the effect of rehabilitation techniques on facilitating recolonisation by fauna.
- Heavy metal accumulation in aquatic macro invertebrates at Ernest Henry Copper/Gold Mine.
- Development of a monitoring program of the Vulnerable Ornamental Snake (*Denisonia maculata*) including population estimates (micro-chips) and radio-tracking. In particular, the program was designed to determine the effect of a road through a known population and if specifically designed underpasses facilitated movement and flow within the population. The program was accepted by the Department of Environment and Heritage.
- Research into shelter site characteristics of the Purple-necked Rock-wallaby (*Petrogale purpureicollis*) during summer.

Selected Technical Papers

- McNab, A., and **Sanders, M.G.** (2014). Consumption of exotic grass seeds (Poaceae: *Cynodon dactylon*) by the Eastern Ground Parrot (*Pezoporus wallicus*). *The Queensland Naturalist* Vol 52, 82-84.
- McNab, A., **Sanders, M.G.**, and Vanderduys, E. (2014). New records of blind snakes resembling the Robust Blind Snake *Anilius ligatus* (Peters 1879), on Cape York Peninsula, *Memoirs of the Queensland Museum*. 59, 8.
- McNab, A., and **Sanders, M.G.** (2014). An occasional carnivore, Diadem Leaf-nosed Bat (*Hipposideros diadema reginae*). *The Australasian Bat Society Newsletter*.

Lloyd, P., **Sanders, M. G.**, Reis, T. and Abbott, A. (2013). Targeted trapping surveys shed new light on the distribution and habitat requirements of the Carpentarian Pseudantechinus (*Pseudantechinus mimulus*), a threatened dasyurid marsupial. *Australian Mammology*. **35**: 220-223.

Sanders, M. G., Filewood, L. W. and Fox, B. J. (2005). Differential use of habitat aids local coexistence of three species of wrens (Maluridae) and the White-browed Scurbwren *Sericornis frontalis*: Pardalotidae in Myall Lakes National Park. *The Australian Zoologist*. **33**: 223-232

Sanders, M.G. (2004). Notes on a mass aggregation of *Illyria burkei* (Goding & Froggatt) (Hemiptera: Cicadidae) in central Queensland. *The Australian Entomologist*. 31 (2):79-80

Sanders, M.G., and Slater, L. (2004) New habitat and distributional data for the Vulnerable *Pseudantechinus mimulus*. *Memoirs of the Queensland Museum* **49**: 740.

Macey P. C., McKiernan, C. and **Sanders M. G.** (2002). Is there any science in the Environmental Protection and Biodiversity Conservation Act 1999? A review of the Migratory Species List. Presentation for the 4th Environmental Engineering Conference, May 2002, Brisbane.

A full CV can be provided upon request.

RESUME

Name: Peter Thomas Hall

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Qualifications: Bachelor of Applied Science (Biology)
Central Queensland University
Completed 1995.

Certificate IV in Investigations.
June 2003 Moreton Institute of TAFE

Other skills and Qualifications.

DSEWPac Accredited Ecologist. (Terrestrial Flora and Fauna) 2012

Construction Industry OH&S Induction (White Card)

Experience in using GIS programs, (principally ESRI ArcGIS and GBM), and GPS technology.

Heavy Vehicle Driver's Licence

Agricultural Chemical Distribution and Control Act, Operator's Licence (Restricted).

Level 2 Chainsaw Operator.
Computer and word processing skills.

Workplace Trainer Qualifications 2000

Advanced First Aid Remote Area Operations (refresher training) 2014

In Service Training: Communications Skills 1984

Fire Training 1986

Supervisor Training 1987

Law Enforcement School 1989

Forest Interpretation Workshop 1993

Recreation Training workshop 1994

Customer Service Training 1994

Summer School of Park Management
Canberra University 1995.

Public Speaking Course through Toastmasters
International 1998.

Aboriginal Cultural Heritage Awareness 1999 and 2004

Regional Ecosystem Training 1999 and 2002.

Map Amendment Request Training 2003

Tactical Communications 2004.

Detecting Deception 2004.

Decision Making Training 2005

Technical Report Writing 2005.

Acid Sulphate Soils Training 2005

QGC Induction 2011

4WD training and defensive driving 2011

Vehicle washdown and weed hygiene
certification (Certificate II in Conservation and Land
Management –National Code RTD20102) 2011

Origin Energy induction 2012

All Terrain Vehicle drivers' course. 2012

Remote area first aid 2012

Helicopter landing officer 2012

Erosion and Sediment Control Training 2012

Laing O'Rourke Induction 2013

WDS Induction 2013

Origin Energy Foundation Training 2014

Most Recent Salary: \$100K including superannuation or \$60/hour plus costs for contract work.

