Beetaloo Sub-Basin Multi-Well Drilling, Stimulation and Well Testing Program
Environment Management Plan (ORI10-3)
EP 98, EP76

APPENDIX K to APPENDIX Q

Beetaloo Sub-basin Multi-well EMP originally prepared by Origin B2 Pty Ltd, and updated by Tamboran B2 Pty Ltd

REV	DATE	REASON FOR ISSUE	COMPILER	REVIEWER	APPROVER
0	09/12/2021	EMP released for acceptance	T Khoo	R Ully	M Kernke
1	30/03/2022	Regulation 10 and 11 revisions	L Pugh	M Kernke	M Kernke
2	17/05/2022	Added Section 3.18.2	L Pugh	M Kernke	M Kernke
3	26/03/2025	EMP update to consolidate Regulation 22 submissions	A Court	L Pugh	M Kernke

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APPENDICES K to Q:

APPENDIX K.1

Land Condition Assessment Report (AECOM 2021)

Land Condition Assessment for Exploration Lease Pads 2021

Velkerri 76 N1, Amungee NW and Beetaloo W

22-Feb-2022
Origin Stage 3

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Delivering a better world

Land Condition Assessment for Exploration Lease Pads 2021

Velkerri 76 N1, Amungee NW and Beetaloo W

Client: Origin Energy B2 Pty Ltd

ABN: 42 105 431 525

Prepared by

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Quality Information

Document Land Condition Assessment for Exploration Lease Pads 2021

Ref 60623736

Date 22-Feb-2022

Prepared by David van den Hoek

Reviewed by Alana Court

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	12-Nov-2021	Draft for Client Review	Alana Court Associate Director	
1	09-Dec-2021	Final LCA	Alana Court Associate Director	
2	22-Feb-2022	Final LCA update	Alana Court Associate Director	

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Acronym	Meaning
°C	Degrees Celsius
%	Percentage
AAPA	Aboriginal Areas Protection Authority
AS	Australian Standard
BOM	Bureau of Meteorology
CLA	Cambrian Limestone Aquifer
DoH	Department of Health (NT)
DAWE	Department of the Environment and Energy (Cmwlth)
DPIR	Department of Primary Industry and Resources (NT)
DEPWS	Department of Environment, Parks and Water Security (NT)
EPA	Environment Protection Authority (NT)
EP##	Exploration Permit (e.g. EP76, EP98 and EP117)
EMP	Environmental Management Plan
EPBC	Environmental Protection and Biodiversity Conservation
ESCP	Erosion and Sediment Control Plan
GPS	Global Positioning Device
Ha	hectare
IBA	Important Bird Area
ILUA	Indigenous Land Use Agreement
km	Kilometre
km^2	Square Kilometres
km/hr	Kilometre per hour
LCA	Land Condition Assessment
m	metre
MD	Measured Depth
MNES	Matters of National Environmental Significance
mm	millimetre
NLC	Northern Land Council
NT	Northern Territory
OHS	Occupational Health and Safety
RWA	Restricted Work Area
TO	Traditional Owner
TPWC Act	*Territory Parks and Wildlife Conservation Act*
WoNS	Weed of National Significance

1.0 Introduction

1.1 Purpose of this Report

AECOM Australia Pty Ltd (AECOM) conducted a Land Condition Assessment (LCA) to support Origin Energy's (Origin) application to the Northern Territory Department of Environment, Parks and Water Security (DEPWS) for an Environmental Management Plan (EMP) addressing the following activities:

- civil construction
- groundwater monitoring bore installation and monitoring
- drilling, stimulation and well testing activities
- other activities to support the above.

The purpose of the LCA was to gather baseline information to identify the environment and heritage values across the proposed exploration lease sites. This LCA report summarises the result of the survey and documents baseline conditions within the project footprint.

1.2 Project Boundary

Origin are proposing to undertake a series of low impact investigations to expand their exploration and appraisal program in the Beetaloo Basin. Origin are targeting up to three exploration sites in their development program, consisting of the establishment of the Velkerri 76 N1 lease area and an expansion and development of existing cleared lease areas at Amungee NW and Beetaloo W (refer Figure 1). The location and proposed disturbance area are presented in Table 1.

Table 1 Lease Area Proposed for Site Disturbance

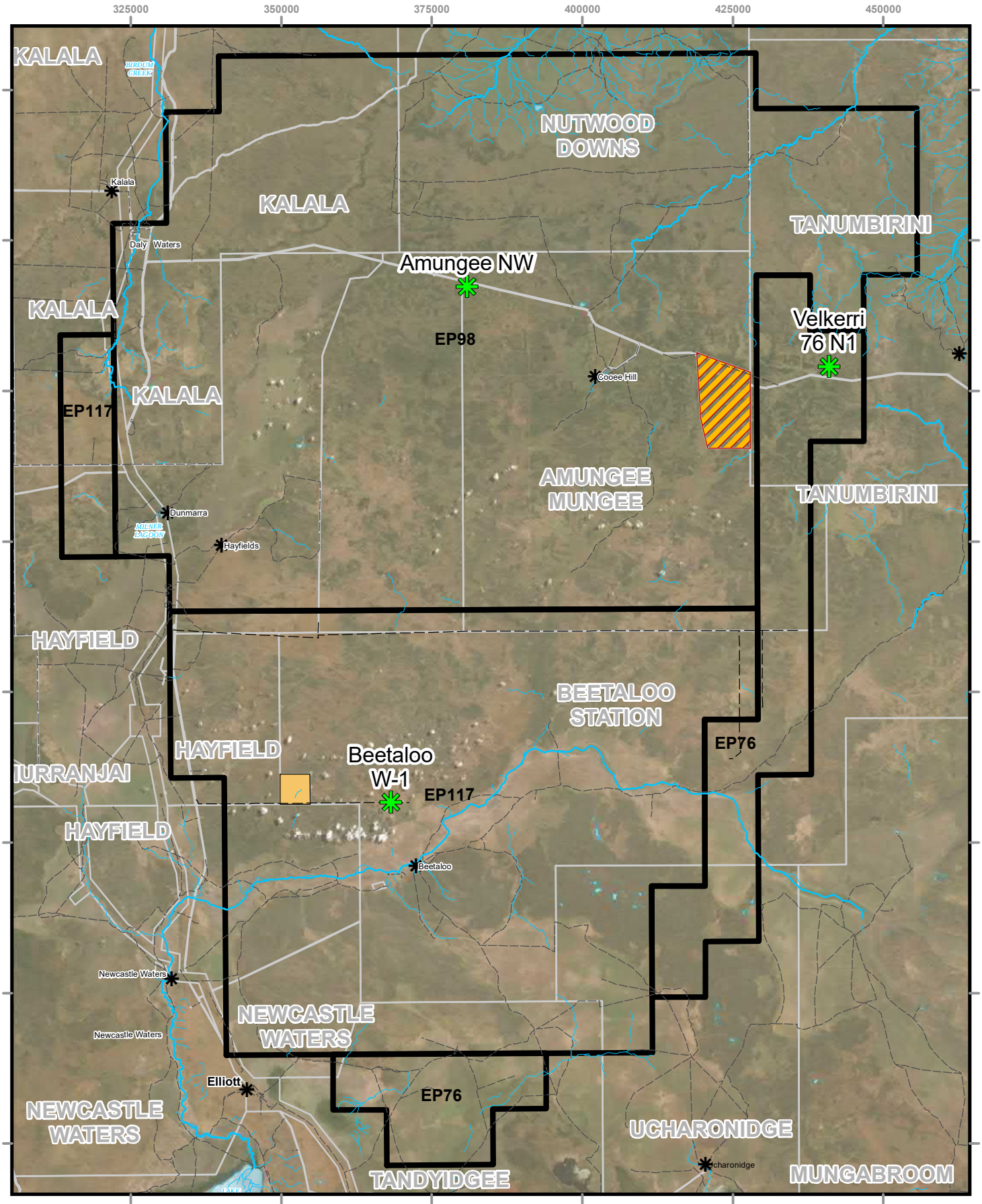
Exploration Permit	Well Name	Pastoral Lease	UTM, zone	Easting	Northing	Disturbance Area (ha)
EP76	Velkerri 76 N1	Tanumbirini	53	440940	8179150	27
EP98	Amungee NW	Amungee Mungee	53	381039	8192324	18.4
EP117	Beetaloo W	Beetaloo	53	368023	8107032	4.6
					Total disturbance area (ha):	**50.0**

**Universal Transverse Mercator (UTM) geographic coordinate system is Geocentric Datum of Australia (GDA) 94*

The location of exploration lease pad areas, camps, access tracks and gravel pits are provided for each of the exploration lease areas Velkerri 76 N1, Amungee NW, and Beetaloo W, in Figure 2 to Figure 4.

For the purpose of this assessment, the project boundaries were defined as the areas which may be affected by the proposed exploration activities, including:

- Initial establishment of lease pad (Velkerri 76 N1)
  - Clearing of up to 10 hectares to contain exploration well lease pad, camp pad, laydown yards, helipad, fence lines, firebreaks, truck turn outs etc.
  - The upgrade of up to 10 km (10 ha) of existing tracks, fence lines and firebreaks to access the exploration lease site (including with heavy vehicles).
  - The installation of approximately 2 km (2 ha) of new access tracks (approximately 10 m wide) to connect site to existing access tracks.
  - Clearing of gravel pit (up to 5 ha).
- Amungee NW and Beetaloo W expansion of the existing exploration lease pads, including on Amungee NW a helicopter pad, extension to camp pad, laydown pad and fenceline/firebreak.



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N

GEOCENTRIC DATUM OF AUSTRALIA 94

0 7.5 15 30
Kilometres

- Exploration Lease Pad Areas
- Populated Place
- Tracks
- Highway
- Creek
- River
- Water Bodies
- Permit Areas
- Aboriginal Land
- Pastoral Lease Boundary
- Bullwaddy Conservation Reserve

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage - StreetPro 2019

ORIGIN ENERGY RESOURCES LIMITED

Project Location - Land Tenure, Exploration Permits and Lease Pad Areas

PROJECT ID	60623736
CREATED BY	david.vandenhoek
LAST MODIFIED	01-Nov-2021
VERSION	1

Figure 1

Filename: L:\Legacy\Projects\606x\60623736\900_CAD_GIS\920_GIS\02_MXDs\Beetaloo Feild Scouting Program - LCA July 2021\Report Figures\Fig.1 Location.mxd

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N

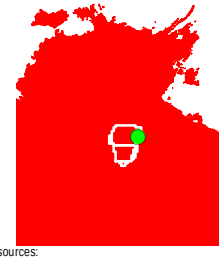
GEOCENTRIC DATUM OF AUSTRALIA 94

0 125 250 500

Metres

- Exploration Lease
- Highway
- Velkerri N1 Lease Pad Layout

LOCATION



Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage - StreetPro 2019

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Velkerri 76 N1 (EP76) - Location of Lease Pad, Access Track and Camp

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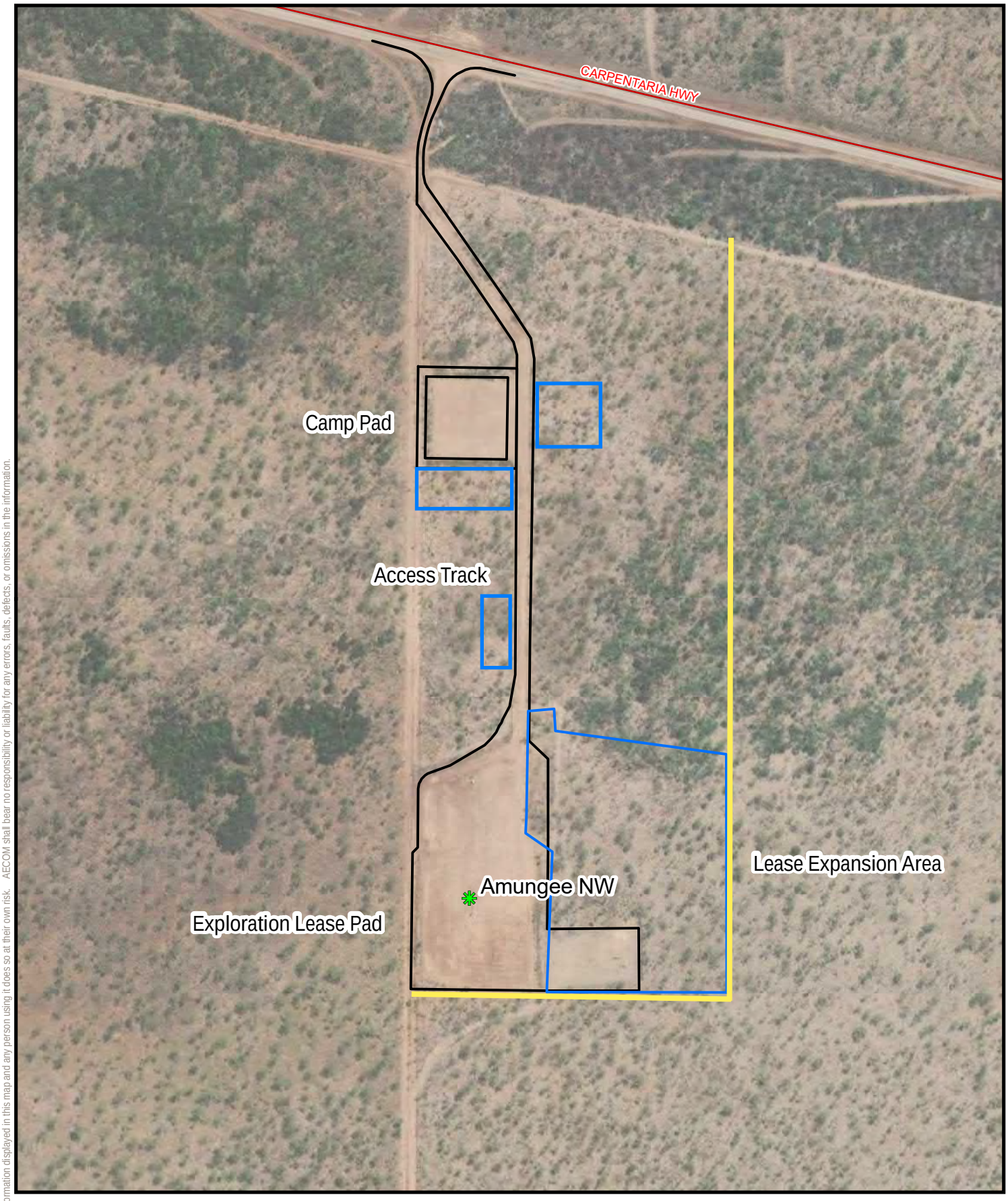
LAST MODIFIED	01-Nov-2021
VERSION	1

Figure 2

Filename: L:\Legacy\Projects\606x\60623736\900_CAD_GIS\920_GIS\02_MXDs\Beetaloo Feild Scouting Program - LCA July 2021\Report Figures\Fig.2 Velkerri 76 N1 Location .mxd



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N

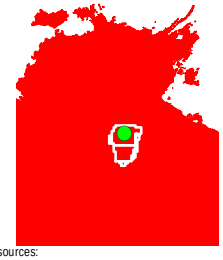
GEOCENTRIC DATUM OF AUSTRALIA 94

0 50 100 200

Metres

- Exploration Lease
- Highway
- Velkerri N1 Lease Pad Layout
- Lease Expansion Area
- New fence with 20m Clearing

LOCATION



Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage - StreetPro 2019

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Amungee NW (EP98) - Location of Lease Pad, Access Track and Camp

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LAST MODIFIED	01-Nov-2021
VERSION	1

Figure 3

Filename: L:\Legacy\Projects\606x\60623736\900_CAD_GIS\920_GIS\02_MXDs\Beetaloo Feild Scouting Program - LCA July 2021\Report Figures\Fig.3 Amungee NW Location.mxd

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N

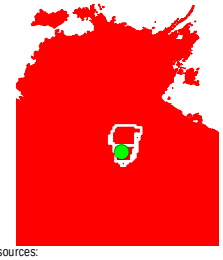
GEOCENTRIC DATUM OF AUSTRALIA 94

0 50 100 200

Metres

- Exploration Lease
- Highway
- Velkerri N1 Lease Pad Layout
- Lease Expansion Area

LOCATION



Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage - StreetPro 2019

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Beetaloo W-1 (EP117) - Location of Lease Pad, Access Track and Camp

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VERSION	1

Figure 4

Filename: L:\Legacy\Projects\606x\60623736\900_CAD_GIS\920_GIS\02_MXDs\Beetaloo Feild Scouting Program - LCA July 2021\Report Figures\Fig.4 Beetaloo W-1 Location.mxd

1.3 Scope of Works

The scope of work for the LCA involved:

- a review of historical data and reports prepared during the previous Beetaloo onshore oil and gas exploration programs
- a search of the Commonwealth Department of the Environment and Energy (DEE) Protected Matters database (20/08/20121
- a search of the Northern Territory (NT) Natural Resource Maps Database (flora and fauna Atlas database) (25/08/2021)
- completion of LCA field survey of the proposed water bore drilling program area (August - September 2021).
- Preparation of this report.

1.4 Report Structure

The report is structured as follows:

- Section 1: Introduction – this section
- Section 2: Assessment Methods – a description of the methods used for data collection
- Section 3: Origin's Proposed Activities – brief summary of Origin's current activities proposed in the exploration permit areas
- Section 4: Physical Environment - Survey results and desktop overview of climate, drainage, ground water, land systems, soils and bushfire within the exploration lease areas
- Section 5: Natural Environment - Survey results and desktop overview of bioregion, vegetation communities, flora, weeds, fauna and habitat, feral animals, conservation areas and matters of national environmental significance
- Section 6 Land Condition Assessment – a summary of the LCA data collected during the August - September 2021 field survey
- Section 5: Conclusion and Recommendations – summary of the survey findings and recommendations
- Section 6: References
- Appendices.