Employment History

January 2016 to present.

Contract Ecologist with Naturecall Environmental Pty Ltd.

This a contract position. Naturecall engages my services when they require specialised ecological advice.

I have worked on two projects in this role,

One was determining and mapping the extent of threatened grasslands on the Army Aviation Base at Oakey. The job included other ecological surveys as well.

The second job was mapping the occurrence of an endangered plant, *Melaleuca irbyana* on a sports reserve in Logan City Council.

April 2015 to present.

Consulting Ecologist with First Steps Environmental (employed on a casual basis).

Duties and responsibilities; principally conducting field surveys of native vegetation in North, West New South Wales under various codes relating to clearing for agricultural purposes under the *Native Vegetation Act 2003*.

June 2014 to April 2015

Field Environmental Advisor with Origin Energy.

Duties and role description; refer to my time in the same role January 2012 – September 2013

September 2013 to June 2014

Senior Vegetation Management Officer, Central West NRW Region.

Duties and role description; refer to my time in the same role January 2008 – March 2011

November 2012 until March 2014

Ecologist and expert witness with First Steps Environmental Pty Ltd, for the Turnbull Case, Croppa Creek. (This work was undertaken concurrently with other employment).

This case involved preparing an ecological report to address the federal *Environmental Protection and Biodiversity Protection Act (EPBC)* requirements of a tree clearing application over a large farming property near Moree in NSW.

Additionally, the case involved preparing an affidavit and giving evidence in the Sydney Land and Environment Court in the capacity of an expert witness ecologist for the Defence, in a tree clearing prosecution under the *Native Vegetation Act 2003*. The case was heard in March 2014.

The case had a favourable outcome for the client in that the Court considerably reduced the fine that the Office of Environment and Heritage (OEH) originally sought. Also, based on my affidavit, potential charges under the EPBC Act and for clearing an Endangered Ecological Community under *The National Parks and Wildlife Act 1974* were not pursued.

Details of the Land and Environment Court Judgement are available at the web address below.

<http://www.caselaw.nsw.gov.au/decision/54a63ede3004de94513dc50f>

In June 2014 an appeal against the Remediation Directions imposed on the landholders by NSW Office and Heritage were also heard in the Sydney Land and Environment Court.

The Court directed that the expert witnesses for the Prosecution and Defence should agree on a compromise Remediation Plan. This plan formed the basis for the eventual Remediation Direction that was imposed by the Court.

Based on my evidence and negotiations with OEH, the Court agreed that rather than order remediation of the entire cleared area, the property owners should be allowed to restore offset areas to high ecological condition and continue to farm some of the unlawfully cleared areas in order to meet the costs of implementing the remediation plan.

The judgement is available at the link below.

<http://www.caselaw.nsw.gov.au/decision/54a63ed53004de94513dc23c>

January 2012 to present until September 2013

Field Environmental Advisor with First Steps Environmental Pty Ltd, contracted full time to Origin Energy.

Duties included;

- Conducting reports and pre-clearance surveys for properties where Origin intended to locate CSG gathering infrastructure.
- Field scouting disturbance footprints for infrastructure associated with the upstream gathering network for the Australia Pacific Liquefied Natural Gas (APLNG) project in SW Queensland.

- Field scouting disturbance footprints for infrastructure associated with exploration wells for APLNG.
- Skills required for field scouting and ecology/pre-clearance reports are, the ability to recognize plant and animal species, including weeds, in the field, ability to conduct watercourse assessments, the ability to recognise regional ecosystems and a basic knowledge of gas field design.
- Ability to recognise soil and geology types, together with a basic knowledge of gas field infrastructure construction and to use this knowledge to identify potential soil erosion issues.
- Writing and reviewing Environmental Constraints Assessments (ECA) capturing the results of field scouting assessed against the various bits of legislation pertaining to the APLNG project. These pieces of legislation and policy include, Queensland Government Environmental Approvals, The Co-ordinator General's Report, Federal Government Approvals, APLNG Environmental Management Plans and miscellaneous pieces of legislation and codes such as those pertaining to land access and Strategic Cropping Land.
- Writing and reviewing ecology reports and pre-clearance survey reports for individual properties.
- Carrying targeted species surveys for rare and threatened plants occurring within development areas as well as complete botanical assessments for disturbance sites.
- Conducting surveys to ground truth regional ecosystems and threatened ecological communities (as described in federal legislation)
- Delivering accredited Regional Ecosystem and Vegetation structure Training to Origin environmental staff.

While working in this role I consistently met Key Practice Indicator targets for the project.

March 2011 until January 2012

Land access consultant with Flinders Group, contracted to the Queensland Gas Corporation (GGC).

Duties included;

- Negotiating Consent to Enter Agreements with landholders on behalf of QGC, to allow coal seam gas exploration on their properties.
- Negotiating Compensation Agreements with landholders to ensure the interests of both landholders and QGC are addressed when determining compensation amounts.
- Ensuring all negotiations are consistent with the Qld Government Land Access Code – November 2010.
- Attending field operations to assess seismic, clear vegetation and carry out seismic operations to ensure compliance with landholder access rules, including certifying weed washdown procedures.
- Attending pegging parties to locate potential appraisal well sites to ensure landholder interests are addressed.
- Assisting in the preparation of Notices of Preliminary Activity and Notice of Intent to negotiate under the *Petroleum and Gas (Production and Safety) Act 2004* where a voluntary agreement with a landholder cannot be achieved.

- Serving as a contact for landholders to address issues with QGC.
- Acting as an advocate for landholders in their dealings with QGC.

January 2008 until March 2011

Senior Vegetation Management Officer, Central West NRW Region.

Duties included,

- Managing the technical, personnel management and training aspects of the Vegetation Management Program within the CW Region.
- The Vegetation Management Program assesses applications made under the *Vegetation Management Act 1999* and *The Integrated Planning Act 1995* for developments that involve the clearing, or potential clearing, of native vegetation. These applications include requests to clear for operational works, weed control, livestock fodder, and material change of use and reconfiguration of properties. The Vegetation Management Unit also assesses and provides comment on major projects, e.g. gas pipelines and major water infrastructure projects. The unit also assesses application for property maps of assessable vegetation (PMAVs), where landholders can produce individual maps showing the vegetation on their properties.
- Training and mentoring staff involved in vegetation management assessment.
- Undertaking desktop and field assessment of major project application through the use of GIS programs, aerial photographs satellite imagery and field observations.
- Providing policy advice and serving on policy development forums
- Answering queries from interested groups and individuals, including delivering addresses to industry groups.
- Dealing with complex inquiries and difficult clients.
- Drafting replies for ministerial correspondence on vegetation management issues.
- Assisting with budget preparation and forward planning.

January 2007 until January 2008.

Senior Vegetation Management Officer, Property Map of Assessable Vegetation (PMAV) Project. This project involves clearing a backlog of PMAV applications in a short period of time.

Duties included

- managing and motivating staff involved in the project,
- monitoring progress of the project and preparing reports,
- Providing policy advice on PMAVs.

During this period I also relieved in the Vegetation Policy Unit in Brisbane.

Duties in this relieving period included,

- providing policy advice to staff throughout Queensland
- answering ministerial inquiries
- Developing policy positions for, and interpreting vegetation legislation.

January 2005 until January 2007.

Senior Natural Resource Officer (Regional Ecosystems) with the Queensland Department of Natural Resources & Mines, Vegetation Management Unit.

My duties under this position included;

1. Undertaking Regional Ecosystem Map amendments.

This is done by;

- conducting field assessments of species present,
- sampling and measuring vegetation height and percentage crown cover using Queensland Herbarium guidelines to determine whether the vegetation in question is remnant or non-remnant as defined under *The Vegetation Management Act 199*,
- assessing aerial photos and satellite imagery to determine the clearing history of the vegetation in question. (Sometimes the imagery and or air photos can be used to determine the remnant status of an area without the need for a field survey).
- After gathering the evidence I prepare an assessment report to forward to the Queensland Herbarium. Part of the report process involves using a GIS program to prepare maps.

2. Managing the RE map amendment program within the Central West Region of Natural Resources. The Central West Region covers 28 shires and is roughly defined in the south by a line running from Gladstone to Birdsville, and in the north by a line running from Proserpine through Winton to the NT border.

Management duties included;

- maintaining a database of RE map amendment requests,
- checking assessment reports submitted by other officers,
- training other staff in vegetation structure, species identification and report preparation,
- preparing and supervising work programs to complete RE map amendments.

3. Providing expert advice to the public and other sections of the department on vegetation issues.

Examples of such advice;

- checking EI Statements for major projects and advising the assessment manager whether or not vegetation issues have been sufficiently addressed,
- assisting vegetation officers with RE and plant identification when assessing tree clearing permit applications,
- reporting on vegetation issues that arise from applications under *Integrated Planning Act* for subdivision or Material Change of Use,
- preparing statements and giving evidence in court hearings for prosecutions under vegetation legislation.
- Answering phone and counter queries from the public in regard to complex vegetation issues.
- Meeting with consultants and project managers for large development operations to discuss vegetation issues.
- Giving expert advice on plant identification and monitoring techniques for the Mount Morgan mine rehabilitation project.
- For my work on this project, I received a ‘Highly Commended’ award from the Director General of the Department of Mines and Energy.