2.0 Assessment Method

2.1 Desktop Review

The existing data collected between 2005 and 2021 for the permit areas was mapped based on image interpretation, with ground-truthing of the proposed water bore lease areas completed during the field assessment (refer Section 2.2). This information was reviewed prior to the field work to identify the following:

- terrestrial vegetation types and flora and fauna species occurring within the region and with potential to occur within the project area, using existing documents and aerial / satellite imagery.
- *Environment Protection and Biodiversity Conservation Act* (EPBC Act) and *Territory Parks and Wildlife Conservation Act* (TPWC Act) listed threatened species or communities identified within the region and with potential to occur within the project area.
- matters of national environmental significance or other matters protected by the EPBC Act that are likely to occur within the project area.
- weeds or feral animals listed under the EPBC Act or *Weeds Management Act* that potentially occur within the project area.

Table 2 provides a chronological list of reports (2004 - 2021), previously compiled in relation to environmental approvals and management support for petroleum exploration activities in the Beetaloo Sub-basin, NT.

The extent of work undertaken since 2004 has enabled a good understanding of the natural and cultural environment, which has been used in assessing the proposed exploration lease pad activities within the Permit Areas.

Table 2 Summary of existing Environmental Assessments and Reports for the Beetaloo Basin (2004 to 2021)

Date	Report
Sweetpea Petroleum	
Jul- Aug 2004	Baseline land condition assessment
	Site database established
Jul 2005	Exploration EMP finalised and approved
Petrohunter Australia (Partner to Sweetpea)	
Dec 2006	Baseline vegetation assessment
Apr 2007	Drill site assessments
Apr 2007	Annual report
Jun 2007	Update of the existing EMP to include the new Exploration Permit areas
Jul 2007	Drill Site maps
Jul 2007	Supplemental Environmental Management Plan, Drilling Program 2007, Beetaloo Basin, NT
Jul 2007	Soil erosion assessment
Jul 2007	Groundwater quality
July 2007	Emergency Maps
Jul 2007	Environment & Heritage Induction Materials

Date	Report
Falcon Oil and Gas	
Dec 2010	Drill site condition assessments
Jan 2011	Archaeological survey
March 2011	Site-specific drilling EMP
2011	Falcon Shenandoah 1 Stimulation and Testing Groundwater Monitoring
2011/2012	Shenandoah 1 Re-Entry Environment Plan (EP)
July 2012	EP99 Archaeological Survey, Beetaloo Basin
2013	EP99 Seismic Exploration Environmental Management Plan
Origin	
2015 and 2016	Beetaloo Basin Environmental and Heritage Assessment and preparation of Approval documentation.
October 2018	Land Condition Assessment and Heritage Assessment of proposed lease area (Velkerri 76 S1-1, Velkerri 76 S2-1, Velkerri 117 E1-1, Velkerri 98 N1-2, Kyalla 117 N2-1 and Kyalla 117 W1-2, Kyalla 98 W1-1)
July 2019	Weed Survey of Kyalla 117 N2-1 and access tracks, including Kalala S1 and Amungee NW-1H
June 2020	Beetaloo Exploration Program Annual Weed Survey Report 2020

2.2 Field Assessment and Reporting

The LCA of the proposed Velkerri 76 N1 lease area and access track was conducted in October 2019. The survey involved ground truthing the area, within 500 m and 1,000 m from the lease area centre point and along associated access tracks. A re-scout was undertaken between 30 August and 1 September 2021 to inform the widening of Amungee NW and Beetaloo W lease areas.

Scouting covered a footprint of the proposed lease extension area. Field work was undertaken by AECOM senior botanist [redacted] and ecologist [redacted]. A weed survey was undertaken in addition to the lease area land condition assessment, covering both scouting and disturbed areas and access tracks at Amungee NW and Beetaloo W, and disturbed areas, gravel pits and access tracks associated with lease operations at Kyalla 117 N2 and Velkerri 76 S2.

The aim of the LCA was to identify and document site condition prior to activities occurring within the footprint of the proposed lease areas and associated access tracks and inform the preparation of the program's Environmental Management Plan (EMP).

Following the desktop review, AECOM undertook a land condition assessment at each of the nominated sites and access tracks to record site-based characteristics, including:

- the presence of drainage lines and the direction of surface flows
- the distance to the nearest sensitive receptors (such as significant vegetation communities or fauna habitats)
- soil characteristics and intactness
- vegetation communities (based on dominant species within each canopy strata)
- fauna habitat features, such as hollows, logs and burrows (the fauna habitat quality for each mapped vegetation community type would be assessed)

- incidental fauna sightings
- the presence of weeds and/or feral animals (i.e. indication of scats, tracks, wallows etc.)
- general land use description.

Two types of assessment were undertaken depending on the stage of development:

- Initial Establishment of Lease Pad Area - Velkerri 76 N1, environmental scouting included a 500 m area around the centre of the proposed lease pads, plus an additional 500 m buffer (1000 m total distance from centre) to allow for flexibility of lease placement in case of land constraints.
- Expansion of Existing Lease Pad Area - Amungee NW and Beetaloo W, environmental scouting covered the proposed lease extension development footprint.

The proposed program at Velkerri 76 N1 requires a series of existing access tracks and boundary fence line tracks to be upgraded and gates installed, to allow for support vehicles to access the site. A 250 m buffer each side of existing access tracks nearby to the lease area were scouted in 2019 to allow for future location of gravel borrow pits. Not all the nominated areas scouted for the exploration lease pads and/or access tracks will be impacted by site activities, but sufficient surrounding area was surveyed to provide flexibility in the siting of infrastructure and borrow pits, to avoid environmental and heritage sensitive areas (*i.e.* habitat avoidance, sacred site avoidance).

Field work was also undertaken to determine the land capability for wastewater disposal and lead pad placement at Amungee NW and Beetaloo W. Soil samples were collected to determine wastewater disposal capability and suitability of lease pad placement. The results of this field investigation are provided in a separate report - Land Capability Assessment for Wastewater Disposal and Lease Pad Placement, Amungee NW and Beetaloo W (AECOM 2021).

3.0 Origin's Proposed Activities

The exploration permits cover 18,512 square kilometres (km^2) of pastoral lease on the Sturt Plain with a small section of EP98 falling in the Gulf Falls Uplands and part of EP76 falling in the Barkly Tableland, approximately 500 km south-east of Darwin (refer Figure 1). Origin is the Operator of exploration permit areas EP76, EP98 and EP117. Previous exploration works within the permit area includes the installation of groundwater monitoring bores on five of Origin's proposed lease sites within the Origin Beetaloo Exploration Area.

The network of groundwater monitoring bores across the exploration permit areas has been used to obtain baseline groundwater quality and quantity data adjacent to the proposed future drilling and stimulation lease sites, to meet Recommendation 7.5 of the *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory* and relevant guidelines published by NT DENR on *Well Pad Groundwater Monitoring Bores*.

The number and aquifer monitoring zones have been selected to be monitored based on their quality and importance as a local water source and are anticipated to include the following units:

- Perched aquifer (if present)
- Cretaceous aquifer (if present)
- Anthony Lagoon Beds
- Gum Ridge Limestone.

The core activities of Origin's application will be to:

- Establish new lease area (Velkerri 76 N1):
  - Clearing of up to 10 hectares to contain exploration well lease pad, camp pad, laydown yards, helipad, fence lines, firebreaks, truck turn outs etc.
  - Upgrade of 10 km of existing tracks, fence lines and firebreaks to access the exploration lease sites (including with heavy vehicles).
  - Clearing and construction of up to 2 km of new access roads approximately 10 m wide to connect site to existing access tracks
  - Clearing of gravel pit (up to 5 ha)
  - Construction of gravel pits in the vicinity of the exploration lease pads or access tracks
- Extend existing lease areas (Amungee NW and Beetaloo W):
  - Clearing and development of a 4.5 ha expansion area adjoining the existing lease area
- Installation of fencing, gates and grids (as required and in accordance with access agreements with the land holders).
- Develop ground water monitoring wells at each lease area
  - Construction of drilling sumps, exploration well cellars, sediment basins and site bunding
  - Construction of groundwater monitoring and extraction bores at each location.
- Drilling, stimulation and well testing (including flaring) of up to 8 exploration wells at each location
- Drilling waste:
  - Storage and treatment of wastewater (flowback and drilling) and chemicals onsite
  - Onsite mix, bury and cover of drilling cuttings and muds
- Operation of camps, including treated sewage irrigation onsite (wastewater disposal area - max 600 m^2).

Further detail of the proposed activities is provided in the relevant Environmental Management Plan (EMP).

4.0 Land Condition Assessment

The results of the LCA and desktop review has been summarised in the following sections. The area covered during the assessment is shown in Figure 1. During the field surveys, three sites proposed for exploration lease pads were ground-truthed, along with the proposed access tracks (refer Section 1.2).

4.1 Climate

The climate of the Origin permit areas can be described as arid to semi-arid, with rainfall decreasing in frequency and quantity from north to south. The climate is monsoon influenced and has a distinctive wet and dry season. The wet season occurs in summer, between October and March and is characterised by hot and wet conditions. The dry season occurs during the winter months between May and August and is characterised by mild days and cool nights. September and April are transitional months, with occasional rainfall. Approximately 90% of the rainfall occurs during the Wet Season, and annual totals show moderate variability from year to year.

The maximum rainfall for the permit area occurs in January and February, coinciding with the northern Australian annual monsoon event. Daly Waters Aerodrome is on a similar latitude with the northern end of the permit area and recorded the highest average rainfall in the region at this time, with 163.9 mm falling in January and 185.4 mm in February, followed by Elliott (137.9 mm average rainfall in January and 156.3 mm in February) situated toward the southern end of the permit area. July and August experience the least amount of rainfall and are the driest months across both weather monitoring sites, ranging from 0.3 - 2.8 mm of average monthly rainfall (BOM 2021).

The annual rainfall pattern within the area is highly variable and becomes increasingly unpredictable the further south the location is away from the northern coastal monsoon influence. Drought conditions are known to occur in the region once every ten years (Holt & Bertram, 1981). Annual records show that very low rainfall was recorded in the region for 2019 resulting from a poor end to the 20218-2019 wet season and start to the 2019-2029 wet season.

Land condition assessments were undertaken in the late dry season, with Velkerri 76 N1 assessed in October 2019 and both Amungee NW and Beetaloo W assessed in late August - early September 2021. No rainfall was recorded during these months at either weather station.

The average annual rainfall experienced across the region (which includes the BOM data from Daly Waters Airstrip and Elliot) is shown in Table 3.

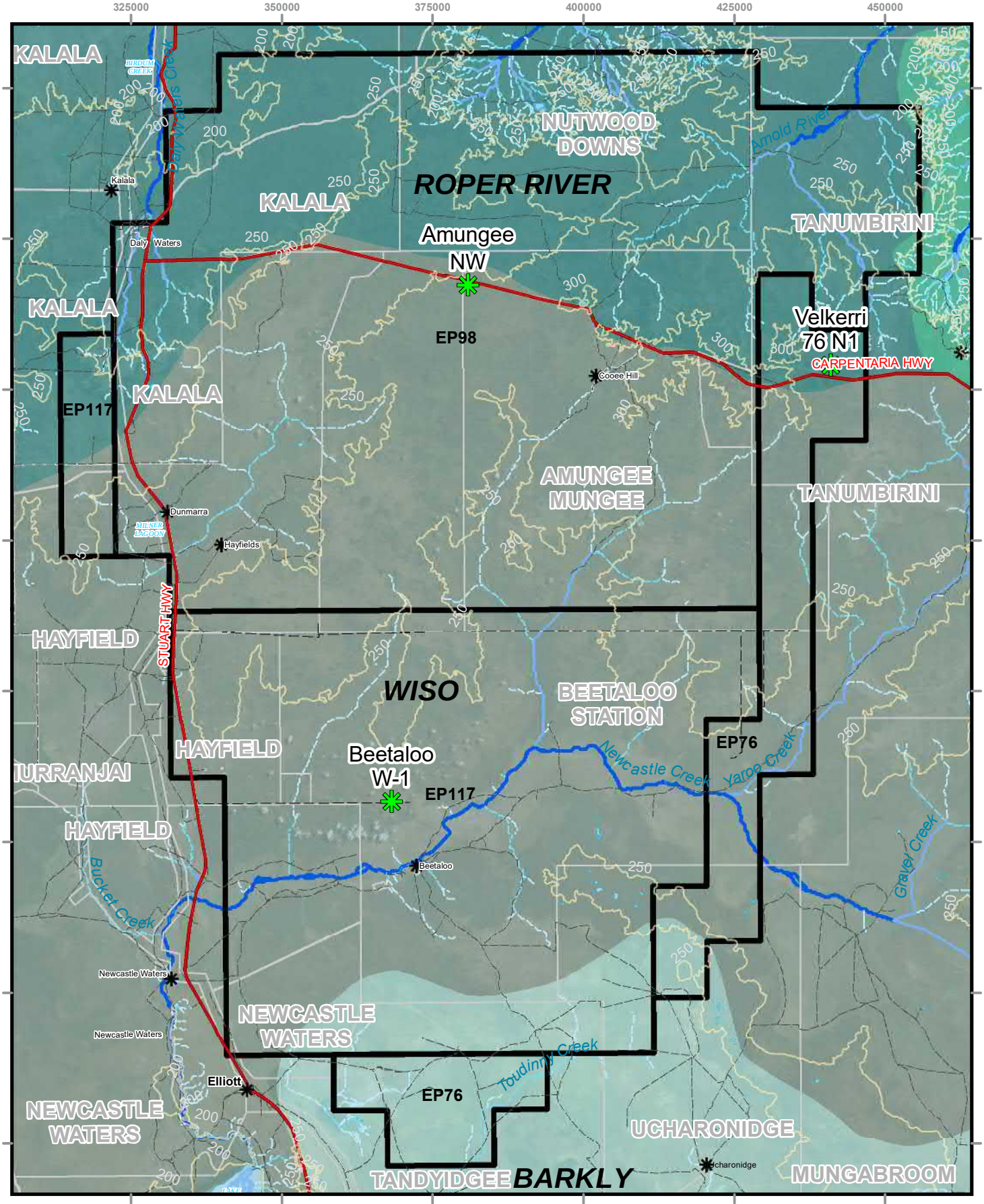
Table 3 Annual rainfall 2019 - 2021

Year	Annual Rainfall (mm)		Months Rain was recorded	
	Daly Waters Aerodrome	Elliot	Daly Waters Aerodrome	Elliot
2016	608	570	12	9
2017	866	607	7	6
2018	751.6	357.8	7	7
2019	277	97.6	8	7
2020	951.2	797.9	9	9

4.2 Topography, Surface Water and Drainage

The permit area is located within three main topographic zones. These are primarily made up of black soil plains in the south, laterite plains in the north and small sections of bedrock hills in the south west and north east of the permit areas (Tickell, 2003). The current proposed lease areas all occur within the lateritic plains and predominantly slope in a south and south westerly direction.

Three main river basins, Roper River Basin to the north, Wiso River Basin in the centre and the Barkly River Basin in the south occur within the exploration permit area (Figure 5).



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N

GEOCENTRIC DATUM OF AUSTRALIA 94

0 7.5 15 30
Kilometres

- Exploration Lease
- Populated Place
- Tracks
- Highway
- Permit Areas
- Contours
- Water Bodies

Intermittant Streams
- 1
- 2

Creeks
- 3
- 4

River Basins
- Barkly
- Limmen Bight River
- Roper River
- Wiso

ORIGIN ENERGY RESOURCES LIMITED

Permit Area Surface Water and Drainage

PROJECT ID	60623736
CREATED BY	david.vandenhoek
LAST MODIFIED	01-Nov-2021
VERSION	1

Figure 5

Filename: L:\Legacy\Projects\606x\60623736\900_CAD_GIS\920_GIS\02_MXDs\Beetaloo Feild Scouting Program - LCA July 2021\Report Figures\Fig.5 Surface_Water_Drainage.mxd

The Velkerri 76 N1 lease area is situated on the southern edge of the Roper River Basin, draining northward into the Roper River before discharging into the sea. The Amungee NW and Beetaloo W lease areas are situated in the Wiso River Basin. The Wiso River Basin covers the southern half of EP98 (south of the Carpentaria Highway) and the majority of EP117 and is internally drained by Newcastle Creek and a number of small ephemeral creeks. Newcastle Creek flows into Lake Woods, which is located south of Newcastle Waters Station.

Lake Woods covers an area of inundation of approximately 50,000 ha in normal rainfall years, extending to 80,000 ha in exceptionally wet years, after which it can retain water for several years (AECOM, 2015). Lake Woods is described as a major quasi-permanent surface water body in the region, although some semi-permanent and many ephemeral waterholes are located across the permit area (HLA, 2006) and is listed as a Site of Conservation Significance by the Department of Environment and Natural Resources (DENR) and is listed on the Directory of Important Wetlands in Australia. Lake Woods is listed as a wetland of national significance in the Directory of Important Wetlands in Australia (DIWA: NT013 Lake Woods).

Although Lake Woods is located outside of the exploration permit areas, it is fed principally by surface inflow of Newcastle Creek, originating more than 160 km north-east on Amungee Mungee Station (NTG, undated). During the period of inundation, Lake Woods supports over 100,000 waterbirds including internationally significant numbers of Plumed Whistling-Duck. Numerous bird species nest and feed in the diverse wetland habitat, and the conservation group ‘Birdlife International’ nominated Lake Woods as an ‘Important Bird Area’ (IBA). The lake also includes the largest area of lignum swamp in the Northern Territory and in tropical Australia (NRETAS, 2009).