June 2001 until January 2005

Regional Investigator, Natural Resources & Mines Compliance Unit.

Duties included;

- Investigate suspected breaches of the *Vegetation Management Act 1999*, *The Land Act 1994*, *and The Integrated Planning Act 1995*, *The Water Act 2000*, *The Aboriginal Cultural Heritage Act 2003* and *Land Protection (Pest and Stock Route Management) Act 2002*.
- Undertaking site inspections and surveys, taking out warrants, interviewing suspected offenders, taking witness statements and preparing court briefs in the course of investigations.
- Acting as a prosecutor in Magistrate's Court callovers.
- Assisting Crown Law solicitors to prepare cases for hearings and giving evidence at such hearings.
- Prioritising, managing timelines and maintaining case files. Collecting and managing evidence that may be used as exhibits.
- Preparing rehabilitation plans and restoration orders for areas cleared illegally. Monitoring the rehabilitation of these areas.

During my time in this role I investigated and prosecuted some major contested cases.

Hall v Glasgow was an investigation into one of the largest area of illegally cleared endangered vegetation to be prosecuted under the *Vegetation Management 1999*. This case attracted media interest and was attended by Senator Len Harris.

All of the cases I investigated that proceeded to court resulted in a successful prosecution.

As well as the above mentioned legislation, I have gained familiarity with a number of other acts through gathering evidence as an ex officio investigator. These include the federal *Environmental Protection and Biodiversity Conservation Act*, and the Queensland *Environment Protection and Nature Conservation Acts*.

April 1999 until June 2001

Forestry Environmental Management Officer.

The purpose of this position was to monitor and audit logging operations and quarry sales on state land as per the Commonwealth National Forests Policy.

Specific tasks included;

- Conducting surveys prior to logging operations to identify rare, endangered and vulnerable species, cultural heritage sites, potential weed and pest animal infestation, potential threats to the interests of other operators and lessees and identifying threats to the aesthetic and recreational qualities of the land in question. These surveys were done by both field inspections and desktop analysis, i.e consulting EPA databases and maps.
- Conducting environmental audits of ongoing operations to ensure that they complied with various industry codes. The codes stipulate how the operation should meet guidelines relating to soil erosion, watercourse protection, habitat tree retention, safety, cultural heritage, endangered, rare and vulnerable species, waste management, fire protection and protection of the remaining forest from logging damage.

- Preparing management plans for specific species. An example is a management plan I prepared for a vulnerable plant, *Acacia gittinsii*. The plan dictated measures that would allow logging operations in areas where this plant occurred, at the same time ensuring that the species was preserved. This plan was endorsed by EPA.
- Contributing to the development of industry codes under ISO 14001 standards.
- Conducting fauna and flora surveys on state forests.
- Reporting sightings of vulnerable, rare and threatened species for inclusion in the EPA database.

March 1993 until April 1999

Forest Ranger Recreation and Extension, Byfield.

This position involved the management of three camping and day use areas on Byfield State Forest, as well as other sites in the Central Queensland Region.

Byfield State Forest averaged 20,000 visitors per year.

Specific tasks included;

- Managing staff and contractors involved in construction, maintenance and servicing.
- Conducting patrols and law enforcement.
- Budgeting and planning.
- Managing capital works projects.
- Providing advisory services to landowners on forestry issues.
- Delivering talks to school and tertiary students and other interested groups.
- Writing a regular column for a local newspaper.
- In this position I spoke on behalf of the department in several television and radio interviews.

February 1979 until March 1993.

Forest Officer in various parts of Queensland.

During this time I was employed in North, South and Central Queensland in both native forests and plantations.

Among the tasks I performed in this role;

- Site design and preparation, weed control, pruning, planting, harvesting, control burning and fire protection in exotic pine and hoop pine plantations.
- Timber assessment, tree marking, log assessment, sale preparation and site rehabilitation in native forests including North Queensland rainforests.
- Supervising sales of round timber and quarry material, floral and seed harvesting, and grazing permits on state forests and other crown land.
- Forest inventory studies in plantations and native forests.
- Seed and pollen collections in plantations and native forests. Managing an artificial pollination program in exotic pines.
- Soil surveys to determine suitability for plantation establishment.

- Surveying.
- Prescribed burning and fire fighting.
- Law enforcement.

In 1991 I designed, implemented and supervised a program to monitor the harvesting of *Bowenia serrulata*, a plant used for floral arrangement.

The data gathered in this study is still used to determine harvesting levels for this resource.

Prior to 1979.

Grew up on rural properties near Clermont Qld and on Queensland's Sunshine Coast.

Worked as a stockman and sharefarmer during high school and afterward.

Origin referees

Les Merton

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