The only major creek in the permit area that could potentially be impacted by the proposed activities is Newcastle Creek (Stream Order 4) and a number of small ephemeral streams (Stream Order 1 and 2) located along the proposed access tracks (refer Figure 5). The streams only flow for a short period during the wet season, with waterholes forming at the beginning of the dry season. If the wet season is poor, the waterholes will often remain dry, whereas, during heavy wet seasons, large areas of the internal drainage systems are flooded. The stream banks are often lined with a scatter of small trees which indicates the location of drainage features within the surrounding plains.

There are no stream (stream order 4) crossings intersecting access tracks within the lease areas. The retention of vegetation buffers, as outlined in the NTG Land Clearing Guidelines – Northern Territory Planning Scheme 2010, as they relate to stream order should be considered for the preparation of access tracks and pads.

During the wet season it is likely the region would experience widespread surface flooding, to a depth of 30 cm, which has previously been identified by debris being collected on fence lines (HLA, 2005).

4.3 Flood Assessment

The extent of inundation within the permit area depends on the severity of the wet season and can range from remaining completely dry to widespread flooding. As part of the preparation of the LCA, AECOM prepared a preliminary assessment of the 1% Annual Exceedance Probability (AEP) flood levels to determine the risk of flood inundation during the 100-year flood event for Amungee NW, Beetaloo W and Velkerri 76 N1 lease pads from a local or regional flooding.

Survey data for the sites are available for the immediate area of the exploration lease pads and does not include any of the surrounding land or flow paths. The flood levels determined for the sites are based on Shuttle Radar Topography Mission (SRTM) 1s (30m) data. Noting that SRTM data is unreliable for determining flood elevations as it obtains varying degrees of accuracy in different areas, such as seen on the Amungee NW lease pad.

The preliminary assessment has considered the magnitude of flood events from regional flooding (defined as large event over many catchments) as well as local flooding (rainfall immediately over the area draining to the site).

The results from the 1% AEP assessment for each site is summarised below.

4.3.1 Velkerri 76 N1

Velkerri 76 N1 lease area is located on the side of a low ridge with a ~1% gradient. The lease area is approximately 8 m above the 1% AEP flood level of Newcastle Creek and 2.8 km away from the 1% AEP flood extent of the creek with a discharge of approximately 298.0 m^3/s. The risk of floodwater inundation to the Velkerri 76 N1 lease pad on a regional scale is considered low (refer Plate 1a).

The 1% AEP flood level on a local catchment scale indicates a potential for approximately 0.1 m depth of flooding to occur along the western extent of the lease pad, but low risk on the eastern extent. The local flow path discharge expected is 34.4 m^3/s (refer Plate 1b).

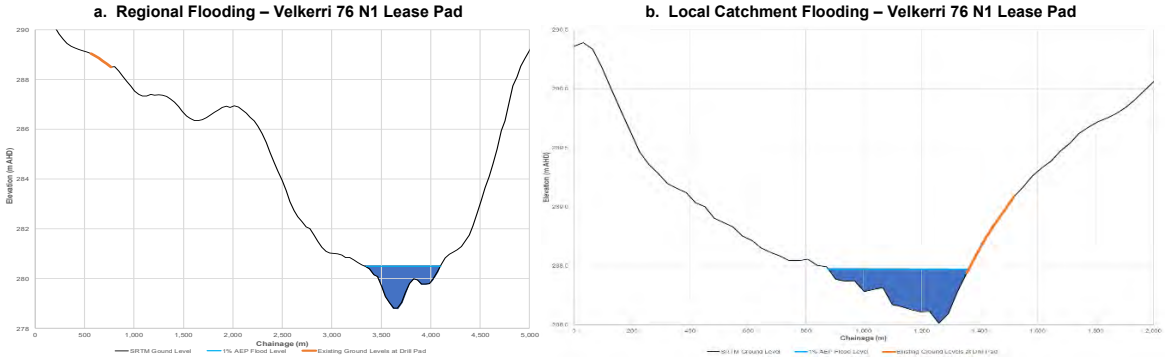


Plate 1 Cross section showing relative flood level and location of Velkerri 76 N1 lease pad with respect to regional and local flow path in 100-year event

The SRTM data also indicates that sheet flow from the surrounding higher-lying areas requires consideration for the lease pad. Plate 2 shows that diversion drains around the lease pad will likely be required to direct flow around the lease pad, along with other design requirements.

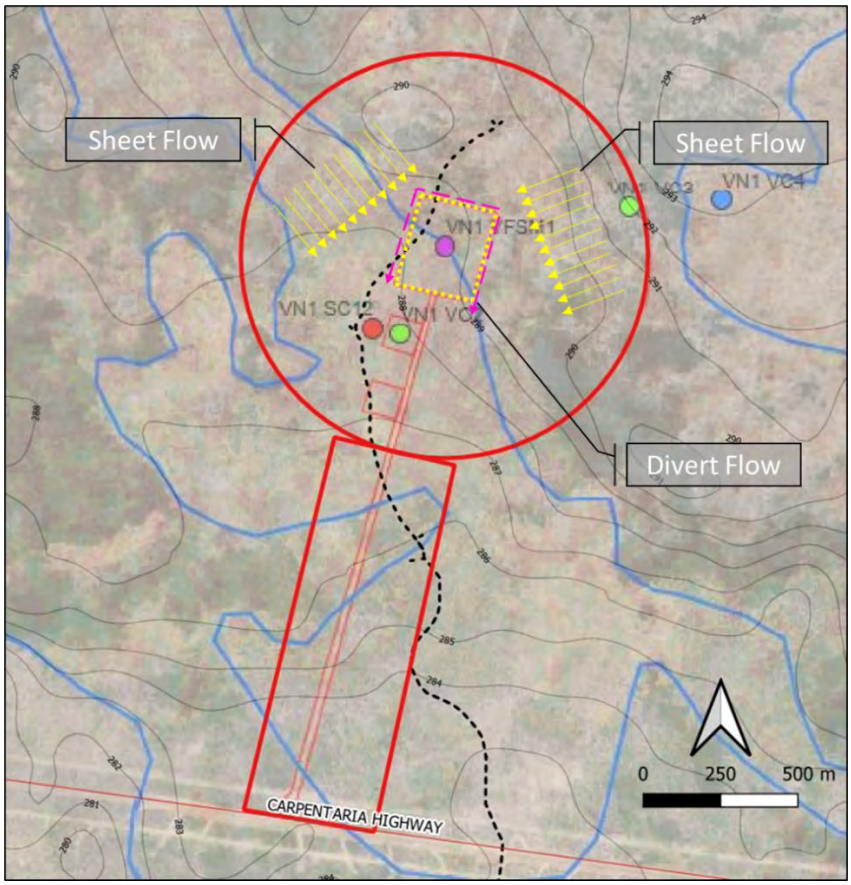


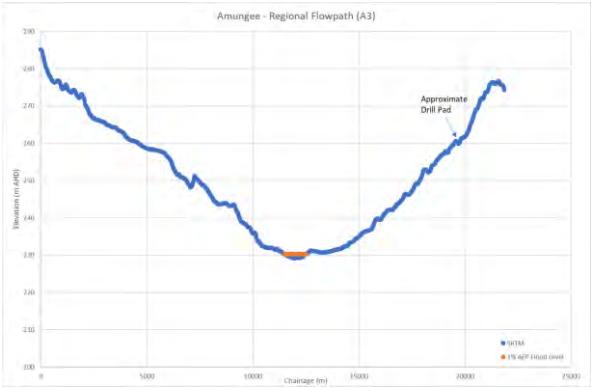
Plate 2 Sheet Flow from the Surrounding Hills

4.3.2 Amungee NW

Amungee NW lease area lies at an elevation of approximately 261 m AHD, 8 km away from the estimated 1% AEP extent and therefore is considered a low risk from regional flooding (refer Plate 3a). The regional flow paths in the 1% AEP was determined as 371 m^3/s (Sub-catchment AC3).

The SRTM data was analysed to determine the approximate catchments for the Amungee NW lease pad (Plate 4). On a local scale, the Amungee NW lease pad is likely to experience inundation of up to 0.5 m in some areas, but is highly dependent on the horizontal accuracy of the SRTM data (refer Plate 3b). The local flow path for the 1% AEP was determined as 21.3 m^3/s (Sub-catchment AC1).

a. Regional Flooding – Amungee NW Lease Pad



b. Local Catchment Flooding – Amungee NW Lease Pad

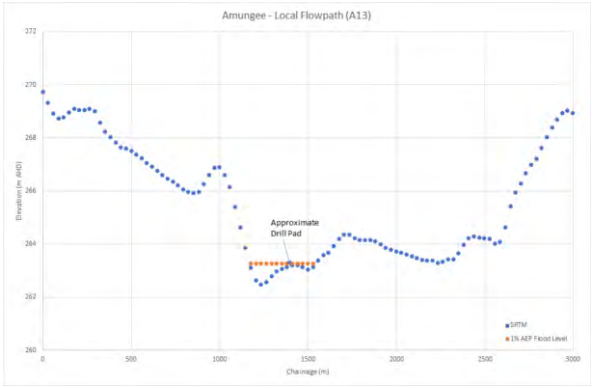


Plate 3 Cross section showing relative flood level and location of Amungee NW lease pad with respect to local and regional flow path in 100-year event

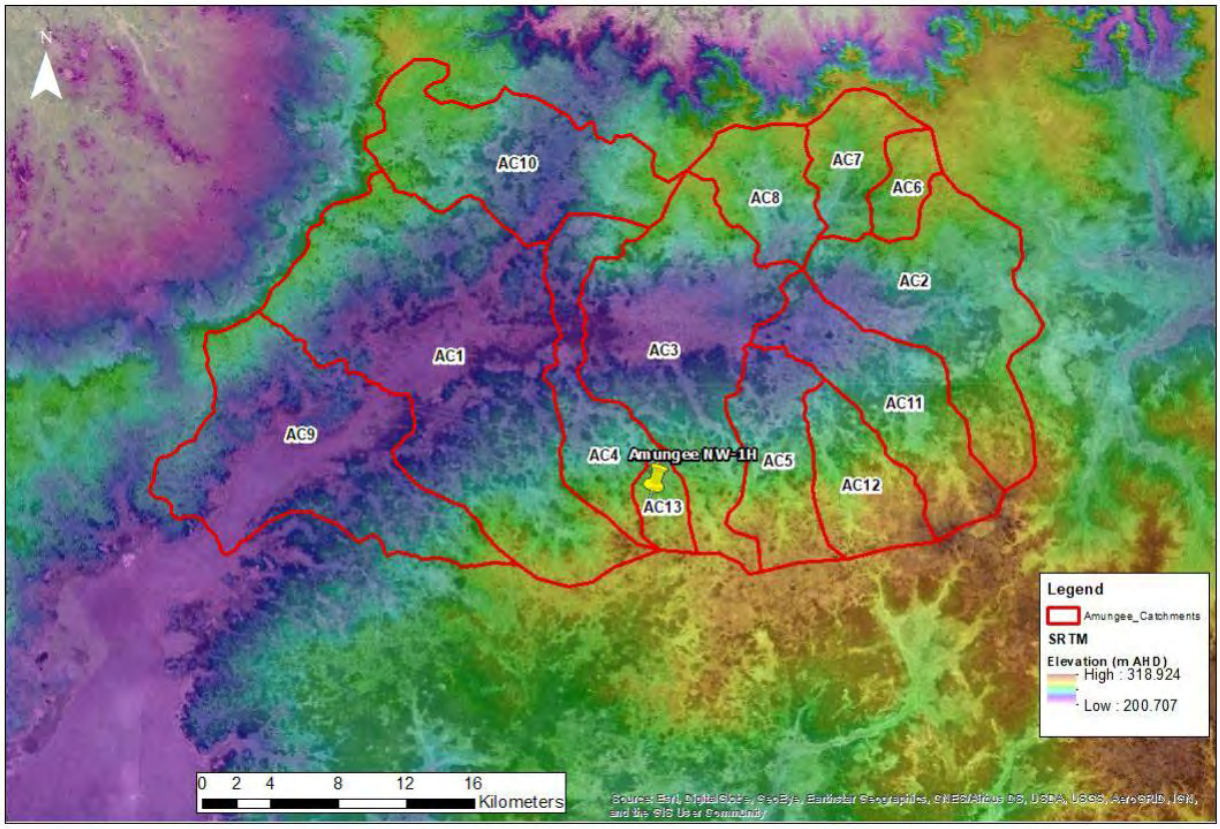


Plate 4 Catchments of Amungee NW

The existing Amungee NW lease pad has been designed to divert upgradient runoff from around the lease pad to avoid risk of flooding.

4.3.3 Beetaloo W

Beetaloo W lease area lies at an elevation of approximately 235 m AHD, 4 km north of and 20 m above the Newcastle Creek floodplain (refer Plate 5a). The SRTM data was analysed to determine the approximate catchments draining past the Beetaloo W lease pad (Plate 6). The Beetaloo lease pad is approximately 3 m above the 100-year flood level (a discharge of 81 m^3/s) of the local flow path and approximately 20 m above the 100-year flood level of Newcastle Creek (with a discharge of approximately 3,000 m^3/s). The risk of floodwater inundation to the Beetaloo W lease pad is considered low (refer Plate 5a and b).

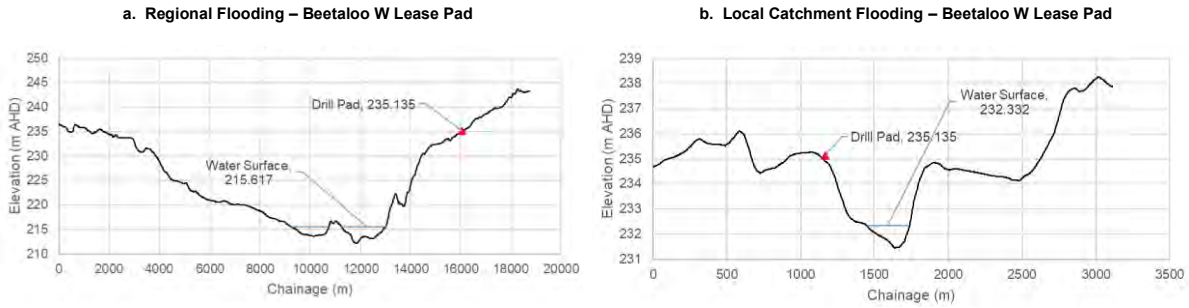
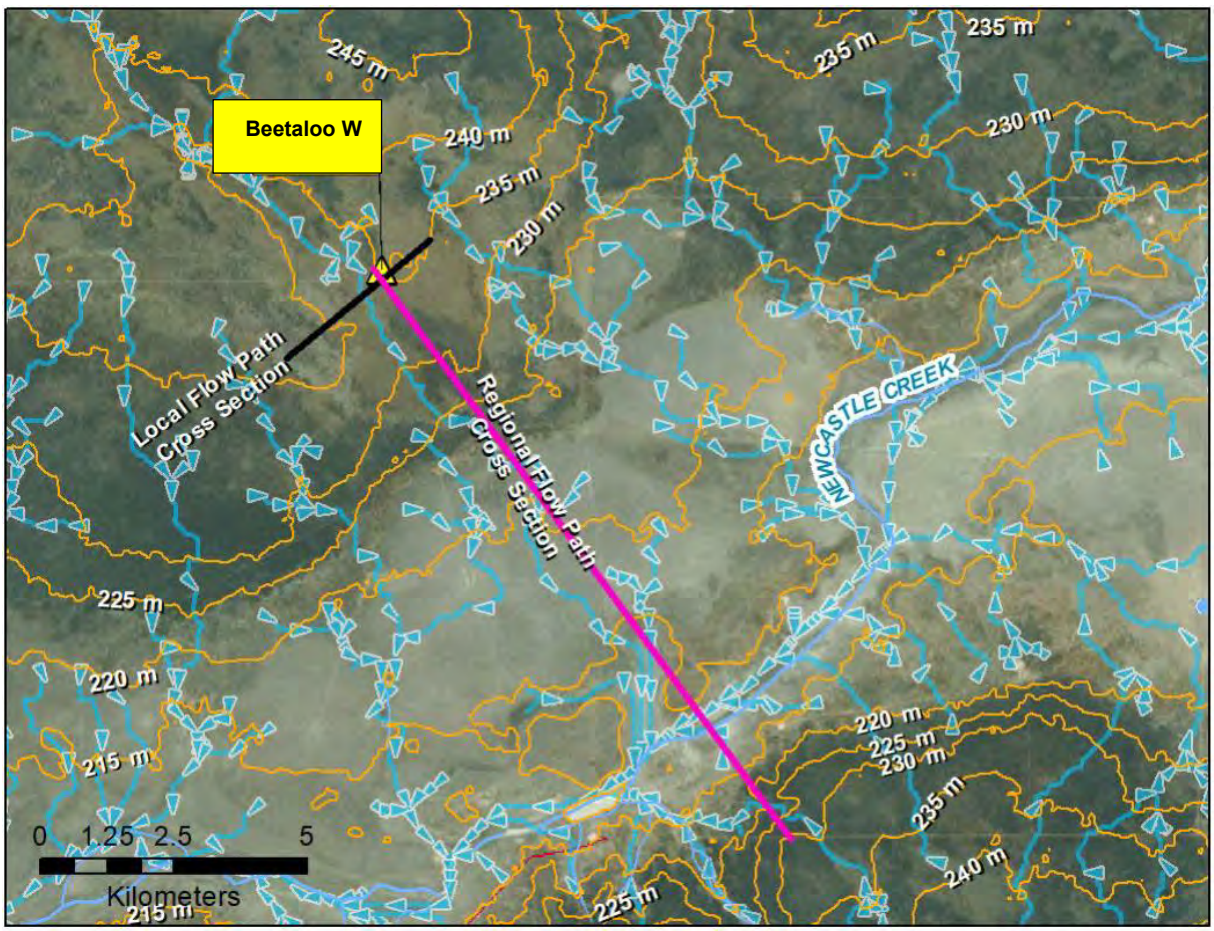


Plate 5 Cross section showing relative flood level and location of Beetaloo W lease pad with respect to local and regional flow path in 100-year event



(blue lines with arrows illustrate flow paths)

Plate 6 Catchments draining past Beetaloo W

4.4 Groundwater

Origin commissioned CloudGMS to undertake a desktop hydrogeological study of the Beetaloo Basin (CloudGMS, 2015) to compile a current understanding of the groundwater regime in the Beetaloo and adjacent groundwater basins. The conceptual hydrogeological model described below is from the Beetaloo Basin Hydrogeological Assessment.

The Beetaloo Basin comprises a thick sequence of flat-lying mudstone and sandstone formations (Roper Group) that were deposited between 1,500 and 1,430 million years ago (Ma) (Table 4). The Roper Group is estimated to reach 5,000 m in thickness in the centre of the basin, with the exception of the north and eastern margins occurs at an average depth of about 500 m. The Roper Group is overlain by the Georgina Basin (630 – 497 Ma), which includes widespread basalts and a thick limestone sequence that forms the Cambrian Limestone Aquifer (CLA), which is a significant water supply aquifer in the region. The Georgina Basin is capped by Cretaceous mudstone and sandstone (145 – 66 Ma) and recent alluvial and laterite deposits.

Table 4 Summary of Beetaloo Basin Hydrostratigraphy

Province	Period/Age	Formation		Aquifer Status	Thickness (m)	Yield (L/s)	Ave EC (µs/cm)
CARPENTARIA BASIN	CRETACEOUS 145 – 66 Ma	Undifferentiated		*Local Aquifer*	0 - 130	0.3 - 4	1,800
GEORGINA BASIN	CAMBRIAN 497-630 Ma	Cambrian Limestone Aquifer (CLA)	Anthony Lagoon Beds	REGIONAL AQUIFER	0 – 200	1 - 10	1,600
			Gum Ridge Formation	REGIONAL AQUIFER	0 – 300	0.3 - >20	1,400
		Antrim Plateau Volcanics		REGIONAL AQUITARD	0 – 440	0.3 - 5	900
		Bukalara Sandstone		*Local Aquifer (not regionally connected)*	0 – 75	0.3 - 5	1,000
BEETALOO BASIN (ROPER GROUP)	NOT KNOWN	Hayfield Mudstone		REGIONAL AQUITARD	0 – 450	-	32,000
		Jamison Sandstone		*Local Aquifer (not regionally connected)*	0 – 150	-	138,000
	MESO-PROTEROZOIC 1,430-1,500 Ma	Kyalla Formation		REGIONAL AQUITARD	0 – 800	-	-
		Moroak Sandstone		*Local Aquifer (not regionally connected)*	0 – 500	0.5 - 5	131,000
		Velkerri Formation		REGIONAL AQUITARD	700 – 900	-	-
		Bessie Ck Sandstone		*Local Aquifer (not regionally connected)*	450	0.5 - 5	-

Across parts of the Beetaloo Basin, undifferentiated Cretaceous deposits form the uppermost aquifer targeted for stock use. Notably, a basal sandstone unit immediately overlying the CLA produces yields of up to 5 L/s. Shallow groundwaters have also been recorded within the permit area between 1 and 2 metres below ground level.

The CLA, comprising the Gum Ridge Formation and the Anthony Lagoon Beds, is an extensive regional aquifer system that forms the principal water resource in the Beetaloo Basin. Limestone in the CLA is commonly fractured and cavernous; regionally bore yields of up to 100 L/s have been recorded from this aquifer. Approximately 80% of groundwater bores drilled in the basin screen the CLA and the aquifer supplies water for the pastoral industry and local communities including Elliot, Daly Waters, Larrimah and Newcastle Waters.

The CLA contains a significant but largely undeveloped groundwater resource with the sustainable yield from the Georgina Basin estimated to be in the order of 100,000 ML/year (NALWTF, 2009). Existing groundwater use in the Beetaloo Basin is estimated at 6,000 ML/year.

The regional groundwater flow direction in the CLA is north-west toward Mataranka, where the aquifer discharges into the Roper River and supports significant groundwater dependent ecosystems including the Roper River at Elsey National Park and Red Lily/57 Mile Waterhole. These discharge features occur around 100 km north-west of the Beetaloo Basin. Dry season flow in the Roper River has been gauged at 95,000 – 126,000 ML/year and provides an estimate of the magnitude groundwater discharge from the CLA. Large decadal changes in the discharge to the Roper River suggest that most recharge input occurs close to the discharge zone (i.e. beyond the Beetaloo Basin region). Groundwater recharge mechanisms to the CLA are poorly characterised but are likely to be dominated by infiltration through sinkholes and preferential recharge through soil cavities.

Limited information exists on the hydrogeological characteristics of the Roper Group sequence as it occurs at depth within the Beetaloo Basin. Sandstone dominated formations may behave as aquifers, however, drilling results suggest these formations have limited permeability and will only form marginal, very local scale aquifers. Groundwater in the Roper Group is highly saline and contrasts with the shallower, utilised aquifers in which groundwater is generally of drinking water quality.

The Velkerri Formation represents the primary unconventional gas target in the Beetaloo Basin, although small hydrocarbons intersections have been encountered in other formations within the Roper Group. Vertical pressure gradients between the Roper Group and the CLA are not well characterised, however, previous exploration well formation tests indicate there is an upward pressure gradient from the Roper Group to the CLA. Over much of the basin the CLA is separated from these formations by multiple aquitards including the Antrim Plateau Volcanics and Hayfield Mudstone.

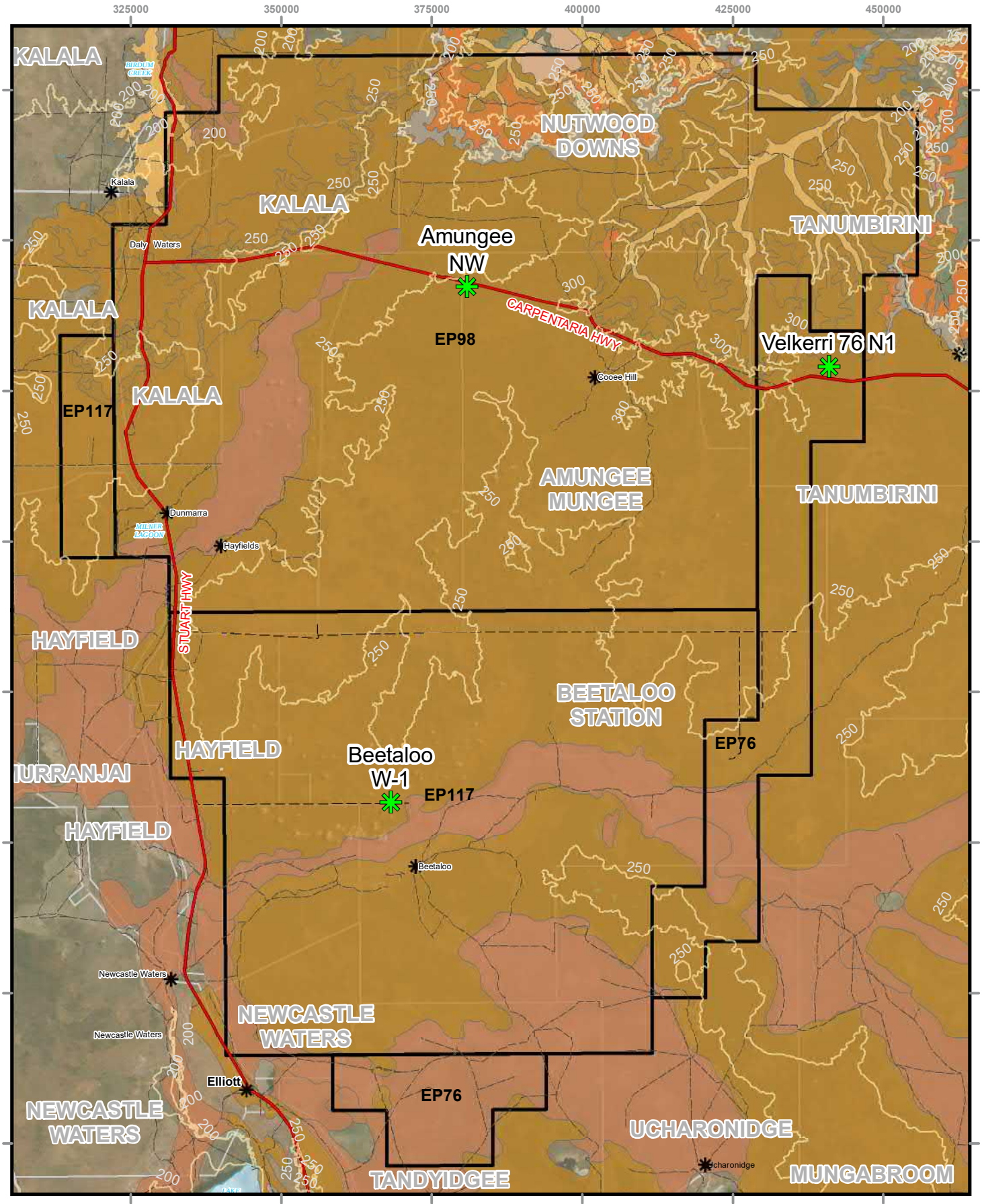
The Origin permit area currently falls within the Daly Roper Beetaloo Water Control District, that encompasses 175,580 km^2 and includes the Roper River and its tributaries as well as the Beetaloo Sub-basin (DENR, 2018). Legislation in Water Control Districts covers all aspects of sustainable water management, including the investigation, use, control, protection and allocation of water resources. Through the NT *Water Act*, water control districts and water allocation plans, allocation of water to various declared beneficial uses including; agriculture, aquaculture, public water supply, riparian and industry while ensuring that adequate provisions are made to maintain cultural and environmental requirements. Water control districts are geographical areas declared under the *Water Act* by the minister to allow for intensive management of water resources. Origin have an existing water extraction licence from DEPWS Water Resource Division in accordance with the *Water Act 1992*.

4.5 Land Systems

Land systems are defined because of their distinct differences from the surrounding areas and by the recurring pattern of geology, topography, soils and vegetation. Land system mapping for the project area is derived from *Land Systems of the Southern Part of the NT*, which is a compilation of three existing land system surveys and the Atlas of Australian Soils (scale 1:1,000,000). It covers the southern part (approximately 70%) of the Northern Territory. Published maps were made digital and edited to accommodate overlaps, gaps and mismatching boundaries. Where possible, the land system descriptions have been extrapolated into areas covered by the broader scale Atlas mapping (DLRM, 2013).

The proposed lease pad at Velkerri 76 N1 and lease extensions at Amungee NW and Beetaloo W all occur within the Beetaloo Land System classified as Lateritic Plains and Rises. This land system is characterised by plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products, sandy and earth soils.

Land system mapping for the exploration lease areas is shown below in Figure 6.



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GEOCENTRIC DATUM OF AUSTRALIA 94

0 7.5 15 30

Kilometres

Exploration Lease
Populated Place
Tracks
Highway
Permit Areas
Contours

Landscape Class

- lateritic plains and rises
- clay plains
- alluvial floodplains
- sandstone plains and rises
- lateritic plateaux
- basalt plains and rises

ORIGIN ENERGY RESOURCES LIMITED

Permit Area Land Systems
Landscape Class

PROJECT ID	60623736
CREATED BY	david.vandenhoek
LAST MODIFIED	01-Nov-2021
VERSION	1

Figure 6

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4.6 Soils

The dominant soils encountered within the permit area have been derived from ancient rock formations and ancestral soils that were formed during the earlier weathering cycles. The soils are deeply weathered and leached (Orr & Holmes, 1984). The soils in the permit area have been influenced by:

- past wetter conditions that formed relict Tertiary plains which comprise highly leached and lateritic soils
- extensive areas of Post-Tertiary Alluvia on which a variety of mature soils formed
- the dissected hilly country that is dominated by skeletal soils or rocky outcrops
- a range of parent materials of residual soils, ranging from basic volcanic and highly calcareous rocks to granitoid rocks and sandstones (Christian et al, 1951).

The lateritic plains, located within the permit area, are classed as very strongly leached soils of the Tertiary land surface. The three main soil types located within the permit area, include:

- **Tertiary Lateritic Red Earths (Red Kandosols)**, which occur on the gently undulating topography. The soil profile can be described as:

  A-Horizon Grey-brown sandy loam

  B-Horizon Reddish brown sandy clay loam

  C-Horizon Red-brown to red light clay, overlying heavy ferruginous gravel and massive laterite

Tertiary Lateritic Red Sands, which occur on gently undulating to undulating topography of the Tertiary Lateritic Plain, formed from sandstones and complex parent materials of the deep sandy soils. The soil profile can be described as:

A-Horizon Grey-brown to brown sand

B-Horizon Brown sand

C-Horizon Red-brown to yellow-brown sand overlying pisolitic ferruginous gravel and massive laterite. Altered colouring of highly siliceous parent sandstone is only evident in the mottled and pallid zones.

- **Tertiary Lateritic Podzolic Soils** formed on the gently undulating topography over a variety of rocks. These soils are located in the northern section of the Barkly Basin. The soil profile can be described as:

  A-Horizon Grey sand

  B-Horizon Yellowish-grey sand

  C-Horizon Yellow-grey sandy loam with ferruginous gravel overlying massive laterite, mottled and pallid zones.

Field soil tests where conducted at Velkerri 76 N1 in October 2019 and at both Amungee NW and Beetaloo W in August/September 2021. Soils at Velkerri 76 N1 were found to be dark brown slightly acidic pH (6 to 6.5) sandy loam and presented stable properties. The Amungee NW soils were found to be dark grey to greyish brown, slightly acidic (5.6 - 6 pH) light clays. Dark yellowing brown sandy loam soils with a neutral pH (6.9 - 7.3) were recorded within the Beetaloo W area.

Soils were found to be fairly shallow with lateritic bedrock located at a depth of around 400 - 450 mm across all sites.

4.6.1 Erosion Susceptibility

Soil erosion susceptibility varies throughout the permit area, dependent upon soil types, slope and extent of ground disturbance. Apart from the erosive impact of climatic conditions, soil erosion is influenced mainly by the inherent properties of the soils and the processes which occurred during the formation of the landscapes (Aldrick & Wilson, 1990).

Erosion will occur in the permit area if the land is used beyond its capacity, as is seen if land is overstocked or vehicle movements not controlled, for example. The location of proposed lease expansion areas at both Amungee NW and Beetaloo W has been examined on the ground, to determine the risk of erosion occurring. Factors considered include the following:

- Soil type – soils with higher clay content are prone to generation of bulldust and are easily eroded by wind and water. Gravelly soils tend to be more robust to disturbance on the scale expected during the lease exploration program. The lease pad areas were reported as generally non-dispersive soils and with relatively high gravel content as shown below:
  - Velkerri 76 N1 – Surface gravel 15%, subsurface gravel – 10% - 40%
  - Amungee NW - Surface gravel 30%, subsurface gravel 30% - 50%
  - Beetaloo W - Surface gravel 15%, subsurface gravel 10% - 45%.
- Slope – the slope of the site will determine the risk of erosion during rainfall events, with steeply inclined areas a higher risk than small undulations in the landform. All sites where considered flat with a slope of <1%, with exception of the surrounding area of Velkerri 76 N1 which consists of a low ridge with a ~1% gradient.
- Aspect – the position of the access track and pads in relation to the direction of the contour should be considered and creation of tracks across (as opposed to parallel with) the contour should be avoided.
- Rainfall – Table 5 and Table 6 present the erosion risk rating based on average monthly rainfall using the rating system provided in the IECA (2008) for Daly Waters Aerodrome (located approximately 55 km to the west of Amungee NW) and Newcastle Waters (located approximately 45km km to the south west of Beetaloo W. Construction activities for lease pad expansions is planned for completion prior to the wet season, to minimise the risk of erosion resulting from rainfall impacts.

Table 5 Erosion Risk Rating based on average monthly rainfall at Daly Waters Aerodrome

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	163.9	185.4	107.5	20.7	6.4	2.8	1.7	0.3	1.9	21.2	48.1	119.1
Erosion Risk	H	H	H	VL	VL	VL	VL	VL	VL	VL	L	H

* E = Extreme (>225 mm); H = High (100+ to 225 mm); M = Moderate (45+ to 100 mm); L = Low (30+ to 45 mm); VL = Very Low (0 to 30 mm) Data sourced from Bureau of Meteorology, Climate Averages for Station 014626 Daly Waters Aerodrome recorded from 1939-2021, Station 015131 Elliot recorded from 1949-2019. * note 2021 is only current to date (September 2021)

Table 6 Erosion Risk Rating based on average monthly rainfall at Newcastle Waters

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	125.9	131.0	83.2	19.3	7.4	4.8	2.5	1.2	4.9	17.6	38.6	74.3
Erosion Risk	H	H	M	VL	VL	VL	VL	VL	VL	VL	L	M

* E = Extreme (>225 mm); H = High (100+ to 225 mm); M = Moderate (45+ to 100 mm); L = Low (30+ to 45 mm); VL = Very Low (0 to 30 mm) Data sourced from Bureau of Meteorology, Climate Averages for Station 014626 Daly Waters Airstrip recorded from 1939-2019, Station 015131 Elliot recorded from 1949-2021. * note 2021 is only current to date (September 2021).

4.7 Bushfire

Fire is a natural occurrence in most Australian ecosystems and plays an important ecological role. Fire is generally excluded from Mitchell grasslands by pastoral management in order to maintain forage throughout the dry season (HLA, 2005). Fire is more frequent in the Eucalypt and Acacia woodlands situated within the Sturt Plateau bioregion.

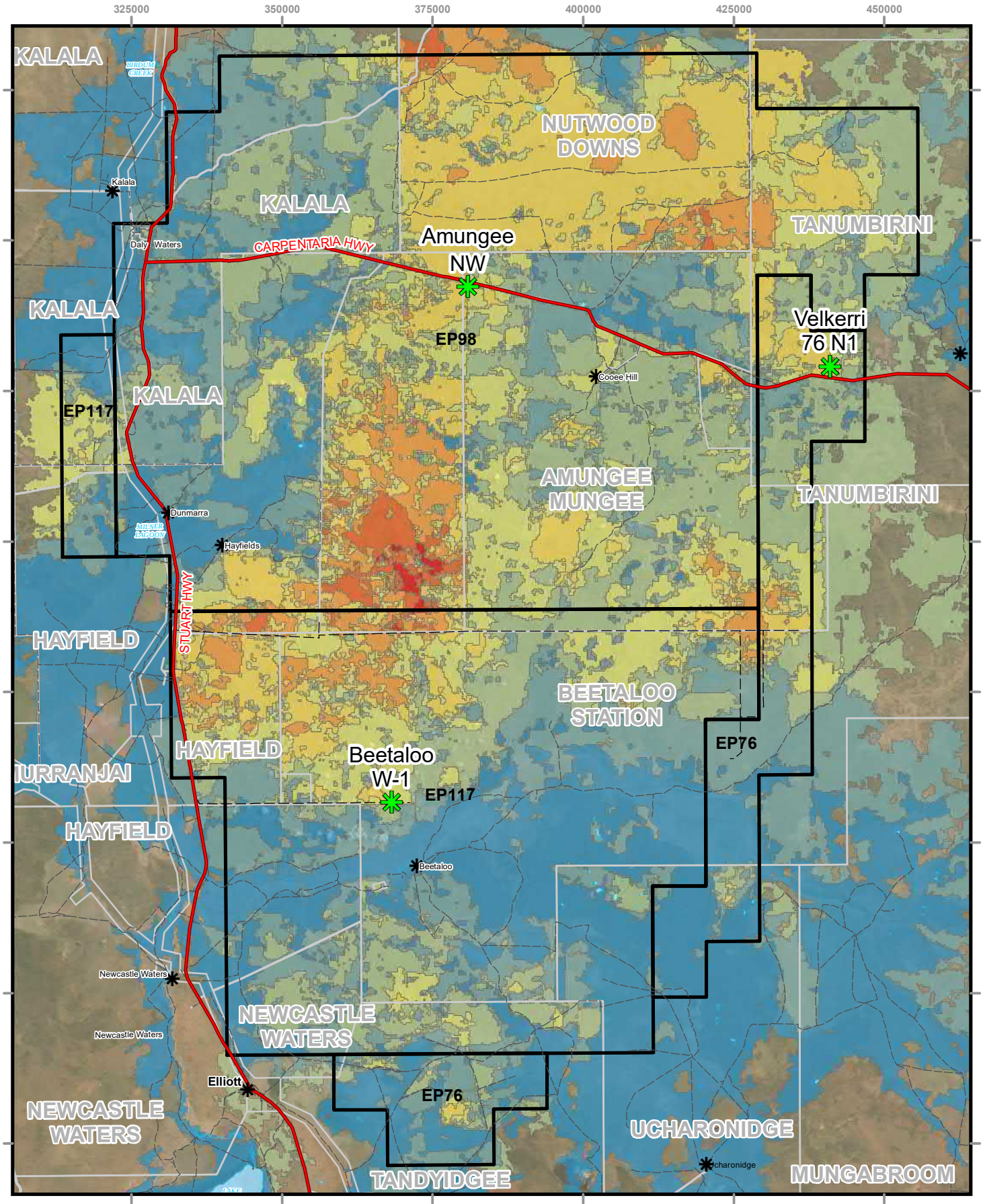
Historically most high intensity fires occur during the dry season fires (June to September) and are primarily located in EP76 and EP98, in the northern half of the permit area. (HLA, 2005). Wet season fires (October to May) have occurred within the permit area. These fires are likely to be patchy and of lower intensity, depending on the state of curing of the fuel load.

Fire sensitive Bullwaddy and Lancewood communities are located throughout the permit area. The impacts of hot fires can impact flora and fauna species and reduce habitat quality. Research suggests that hot fires may impact fauna diversity and in particular diurnal reptiles (e.g. Legge *et al*., 2008).

Field survey

Land condition assessments undertaken at Velkerri 76 N1in 2019 recorded a low intensity fire event in the previous 2-3 years, with minor scars on some trees and shrubs. The 2021 survey recorded moderate intensity fires around 3 years prior at both Amungee NW and Beetaloo W. Evidence of shrub stem death (*Acacia* sp. and *Hakea* sp.) and regrowth was evident at varying degrees at both sites.

Fire data was acquired from the NAFI site and queried for each site. Ten-year fire data (2010 to 2020) shows that the majority of land burnt around Velkerri N1, Amungee NW and Beetaloo W exploration lease pads took place around 3- 4 years ago. In this period 2 to 4 fire event have occurred on the sites, with the majority occurring later in the fire season, after 31st of July. Fire frequency was highest in areas of woodland and less frequent in areas of dense Lancewood and Bullwaddy shrubland. Figure 7 shows the fire frequency within the exploration areas over the past 10 years (2010 to 2020).



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GEOCENTRIC DATUM OF AUSTRALIA 94

0 7.5 15 30
Kilometres

Exploration Lease
Populated Place
Tracks
Highway
Permit

Number of years burnt

0
1
2
3
4
5
6
7

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Permit Area Annual Fire Frequency
10 year, 2011 - 2020

PROJECT ID	60623736
CREATED BY	david.vandenhoek
LAST MODIFIED	01-Nov-2021
VERSION	1

Figure 7

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5.0 Natural Environment

5.1 Bioregion

The Interim Biogeographic Regionalisation of Australia (IBRA) is a nationally recognised ecosystem classification system (Thackway & Creswell, 1995). Bioregions are large, geographically distinct ecosystems that are distinguished by broad physical and biological characteristics, which can be further classified into Subregions. These regions and subregions are used as the basis for regional comparisons and conservation of flora and floristic communities. Of the 85 bioregions mapped nationally, 20 occur within the Northern Territory. The Velkerri 76 N1, Amungee NW and Beetaloo W exploration areas are situated entirely within the Sturt Plateau Bioregion.

The following provides the description of the Sturt Plateau bioregion based on the biodiversity audit carried out by Parks and Wildlife Services (Baker *et al*, 2005) Sturt Plateau Bioregion - comprises undulating plains on sandstone, with predominantly neutral sandy red and yellow earth soils. Dominant vegetation is eucalypt woodland (dominated by variable-barked bloodwood *Eucalyptus dichromophloia*) with spinifex understorey, as well as extensive areas of Lancewood (*Acacia shirleyi*) - Bullwaddy (*Macropteranthes kekwickii*) vegetation association and associated fauna, including the Spectacled Hare-Wallaby (*Lagorchestes conspicillatus*). Land condition in the bioregion is moderate to good but is threatened by impacts from weeds, feral animals, pastoralism and changed fire regimes.

5.2 Vegetation Communities

The field assessment undertaken in October 2019 and August/September 2021 confirmed that the main vegetation communities identified within the exploration lease scouting areas are woodlands, typically dominated by bloodwoods (*Corymbia* spp.) and Eucalypt and patches of tall shrubland / woodland of Lancewood (*Acacia shirleyi*) and Bullwaddy (*Macropteranthes kekwickii*) with open grassland understorey. Other less common vegetation communities within the permit area include *Acacia* spp. shrubland over spinifex and Bullwaddy-dominated woodland.

Vegetation communities are discussed for each site in the following sections.

Velkerri 76 N1

Vegetation communities surrounding the Velkerri 76 N1 proposed lease area include Lancewood/Bullwaddy open forest and mixed Eucalyptus spp. open woodland. Dominant canopy species are within the open forest are *Acacia shirleyi* and *Macropteranthes kekwickii* with *Corymbia dichromophloia* and *Eucalyptus pruinosa* dominant in the open forest. Midstrata species found within the open woodland include *Melaleuca viridiflora* and *Erythrophleum chlorostachys*. The grassy understorey is dominated by *Themeda avenacea*, *Eriachne armitii* and *Triodia bitextura*.

A detailed description of vegetation communities identified within the Velkerri 76 N1 scouting area is provided in Table 13. Vegetation communities will be mapped following completion of updated survey scheduled in November 2021.

Amungee NW

Vegetation communities surrounding the Amungee NW lease area and proposed lease expansion area include *Corymbia* spp. open woodland and a mixed community supporting patches of Lancewood and Bullwaddy open forest surrounded by *Corymbia* spp. open woodland. Dominant species within the open woodland include *C. ferruginea*, *C. polycarpa* and *C. dichromophloia* in the upper strata, over *Petalostigma pubescens*, *Terminalia canescens* and *Hakea arborescens* dominant in the mid strata. The tussock grassland understory supports grasses such as *Chrysopogon fallax*, *Themeda avenacea* and *Sorghum timorense*. Lancewood is the dominant canopy species within the open forest, with Bullwaddy dominating the midstrata. Other common midstrata species include *Santalum lanceolatum* and *Terminalia volucris*.

The current Amungee NW lease pad and camp area are situated within areas of Corymbia spp. open woodland. This vegetation community also makes up the majority of the lease expansion area, with only a small area on the north east boundary falling within a patch of Lancewood/Bullwaddy open forest.

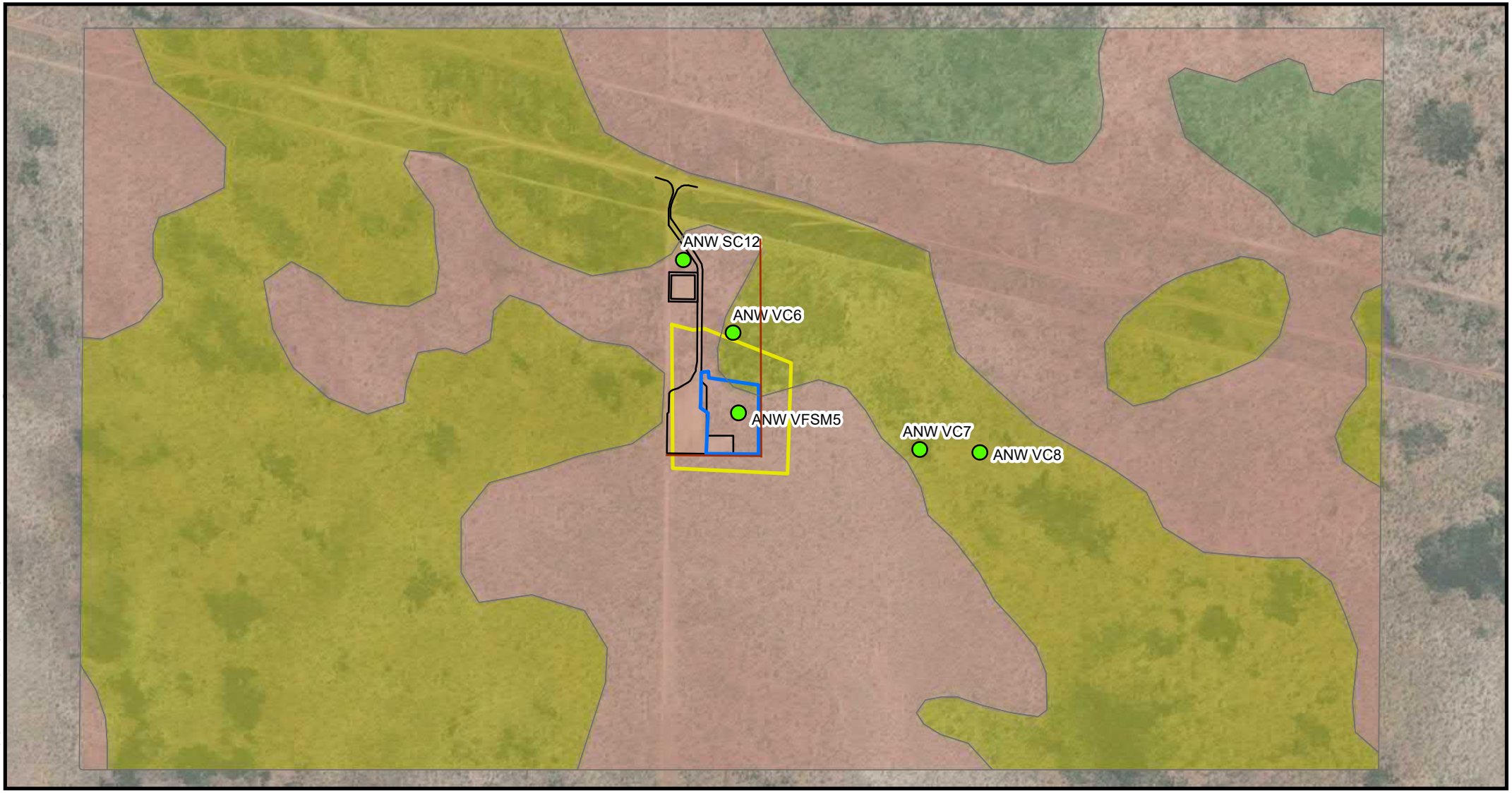
Vegetation communities identified within the Amungee NW scouting area during the field survey are shown in Figure 8, with detailed descriptions provided for each survey site in Table 14.

Beetaloo W

Vegetation communities surrounding the Beetaloo W lease area include patches of Lancewood/Bullwaddy open woodland/open forest, *Corymbia* spp./*Eucalyptus* spp. open woodland and mixed species open woodland. Lancewood is the dominant canopy species within the open forest, with Bullwaddy found dominant in the midstrata. Other common midstrata specie include *Santalum lanceolatum* and *Terminalia volucris*. Dominant canopy species within the *Corymbia sp.*/*Eucalyptus* sp. open woodland are *Corymbia polycarpa* and *Eucalyptus chlorophylla*, with Bullwaddy and *Acacia* spp. dominant in the midstrata, over grassy understory species including *Aristida* sp. and *Sorghum plumosum.* Dominant species within the mixed species open woodland include *Atalaya hemiglauca* and *Gyrocarpus americanus* in the upper strata, over midstrata species including Bullwaddy, *Terminalia canescens* and *Hakea arborescens* and a grassy understory.

The current Beetaloo lease pad is situated within the mixed open woodland community and the camp and access track are within the *Corymbia sp.*/*Eucalyptus sp.* open woodland. The planned lease expansion area is proposed along the northern edge of the existing lease pad area and will potentially impact all three identified vegetation communities.

Vegetation communities identified within the Beetaloo W scouting area during the field survey are shown in Figure 9, with detailed descriptions provided for each survey site in Table 15.



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GEOCENTRIC DATUM OF AUSTRALIA 94

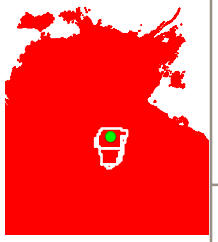
0 250 500 1,000
Metres

- Vegetation Survey Locations
- Lease Pad Layout
- Lease Expansion
- Scouting
- Fenceline

Vegetation Community Boundaries

- Lancewood / Bullwaddy open woodland / open forest
- Lancewood open forest / *Cory spp.* open woodland
- *Corymbia spp.* open woodland

LOCATION



Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage - StreetPro 2019

ORIGIN ENERGY RESOURCES LIMITED

Amungee NW (EP98)
Vegetation Community Boundaries

PROJECT ID	60623736
CREATED BY	david.vandenhoek
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VERSION	1

Figure
8

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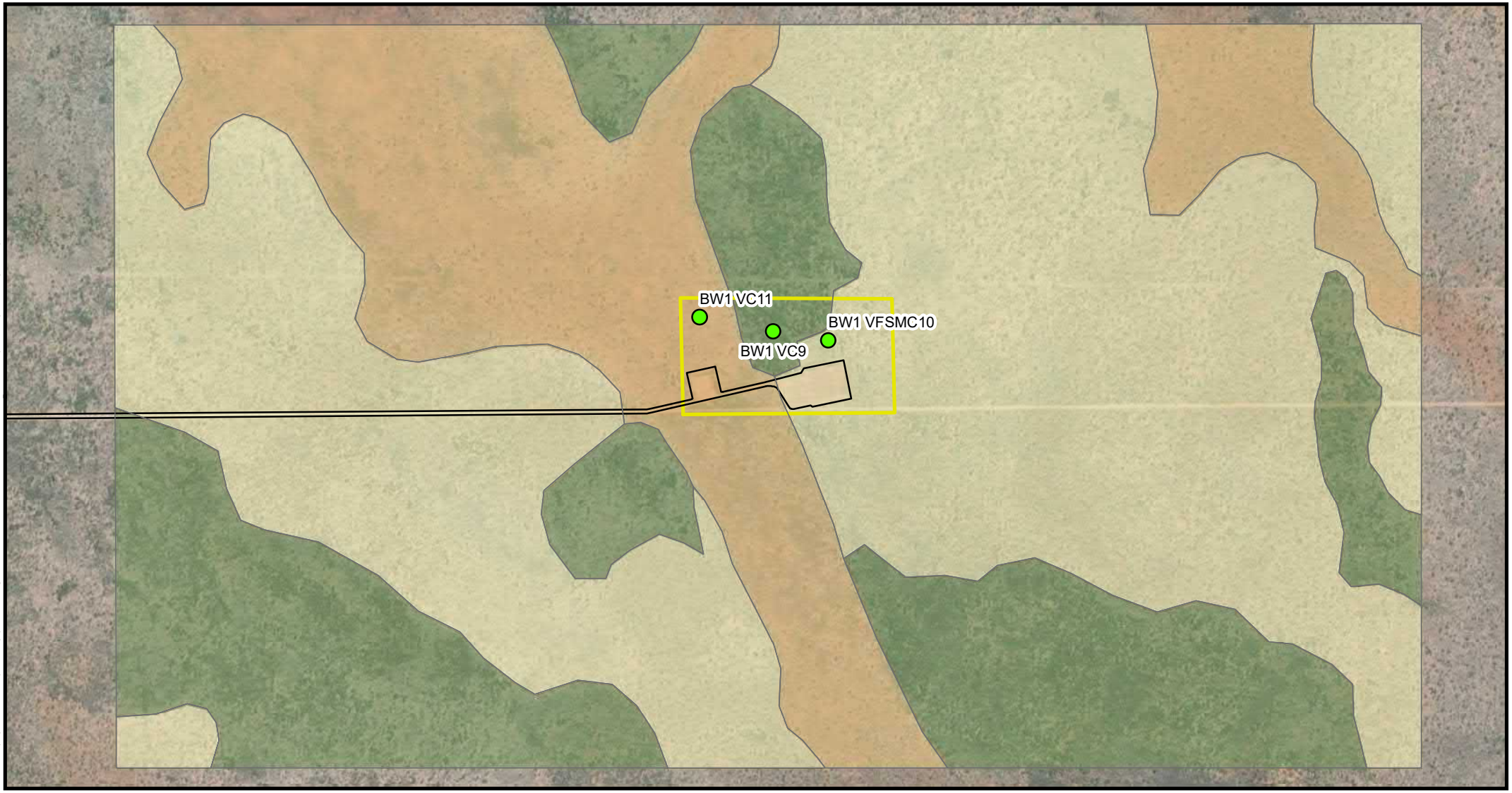

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N

GEOCENTRIC DATUM OF AUSTRALIA 94

0 250 500 1,000

Metres

Vegetation Survey Locations

Lease Pad Layout

Scouting Area

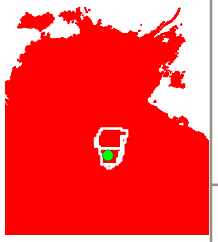
Vegetation Community Boundaries

Lancewood / Bullwaddy open woodland / open forest

Cory polycarpa / Euc chlorophylla open woodland

Mixed open woodland

LOCATION



Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage - StreetPro 2019

ORIGIN ENERGY RESOURCES LIMITED

Beetaloo W-1 (EP117) Vegetation Community Boundaries

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VERSION	1

Figure 9

5.3 Flora

A search of the DAWE Protected Matters database of nationally significant fauna (PMST) and the NT Government flora atlas database was undertaken for the exploration area, with a 10 km buffer applied. No threatened vegetation communities are listed as likely to occur within the project area.

The prostrate, herbaceous vine *Ipomoea argillicola*, is listed as Near Threatened under the Territory Parks and Wildlife Conservation Act 2000 (TPWC Act) and potentially occurs within the project area. The NT flora data base shows that this species has been recorded from the Bullwaddy Conservation Reserve and nearby areas (AECOM, 2015).

Field surveys undertaken in 2019 and 2021 recorded a total of 40 flora species within the lease exploration scouting areas (Table 7). The survey focused on recording dominant species to describe vegetation communities rather than undertake a comprehensive floristic assessment.

Table 7 Flora Species Recorded, 2019 and 2021 Field Surveys

Family	Genus	Species	Velkerri 76 N1 (2019)	Amungee NW (2021)	Beetaloo W (2021)
APOCYNACEAE	*Carissa*	*lanceolata*	*		
ASTERACEAE	*Biden*	*bipinnata*			*
COMBRETACEAE	*Macropteranthes*	*kekwickii*	*	*	*
	Terminalia	*canescens*		*	*
	Terminalia	*volucris*		*	*
FABACEA	*Acacia*	*difficilis*			*
	Acacia	*dimidiata*			*
	Acacia	*lysiphloia*		*	
	Acacia	*shirleyi*	*	*	*
	Bauhinia	*cunninghamii*			*
	Erythrophleum	*chlorostachys*	*	*	*
HERNANDIACEAE	*Gyrocarpus*	*americanus*			*
LAMIACEAE	*Mesosphaerum*	*suaveolens***		*	
MALVACEAE	*Grewia*	*retusifolia*	*		
	Waltheria	*indica*		*	
MYRTACEAE	*Calytrix*	*exstipulata*			*
	Corymbia	*dichromophloia*	*	*	*
	Corymbia	*ferruginea*		*	
	Corymbia	*polycarpa*		*	*
	Eucalyptus	*chlorophylla*		*	
	Eucalyptus	*microtheca*	*		
	Eucalyptus	*pruinosa*	*		
	Melaleuca	*citrolens*	*		
	Melaleuca	*viridiflora*	*		
PICRODENDRACEAE	*Petalostigma*	*pubescens*	*	*	
	Aristida	sp.			*

Family	Genus	Species	Velkerri 76 N1 (2019)	Amungee NW (2021)	Beetaloo W (2021)
POACEAE	*Aristida*	*inaequiglumis*		*	
	Chrysopogon	*fallax*		*	
	Dichanthium	*fecundum*	*		
	Eriachne	armitii	*	*	*
	Themeda	*avenacea*	*	*	
	Schizachyrium	*fragile*		*	
	Sorghum	*plumosum*			*
	Sorghum	*timorense*		*	
	Triodia	*bitextura*	*		
PROTEACEAE	*Hakea*	*arborescens*		*	*
RHAMNACEAE	*Alphitonia*	*excelsa*		*	*
	Ventilago	*viminalis*		*	*
SANTALACEAE	*Santalum*	*lanceolatum*		*	*
SAPINDACEAE	*Atalaya*	*hemiglauca*			*

5.4 Weeds

Previous surveys within the Origin Permit Areas in 2014, 2015 and 2016 have recorded a low number and density of weed species, indicating that land condition is generally good. Three declared weed species, *Calotropis procera* (Rubber bush), *Parkinsonia aculeata* (Parkinsonia) and *Mesosphaerum suaveolens* (Hyptis), have been recorded during previous surveys.

Table 8 provides a list of weed species that are known to occur or likely to occur within the wider Origin Exploration Permit Areas.

This information is based on the following sources:

- Mapping data provided by the Weed Management Branch, DEPWS.
- Guidelines for the Management of the Weeds of Beetaloo 2018 (DLRM et al 2018).
- Department of the Environment and Energy (DAWE) EPBC Act Protected Matters Report database.
- Previous data collected by AECOM in the permit area.

Table 8 NT Listed Weeds known or likely to occur within the Origin 2021 Explorations Area

Scientific Name	Common Name	Status
Alternanthera pungens	Khaki Weed	Class B and C
Andropogon gayanus	Gamba Grass	Class A and C, WoNS
Azadirachta indica	Neem	Class B and C
Calotropis procera	Rubber Bush	Class B and C (south of 16°30' S latitude)
Cenchrus ciliaris	Buffel Grass	Not declared in NT
Cenchrus echinatus	Mossman River Grass	Class B and C

Scientific Name	Common Name	Status
Datura ferox	Fierce Thornapple	Class A and C
Mesosphaerum suaveolens	Hyptis	Class B and C
Jatropha gossypiifolia	Bellyache Bush	Class B and C, WoNS
Parkinsonia aculeata	Parkinsonia	Class B and C, WoNS
Sida acuta	Spinyhead Sida	Class B and C
Sida cordifolia	Flannel Weed	Class B and C
Sida rhombifolia	Paddy's Lucerne	Class B and C
Tamarix aphylla	Athel Pine	Class B and C, WoNS
Themeda quadrivalvis	Grader Grass	Class B and C, WoNS
Tribulus terrestris	Caltrop	Class B and C
Vachellia nilotica	Prickly Acacia	Class A and C, WoNS

Note: Declarations under the Northern Territory Weeds *Management Act 2013*:

- a Class A weed is to be eradicated
- a Class B weed is to have its growth and spread controlled
- a Class C weed is not to be introduced to the NT.

* All Class A and B weeds are also Class C.

In addition to these 17 species, a range of grassy weeds are known to occur along road corridors throughout the region. This includes Buffel Grass which was originally introduced for livestock feed and soil stabilisation but has subsequently shown to alter fire regimes and impact biodiversity.

The Guidelines for the Management of the Weeds of Beetaloo 2018 (DLRM et al 2018) identifies several introduced plants that have previously been recorded within the permit areas and have been identified as problem weeds across northern Australia. Some of these weeds are not listed under the *NT Weeds Management Act* but are of concern elsewhere in Australia. Understanding the potential weeds likely to occur within the Permit Area is particularly important when proposed activities include transporting machinery and equipment during the construction process.

The Barkly Regional Weed Management Plan provides additional information on regional weed management priorities and management actions to support landholders in their obligations to manage weeds on their land (DLRM, 2015).

This plan includes a list of 'alert' weed species that are not yet naturalised in the region but have the potential to have a high level of impact to the region should they become established. The likelihood of these species naturalising and spreading in the region is considered high (DLRM, 2015).

The alert species identified in the *Barkly Regional Weed Management Plan* are listed in Table 9. If located, the program EMP requires the Weed Management Branch to be contacted for identification and disposal.

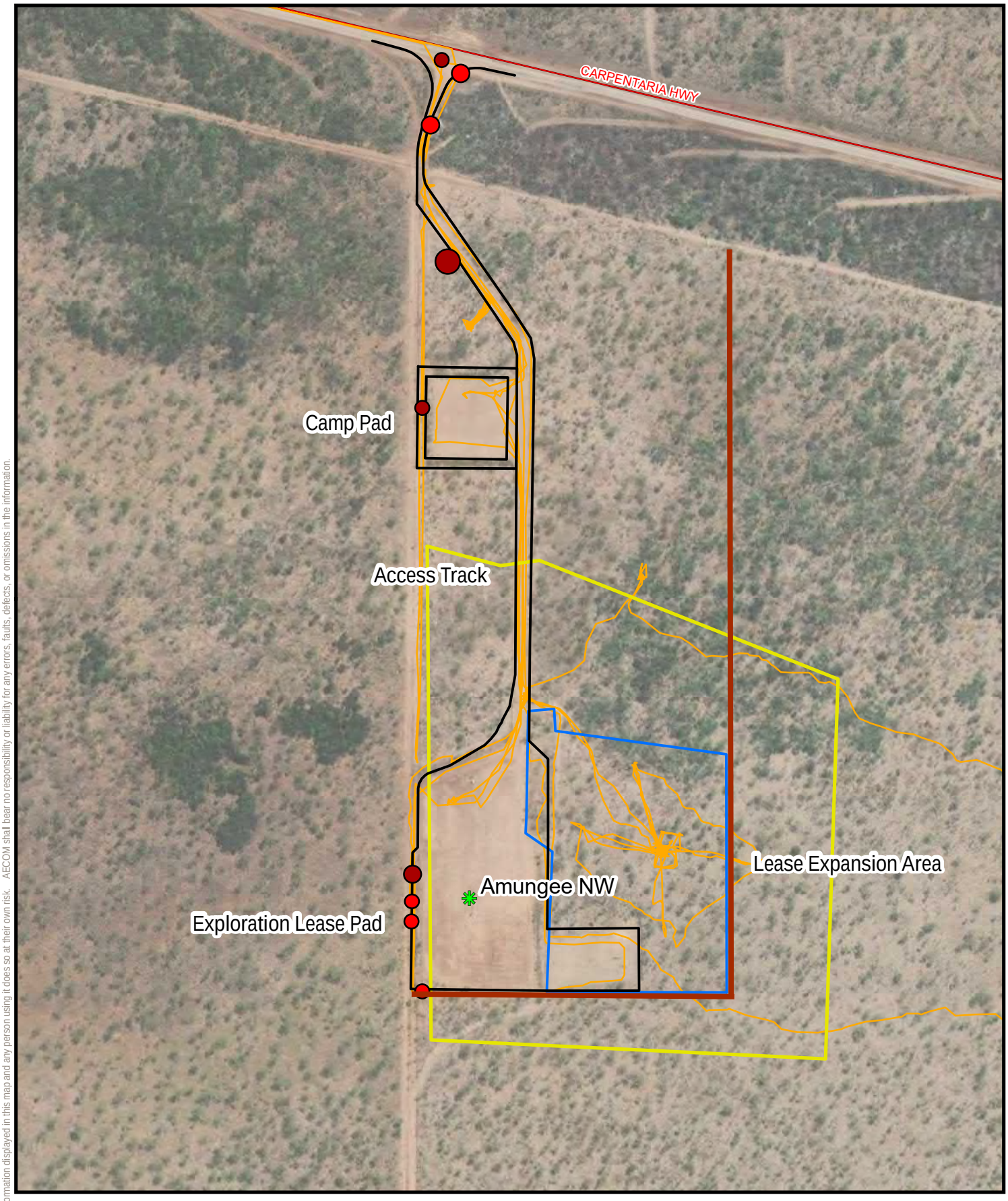
Table 9 Alert Species identified in the Barkly Region

Scientific Name	Common Name	Declaration
Cenchrus setaceum	Fountain grass	Class B and C
Parthenium hysterophorus	Parthenium	Class A and C, WoNS
Cryptostegia grandiflora	Rubber vine	Class A and C, WoNS

A weed survey was undertaken within the Velkerri 76 N1 scouting area in October 2019 and within the Amungee NW and Beetaloo W scouting areas in August/September 2021. Survey areas included the edge of tracks and disturbance areas and within intact areas of woodland that are proposed for clearing and placement of lease infrastructure. Figure showing coverage during the expansion lease pad areas are provided in Figure 10 and Figure 11.

No weeds were observed within the Velkerri 76 N1 site during the 2019 survey. The class B weed Hyptis (*Mesosphaerum suaveolens*) was observed along roadside edges and along fence line tracks associated with the existing Amungee NW exploration lease pad. No weeds were observed within areas of intact woodland within the Amungee NW expansion lease area. The entire Beetaloo W scouting area including tracks, lease and camp pads and proposed lease expansion pad areas, was found to be free of introduced weeds.

A map showing the location, size and density of Hyptis patches located within the Amungee NW exploration lease area is show in Figure 10.



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GEOCENTRIC DATUM OF AUSTRALIA 94

0 50 100 200

Meters

Hyptis Density

- <1% density
- 1 - 10% density
- 11-50% density

Patch Size

- <20m2
- 20-50m2
- >100m2

- Highway
- Survey Track
- Lease Pad Layout
- Lease Expansion Area
- Scouting Area
- Fenceline

ORIGIN ENERGY RESOURCES LIMITED

Amungee NW (EP98) - Weed Survey

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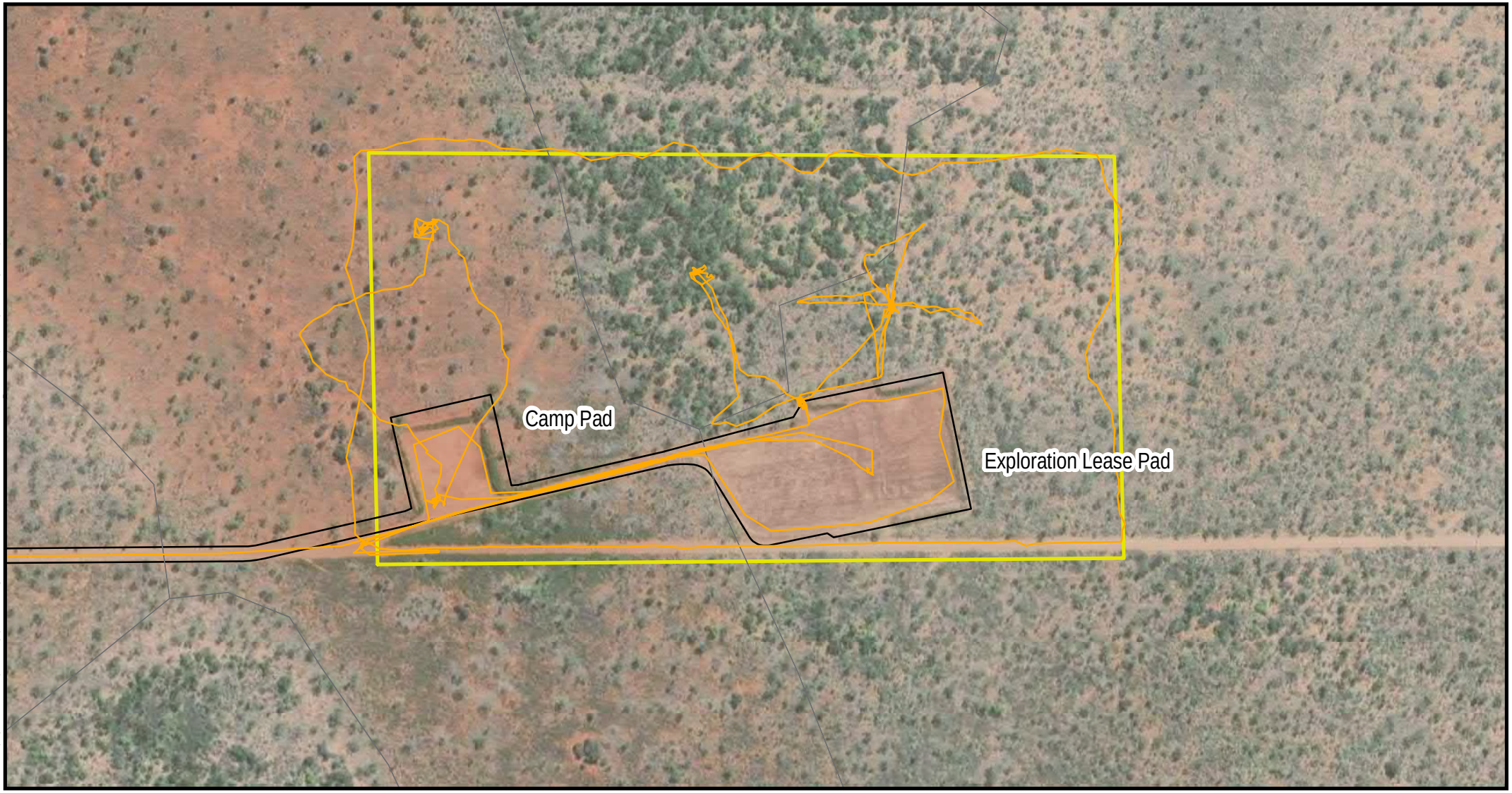
VERSION	1

Figure 10

Filename: L:\Legacy\Projects\606x\60623736\900_CAD_GIS\920_GIS\02_MXDs\Beetaloo Feild Scouting Program - LCA July 2021\Report Figures\Fig.10 Amungee NW Weed Survey.mxd



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N

GEOCENTRIC DATUM OF AUSTRALIA 94

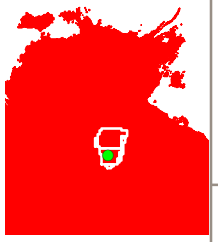
0 50 100 200

Metres

— Lease Pad Layout

— Survey Track

LOCATION



Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage - StreetPro 2019

ORIGIN ENERGY RESOURCES LIMITED

Beetaloo W-1 (EP117) Weed Survey

PROJECT ID	60623736
CREATED BY	david.vandenhoek
LAST MODIFIED	01-Nov-2021
VERSION	1

Figure 11

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5.5 Fauna and Habitat

Previous surveys and database searches indicate that the permit areas are an important area for a diverse array of fauna. The NT Fauna Atlas database (NR Maps) provides records for the following fauna species: 14 species of mammal, 104 species of birds, 31 species of reptiles and 1 species of frog. Surveys undertaken elsewhere within the region have recorded:

- 11 mammal, 78 bird, 33 reptile, and six frog species in the Bullwaddy Conservation Reserve (PWCNT, 2005)
- 21 mammal, 148 bird, 47 reptile and six frog species in the Junction Stock Reserve and nearby Newcastle Waters (Fleming et al., 1983)

A full list of recorded species is provided - Appendix A (Flora Atlas records) and Appendix B (Fauna Atlas records).

The proposed exploration lease scouting area sites are located within similar habitat types, primarily of open woodland consisting of mixed Eucalyptus/Corymbia species with a mixed tussock grass understorey. Often, scattered stands of Bullwaddy/Lancewood communities occur across the proposed sites and individuals of both species are dispersed throughout. In the wider landscape, including proposed access tracks, additional vegetation types include those associated with drainage lines, grasslands/floodplains and *Acacia sp.* shrublands.

*Eucalypt*us/*Corymbia* sp. woodland provides habitat for a range of species. The proposed sites had high native grass cover and included numerous species suitable for granivorous birds (seed eaters). Dense leaf litter and numerous logs provide suitable refuge and foraging sites for fauna such as reptiles. Although most of the species found in this vegetation type are widespread in the tropical savannas of the Northern Territory, some such as the threatened Crested Shrike-tit (*Falcunculus frontatus whitei*) are rare and known to utilise this habitat (Ward, 2008). Many of the sites have a high density of hollow-bearing trees that provide important habitat for many fauna species. Avoiding clearing large hollow-bearing trees will reduce the impact to native wildlife within the permit area.

Savanna grasslands and open woodland provide suitable habitat for species such as Emu (*Dromaius novaehollandiae*) and Australian Bustard (*Ardeotis australis*). Drainage lines and seasonally inundated grasslands may also provide habitat for migratory species during the wet season and are breeding areas for frogs. Limiting disturbances in these areas and avoiding these areas during the wet season would limit impacts on fauna.

Incidental fauna surveys undertaken within the exploration lease pad scouting areas in 2019 and 2021 have identified 24 species. This included one species of reptile, 22 bird species and one mammal, refer Table 10 and Plate 7 and Plate 8 below.

Table 10 Incidental Fauna Observations, 2019 and 2021 Field Surveys

Common name	Scientific Name	Velkerri 76 N1 (2019)	Amungee NW (2021)	Beetaloo W (2021)
Reptiles				
Yellow Two-lined Dragon	*Diporiphora magna*		*	
Birds				
Apostle Bird	*Struthidea cinerea*		*	*
Black kite	*Milvus migrans*		*	
Brown Falcon	*Falco berigora*			*
Brown honeyeater	*Lichmera indistincta*		*	
Cockatiel	*Nymphicus hollandicus*			*
Crested Pigeon	*Ocyphaps lophotes*			*
Diamond Dove	*Geopelia cuneata*			*

Common name	Scientific Name	Velkerri 76 N1 (2019)	Amungee NW (2021)	Beetaloo W (2021)
Galah	*Eulophus roseicapilla*			*
Grey-crowned Babbler	*Pomatostomus temporalis*	*	*	*
Hooded Robin	*Melanodryas cucullata*			*
Long-tailed Finch	*Poephila acuticauda*		*	
Little Woodswallow	*Artamus minor*		*	*
Masked Woodswallow	*Artamus personatus*		*	*
Owlet Nightjar	*Aegotheles cristatus*		*	*
Red-winged Parrot	*Aprosmictus erythropterus*		*	
Rufous Whistler	*Pachycephala rufiventris*			*
Singing Honeyeater	*Gavialis virescens*	*		
Torresian crow	*Corvus orru*		*	
Variegated Fairy-wren	*Malurus lamberti*			*
Whistling kite	*Haliastur sphenurus*		*	
Willie Wagtail	*Rhipidura leucophrys*	*	*	
Yellow-tinted Honeyeater	*Ptilotula flavescens*	*		
Mammals				
Agile Wallaby	*Macropus agilis*	*		

Plate 7. *Diporiphora magna* recorded at the Amungee NW scouting area within *Corymbia* spp.

Plate 8. Owlet Nightjar recorded at the Beetaloo W scouting area within Lancewood forest

5.5.1 Threatened Fauna

A search of the DAWE Protected Matters database of nationally significant fauna (PMST) and records from the NT Government Fauna Atlas database (NR Maps) was undertaken at 10 km and 50 km of the proposed lease areas and access tracks. The search results indicate the potential presence of 15 fauna species listed as threatened under the EPBC Act and/or the TPWC Act. These included eight birds, five mammals and two reptiles.

The likelihood assessment of species occurrence is based on the availability of suitable habitat within the permit area, records in the vicinity and distributional data. Therefore, many of the threatened and migratory fauna species indicated in databases as ‘occurring’ or ‘likely to occur’ have been assessed as unlikely to occur within the proposed exploration lease areas. As some areas in the proposed lease area have not been subject to intensive survey and some species are very cryptic, a conservative approach has been taken to assess species presence. A full description of each species, their distribution and habitat associations are outlined in Table 11 below.

No core habitat for threatened fauna was identified at the sites. However, some species may occur and are known to occur in the wider landscape. Threatened species that potentially occur include:

- Gouldian Finch *Erythrura gouldiae* (Endangered EPBC Act, Vulnerable TPWC Act)
- Grey Falcon *Falco hypoleucos* (Vulnerable EPBC Act and TPWC Act)
- Crested Shrike-tit (northern) *Falcunculus frontatus whitei* (Vulnerable EPBC Act)
- Painted Honeyeater *Grantiella picta* (Vulnerable EPBC Act and TPWC Act)
- Pale Field-rat *Rattus tunneyi* (Vulnerable TPWC Act)
- Common Brushtail Possum (northern) *Trichosurus vulpecula arnhemensis* (Vulnerable EPBC Act)
- Yellow-spotted Monitor *Varanus panoptes* (Vulnerable TPWC Act)

Research has shown that critical components of suitable habitat for the Gouldian Finch include suitable nesting trees during the breeding season (particularly *Eucalyptus tintinnans*, *E. brevifolia* or *E. leucophloia*), a water source and a diverse range of favoured annual and perennial grasses (DoE, 2015).

No nesting habitat was recorded during the surveys and it is unlikely this species breeds in close vicinity of the sites. During the wet season, Gouldian Finches move from breeding habitat on hillsides with suitable trees down to lower lying areas where they forage on perennial grasses such as *Triodia sp.*, *Alloteropsis semialata*, and *Chrysopogon fallax* (Palmer et al. 2012). Some of the perennial grasses were recorded during recent surveys so potential foraging habitat is present; however, there are limited records in the vicinity of the sites suggesting it is not an important area for this species.

The Crested Shrike-tit lives in dry Eucalypt forests and woodlands where it feeds on insects from the canopy and also under bark (Ward, 2008). It has been recorded in wet Melaleuca open woodlands and woodlands dominated by Nutwood (*Terminalia arostrata*) and Bloodwoods with flaky bark and ironwood (DoE, 2014, Ward, 2008). In the NT, nesting has been recorded from September through to January and nests are built in terminal branches at the top of trees (Ward et al., 2009). The stronghold of this species is north of this location and only one old record exists near Borroloola.

Although it is possible the Crested Shrike-tit may be present in the area, it is unlikely to represent an important area for this species. The overall estimated density of the *Corymbia* sp. on Amungee NW was recorded as 6 stems/ha, which based on the impact of the proposed activities of 12.4 ha represents 0.003% of the available *Corymbia* open woodland vegetation community within EP98 (estimated from NVIS of 359,950 ha). Based on the recorded stems/ha for Amungee NW it can also be estimated that within the 1,000 ha directly surrounding the disturbance area there would be up to 6,000 individual stems/ha of *Corymbia* sp.. With additional vegetation clearing controls, such as timing of the clearing activities to avoid the preferred breeding and fledging times (October to March), will further reduce impacts as far as reasonably practicable.

The Grey Falcon (*Falco hypoleucos*) is a widespread species listed as Vulnerable in the NT and considered possibly present in the study area. The species occurs in low densities throughout arid and semi-arid areas of Australia (Ward, 2012). Potential nesting trees will not be cleared for the project, therefore impacts to the species will be minimal.

The Painted Honeyeater (*Grantiella picta*) has been known to occur in region, however, given it does not breed in the NT it would only be present intermittently for foraging. Suitable habitat for the species potentially occurs within the project footprint. The area proposed for clearance is relatively small compared to available suitable habitat within the region.

The Yellow-spotted Monitor (*Varanus panoptes*) occurs across northern Australia where it occupies a variety of habitats, including grasslands and woodlands (Ward et al., 2012). Most records of this species are from the Top End, though it has been recorded in the Barkly Tablelands. The species likely occurs close to wetlands and riparian habitats within the permit areas; however such habitat won't be impacted by proposed activities.

Recent surveys have detected Common Brushtail Possum (*Trichosurus vulpecula arnhemensis*) on Kalala Station, located approximately 45 km from the project area (NTG Flora & Fauna, personal communication, 2022). Suitable woodland habitat is contiguous through the landscape; therefore the species potentially occurs within the project area. Given the large amount of suitable habitat within the region comparative to the project footprint the risk to regional populations of the species are small.

The Pale Field-rat occurs in a wide range of habitats, including tall grasslands and woodlands (Cole & Woinarski, 2002). There are no recent records of the species within the region; however this may reflect a lack of survey effort. Suitable habitat for the species occurs within the project footprint. The proposed area of impact is relatively small compared to available suitable habitat within the region.

As records of species may be limited in remote areas the precautionary principle has been applied. There are some species that have been assessed as possibly occurring even though their primary habitat is not found within the proposed sites or access tracks. These include species that are associated with ephemeral wetlands, low lying areas that may be seasonally inundated and creeks. During the wet and early dry season these areas may sustain threated species such as wetland birds (including migratory species).

Table 11 EPBC and TPWC Listed Threatened Species and Likelihood of Occurrence within the Origin 2021 Exploration Area

Species	Conservation Status		Distribution	Habitat	Likelihood of occurrence
	EPBC	NT			
Birds					
Curlew Sandpiper *Calidris ferruginea*	Marine Migratory	VU	In the NT this species occurs around Darwin, north to Melville Island and Cobourg Peninsula, and east and south-east to Gove. It has been recorded inland from Victoria River Downs and around Alice Springs (Higgins & Davies 1996).	Coastal habitats, inland it has been found around lakes, dams and ephemeral/permanent waterholes.	Unlikely (suitable habitat not present at survey sites but potential sporadic in wider landscape)
Red Goshawk *Erythrotriorchis radiatus*	VU	VU	Found across most of Northern Australia, in the NT most records are from the Top End but there are records from central Australia (Pizzey & Knight, 2012).	Red Goshawks occupy a range of habitats, often at ecotones, including coastal and sub-coastal tall open forest, tropical savannahs crossed by wooded or forested watercourses. In the NT, it inhabits tall open forest/woodland as well as tall riparian woodland (Aumann & Baker-Gabb, 1991).	Unlikely (no records and core habitat absent)
Gouldian Finch *Erythrura gouldiae*	E	VU	Formerly widespread across northern Australia. In the NT they are found in the Top End south past Daly Waters (Palmer *et al*., 2012).	Gouldian Finches occupy different habitat types in the breeding and non-breeding season. Breeding habitat consist of hillsides with suitable nesting trees. Outside of the breeding season they are found in lowland drainages to feed on suitable perennial grasses (Dostine & Franklin, 2002).	Possible (sporadic, foraging only, no recent records)
Crested Shrike-tit (northern) *Falcunculus frontatus whitei*	VU	NT	This species has a very patchy distribution with records from the Victoria River District to Maningrida. Only one record near Borroloola (1930) (Woinarski & Ward, 2012).	Occupies wet and semi-arid melaleuca and eucalypt open woodlands. May be associated with bloodwoods with flaky bark and ironwood (Ward, 2008).	Possible (no records in vicinity although suitable habitat present, very rare)

Species	Conservation Status		Distribution	Habitat	Likelihood of occurrence
	EPBC	NT			
Grey Falcon *Falco hypoleucos*	-	VU	This species has a widespread distribution and records for this species exist throughout the NT. However, most records are from arid and semi-arid regions (Pizzey & Knight, 2012).	Grey Falcons inhabit lightly treed inland plains, gibber desserts, sandridges, pastoral lands, timbered watercourses and, occasionally, the driest deserts. (Pizzey & Knight, 2012). Also found also in association with inland drainage systems.	Possible (unlikely within proposed lease areas but potentially in floodplains across the permit area)
Painted Honeyeater *Grantiella picta*	VU	VU	This species is found throughout eastern Australia, but breeding is known from south-eastern Australia (Pizzey & Knight, 2012). This species is rare.	Painted Honeyeater inhabits woodlands dominated by Acacia and/or Eucalyptus species and open forests but prefers habitats with abundant mature trees that host mistletoes. The species specialises on the fruit of mistletoes although it may also forage on nectar and insects (Garnett *et al.*, 2011).	Possible (suitable habitat occurs within the permit area)
Australian Painted Snipe *Rostratula australis*	CE	VU	In the NT the species probably occurs in shallow ephemeral wetlands in the centre and the south although it also possibly occurs in the northern areas of the NT (Woinarski *et al*, 2007).	These birds prefer a habitat of recently flooded temporary vegetated wetlands during the non-breeding period and brackish temporary freshwater wetlands with minimum vegetation during breeding periods. Birds usually forage in thick, low vegetated areas during the day (Curtis *et al*, 2012).	Unlikely* (one record, no suitable habitat at drill sites but may be present in the wider landscape during the wet season)
Masked Owl (northern) *Tyto novaehollandiae kimberli*	VU	VU	The subspecies occurs in northern Australia, although its distribution is not well known. In the NT, occurs from Cobourg south to Katherine and the VRD and east to the McArthur River (Department of Environment, 2014).	This species inhabits tall open eucalypt forest in the NT, especially those associated with *Eucalyptus miniata* and *E. tetrodonta (*Woinarski, 2007*)*. Also found in riparian and monsoonal forest and rainforest (Department of Environment, 2014).	Unlikely (primary habitat absent)

Species	Conservation Status		Distribution	Habitat	Likelihood of occurrence
	EPBC	NT			
Mammals					
Ghost Bat *Macroderma gigas*	VU	NT	The species' current range in northern Australia ranges from relatively arid conditions in the Pilbara region of Western Australia to humid rainforests of northern Queensland. A large colony occurs in a series of gold mine workings at Pine Creek, NT. This species has also been recorded throughout the mainland Top End north of approximately 17 latitude.	The distribution of this species is influenced by the availability of suitable caves and mines for roost sites (NTG, 2018).	Unlikely (no recent records, no suitable cave located near proposed sites)
Greater Bilby *Macrotis lagotis*	VU	VU	This species occurs in south-western Queensland and in arid north-western Australia (Western Australia and Northern Territory). This species was previously widespread in arid and semi-arid Australia (Pavey, 2009). The most northern records are from Newcastle Waters and Wave Hill (Southgate & Paltridge, 1998).	In the NT, this species is found on sandy soils dominated by spinifex (Pavey, 2009). Low shrubs such as *Acacias* and *Melaleucas* are also common in this habitat. Also hummock grassland associated with low lying drainage systems and alluvial areas.	Unlikely (no recent records, primary habitat limited in permit area)
Bare-rumped Sheath-Tailed Bat *Saccolaimus saccolaimus nudicluniatus*	CE	DD	Wide distribution from India through south-eastern Asia to the Solomon Islands, including north-eastern Queensland and the NT. The north-eastern Australian populations are described as the subspecies *S. s. nudicluniatus*, although it is not clear whether this should be applied to the NT population (Duncan et al. 1999). There have been very few (<5 confirmed) records since 1979 (McKean et al. 1981; Thomson 1991). All confirmed records have been from the Kakadu lowlands.	Previous specimens have been collected from Open *Pandanus* woodland fringing the sedgelands of the South Alligator River in Kakadu National Park (Friend and Braithwaite, 1986). In the NT, it has also been recorded from eucalypt tall open forests (Churchill, 1998)	Unlikely (no records and primary habitat not present)

Species	Conservation Status		Distribution	Habitat	Likelihood of occurrence
	EPBC	NT			
Common Brushtail Possum *Trichosurus vulpecula arnhemensis*	VU	NT	The Gulf of Carpentaria hinterlands near Borroloola, NT, discontinuously through to the Kimberley in Western Australia (DAWE, 2021).	The species occurs mainly in tall eucalypt open forests with large hollow-bearing trees, particularly where the understorey includes some shrubs that bear fleshy fruits (TSSC, 2020).	Possible (recent records of the species occur at nearby Kalala Station and suitable habitat occurs within the project area)
Pale Field-rat *Rattus tunneyi*	_	VU	Inhabiting higher rainfall area including the Top End of the NT (Menkhorst and Knight, 2011).	This species favours dense vegetation found along rivers where it occupies burrows in loose colonies (Cole and Woinarski, 2002). However, this species can be found in a variety of habitats including woodlands if a dense understorey of grasses is present (Menkhorst and Knight, 2011)	Possible (one record from 1999 in greater area, suitable habitat occurs within the project area)
Reptiles					
Gulf Snapping Turtle	-	E	Restricted to rivers draining into the Gulf of Carpentaria, including the Calvert and Nicholson River systems (Woinarski, 2006)	River systems (Woinarski, 2006).	Unlikely No rivers recorded within the project area
Yellow-spotted Monitor *Varanus panoptes*	_	VU	Occurs across a broad geographic range across northern Australia. In the NT most records are from the Top End but occurs as far south as Renner Springs (Ward et al., 2012).	Occupies a variety of habitats including coastal beaches, floodplains, grasslands and woodlands (Ward et al., 2012).	Possible (Records from the Barkly Tablelands)

5.6 Feral Animals

Feral animals known to occur within the region include:

- Pig (*Sus scrofa*)
- Wild Dog (*Canis lupus familiaris*)
- Feral Cat (*Felis catus*)
- Cane Toad (*Bufo marinus*)
- Horse (*Equus caballus*)
- Donkey (*Equus asinus*)
- Water Buffalo (*Bubalus bubalis*)
- Camel (*Camelus dromedarius*)
- Black Rat (*Rattus rattus*)
- Domestic Cattle (*Bos Taurus*)

During the 2019 Velkerri 76 N1 and 2021 Amungee NW and Beetaloo W surveys, evidence of current cattle grazing, or grazing within the last 1 to 2 years was recorded. In previous surveys of the permit area, cat tracks were observed as the only non-native species present o the site. However, records show, many species, especially Wild Dogs/Dingo, Pigs and Cane Toads may occur within the permit area. Cattle disturbance observed across the exploration lease sites showed very little grazing evidence with less than 5%of the area impacted.

The Cane Toad is known to be present in the permit area and the Commonwealth DAWE recognises this species as a 'key threatening process' related to their impacts on biodiversity through predation, competition, land degradation and poisoning. In the NT, the Cane Toad has been implicated in the decline of several species including a large number of reptiles such as the King Brown Snake and water *monitors (Smith & Phillips, 2006).*

Pest predators such as Cats are most likely common, although their abundance is difficult to assess due to their cryptic nature. Introduced predators such as Cats can impact many vertebrates (Dickman, 1996 & 2009). One of the primary concerns of introduced predators are the impacts on EPBC listed species, such as reptiles and ground-dwelling birds. Feral cats are also believed to be one of the factors that have led to the decline of the threatened ground-dwelling bird the Partridge Pigeon (Woinarski et al. 2007).

There is potential for pest species to be attracted to increased site activities resulting in an increase their abundance in the landscape. Therefore, the control of pest species should be taken into consideration when undertaking the proposed site activities. It is of key importance during all phases of the project that care is taken to ensure that rubbish is securely contained (i.e. with suitable lids) and removed from the site as soon as possible to discourage attracting feral animals.

5.7 Conservation Areas

There are no national or world heritage places, Commonwealth land or heritage places or reserves or critical habitat areas listed under the EPBC Act are located within or adjacent to the exploration area.

There is one conservation reserve, the Bullwaddy Conservation Reserve, which lies approximately 13 km west of the Velkerri 76 N1 exploration lease area and approximately 40 km east of the Amungee NW exploration lease area, along the Carpentaria Highway. The Reserve was declared in 2000 and is approximately 115 km² in area. It represents the only declared conservation area within the Sturt Plateau region to protect the Lancewood/Bullwaddy vegetation community. Less than 3% of this vegetation community is reserved nationally (PWCNT, 2005). The most significant values of the reserve are the flora and the associated fauna for which it provides habitat. This includes the Spectacled Hare-Wallaby (*Lagorchestes conspicillatus leichardtii*), the Northern Nailtail Wallaby (*Onychogalea unguifera*) and the Giant Frog (*Cyclorana australis*). It is also a valuable area for research on the ecology of Bullwaddy, particularly the effects of fire (PWCNT, 2005).

Lake Woods is located approximately 70 km south-west of the Beetaloo exploration lease area and is located on Newcastle Waters Station. This wetland is listed as a Site of Conservation Significance by the Department of Land Resource Management and is listed in the Directory of Important Wetlands in Australia (DIWA: NT013 Lake Woods). The site meets criteria 1, 2, 3, 4, 5 and includes DIWA wetland types: B1, B6, B10, B13 and B14. Although Lake Woods is located outside of the exploration area, it is fed principally by surface inflow of Newcastle Creek, itself originating more than 160 km north-east on Amungee Mungee Station. During the period of inundation, Lake Woods supports over 100,000 waterbirds including internationally significant numbers of Plumed Whistling-Duck (*Dendrocygna eytoni*). Numerous bird species nest and feed in the diverse wetland habitat, and the conservation group 'Birdlife International' nominated Lake Woods as an 'Important Bird Area' (IBA). The lake also includes the largest area of lignum swamp in the Northern Territory and in tropical Australia (NRETAS, 2010a).

5.8 Matters of National Environmental Significance

5.8.1 Potential EPBC Act Controlling Provisions

Proposed actions such as the 2021 Origin exploration program may require approval by the Commonwealth Minister for the Environment, under the *EPBC Act*. Approval is only required if the action is likely to result in significant impacts on Matters of National Environmental Significance (MNES) or if the action will have or is likely to have a significant impact on the environment.

Potential triggers under the EPBC Act include a significant impact on:

- The world heritage values of a declared World Heritage Property
- The national heritage values of a listed National Heritage Place
- The ecological character of a declared Ramsar wetland
- A listed Threatened Ecological Community, or its habitat
- The members of a listed threatened species
- The members of a listed migratory species or their habitat
- A water resource, in relation to coal seam gas development and large coal mining development.

5.8.2 Matters of National Environmental Significance

An EPBC Protected Matters Search was generated on the 20 August 2021 (refer to Appendix C) to identify whether MNES or other matters protected by the EPBC Act are likely to occur on or in the near vicinity of the Origin exploration area. The results of the search is provided below in Table 12.

Table 12 Summary of EPBC Aspects for the 2021 Origin Exploration Area

Aspect	Located within the Exploration Area
Matters of National Environmental Significance	
World Heritage Properties	None
National Heritage Places	None
Wetlands of International Significance	None
Great Barrier Marine Park	None
Commonwealth Marine Area	None
Listed Threatened Ecological communities	None
Listed Threatened Species	15
Listed Migratory Species	12
Other Matters Protected by the EPBC Act	
Commonwealth Land	None
Commonwealth Heritage Places	None
Listed Marine Species	18
Whales and other Cetaceans	None
Critical Habitat	None
Commonwealth Reserves Terrestrial	None
Commonwealth Reserves Marine	None
Extra Information (Information that may also be relevant to the Exploration sites)	
State and Territory Reserves	None
Regional Forest Agreement	None
Invasive Species	7 (Velkerri 76 N1 = 10)
Nationally Important Wetlands	None
Key Ecological Features (Marine)	None

Sections 5.2, 5.3 and 5.5 provide details on any listed ecological communities, threatened flora, fauna and migratory species that have potential to occur within the exploration lease pad area. While there are threatened and migratory species that have the potential to occur within the proximity of the exploration area, these are unlikely to be significantly impacted by the exploration activities.

6.0 Land Condition Assessment

Detailed land condition description and photographs of each of the proposed lease areas Velkerri 76 N1 Amungee NW, and Beetaloo W area provided in Table 13 to Table 15.

Table 13 Velkerri 76 N1 Land Condition Description (survey October 2019)

<table>
<tr><th colspan="5">Velkerri 76 N1</th></tr>
<tr><td>Location</td><td>GDA94, Zone 53, 440940E, 8179150N</td><td>Vegetation community</td><td colspan="2">Open mixed woodland</td></tr>
<tr><td>Vegetation description</td><td colspan="4">Acacia sherleyi and Macropteranthes kekwickii with mixed Eucalyptus open woodland.</td></tr>
<tr><td>Basal area (4 sweeps)</td><td colspan="2">146 (Acacia shirleyi, Macropteranthes kekwickii, Corymbia dichromophloia, Eucalyptus pruinosa, Eucalyptus chlorophylla, E.tectifica, Melaleuca sp.)</td><td>Stand basal area (average)</td><td>29.2 m²/ha</td></tr>
<tr><td>Landform
Plain and rises
Habitat
Good - tree hollows and shrubs and flower plants. Abundant woody debris and leaf litter,</td><td colspan="4">   </td></tr>
<tr><td>Slope
<1%
Disturbance
Recent fire damage
No erosion
Cattle tracks</td><td colspan="4">   </td></tr>
<tr><td rowspan="3">Vegetation Structure</td><td>Upper storey: 7 - 8 m</td><td colspan="3">Acacia shirleyi and Macropteranthes kekwickii with Corymbia dichromophloia and Eucalyptus pruinosa</td></tr>
<tr><td>Mid-storey: 7 - 1 m</td><td colspan="3">Melaleuca viridiflora and Erythrophleum chlorostachys</td></tr>
<tr><td>Understorey: 1 - 0 m</td><td colspan="3">Dichanthium fecundum, Themeda avenacea, Eriachne armitii tussock grasses and Triodia bitextura hummock grass, Grewia retusifolia and Carissa lanceolata shrubs</td></tr>
<tr><td>Soil texture</td><td>Sandy loam with sub-rounded fragments present</td><td rowspan="6">  </td><td rowspan="6">  </td></tr>
<tr><td>Soil drainage</td><td>Moderately well drained</td></tr>
<tr><td>Soil colour</td><td>10YR 3/3</td></tr>
<tr><td>Soil pH</td><td>6-6.5</td></tr>
<tr><td>Termite mounds</td><td>Sparse</td></tr>
<tr><td>Ground cover</td><td>10% Vegetation, 20% Litter, 70% Bare Soil</td></tr>
</table>

Table 14 Amungee NW Land Condition Description (survey August - September 2021)

<table>
<tr><th colspan="6">Amungee NW</th></tr>
<tr><td>Location</td><td colspan="2">GDA94, zone 53, 381039E, 8192324N</td><td>Vegetation community</td><td colspan="2">Corymbia open woodland</td></tr>
<tr><td>Vegetation description</td><td colspan="5">Low Corymbia ferruginea open woodland, over Petalostigma pubescens and Hakea arborescens sparse shrubland, over Sorghum timorense and Chrysopogon fallax tussock grassland</td></tr>
<tr><td>Vegetation transect</td><td colspan="5">No canopy 80%, Corymbia ferruginea 8.75%, Corymbia dichromophloia 5%, Terminalia canescens 3.5%, Dead 2%, Acacia shirleyi (Lancewood) 0.75%</td></tr>
<tr><td>Basal area (5 sweeps)</td><td colspan="3">17 (Acacia shirleyi 6, Corymbia dichromophloia 3, C. ferruginea 2.5, C. polycarpa 2, Dead tree 2, Erythrophleum chlorostachys 1, Terminalia canescens 0.5)</td><td>Stand basal area (average)</td><td>17m²/ha</td></tr>
<tr><td>Landform
Plain
Habitat
Tree hollows, mistletoe and flowering plants absent. Scattered fallen logs and shallow litter</td><td colspan="5">   </td></tr>
<tr><td>Slope
<1%
Disturbance
Fire - Moderate
No erosion</td><td colspan="5">   </td></tr>
<tr><td rowspan="3">Vegetation Structure</td><td colspan="2">Upper storey: 7 - 8 m</td><td colspan="3">Corymbia ferruginea (8%)</td></tr>
<tr><td colspan="2">Mid-storey: 7 - 1 m</td><td colspan="3">Petalostigma pubescens (2%), Hakea arborescens (2%), Terminalia canescens (1%)</td></tr>
<tr><td colspan="2">Understorey: 1 - 0 m</td><td colspan="3">Sorghum timorense (40%), Chrysopogon fallax (5%), Themeda avenacea (5%)</td></tr>
<tr><td>Soil texture</td><td colspan="2">Sandy loam</td><td rowspan="6">  </td><td rowspan="6">  </td></tr>
<tr><td>Soil drainage</td><td colspan="2">Moderately well drained</td></tr>
<tr><td>Soil colour</td><td colspan="2">10R 2.5/1</td></tr>
<tr><td>Soil pH</td><td colspan="2">7</td></tr>
<tr><td>Termite mounds</td><td colspan="2">Common</td></tr>
<tr><td>Ground cover</td><td colspan="2">50% Vegetation, 30% Litter, 20% Bare Soil</td></tr>
</table>

Table 15 Beetaloo W Land Condition Description (survey August - September 2021)

<table>
<tr><th colspan="5">Beetaloo W</th></tr>
<tr><td>Location</td><td>GDA94, zone 53, 368023E, 8107032N</td><td>Vegetation community</td><td colspan="2">Low mixed open woodland</td></tr>
<tr><td>Vegetation description</td><td colspan="4">Low mixed spp. open woodland, over Macropteranthes kekwickii, Terminalia canescens open shrubland, over Sorghum plumosum open tussock grassland</td></tr>
<tr><td>Vegetation transect</td><td colspan="4">No Canopy 68.25%, Corymbia dichromophloia 7%, Hakea arborescens 5.5%, Dead 5.5%, Terminalia. volucris 3.25%, Terminalia. canescens 3%, Acacia lysiphloia 2.75%, Macropteranthes kekwickii (Bullwaddy) 2.25%, Acacia difficilis 1.25%, Bauhinia cunninghamii 0.75%, Erythrophleum chlorostachys 0.5%</td></tr>
<tr><td>Basal area (5 sweeps)</td><td colspan="2">19 (Dead trees 4.5, Corymbia dichromophloia 4, Ventilago viminalis 3.5, Terminalia canescens 3, Bauhinia cunninghamii 1, Erythrophleum chlorostachys 1)</td><td>Stand basal area (average)</td><td>19m²/ha</td></tr>
<tr><td>Landform
Plain
Habitat
Tree hollows and flowering plants absent. Mistletoe scattered. Fallen logs abundant and litter shallow</td><td colspan="4">   </td></tr>
<tr><td>Slope
<1%
Disturbance
Fire moderate
No erosion</td><td colspan="4">   </td></tr>
<tr><td rowspan="3">Vegetation Structure</td><td>Upper storey: 6 - 8 m</td><td colspan="3">Ventilago viminalis (3%), Gyrocarpus americanus (2%), Atalaya hemiglauca (1%)</td></tr>
<tr><td>Mid-storey: 1 - 6 m</td><td colspan="3">Macropteranthes kekwickii (10%), Terminalia canescens (6%), Hakea arborescens (2%)</td></tr>
<tr><td>Understorey: 0 - 1 m</td><td colspan="3">Sorghum plumosum (20%), Aristida sp. (4%)</td></tr>
<tr><td>Soil texture</td><td colspan="2">Sandy loam</td><td rowspan="6">  </td><td rowspan="6">  </td></tr>
<tr><td>Soil drainage</td><td colspan="2">Moderately well drained</td></tr>
<tr><td>Soil colour</td><td colspan="2">5YR ¾ Dark Reddish Brown</td></tr>
<tr><td>Soil pH</td><td colspan="2">7</td></tr>
<tr><td>Termite mounds</td><td colspan="2">Sparse</td></tr>
<tr><td>Ground cover</td><td colspan="2">30% Vegetation, 10% Litter, 55% Bare Soil, 5% Gravel</td></tr>
</table>

7.0 Conclusions and Recommendations

AECOM undertook land condition assessments at three proposed lease areas and access tracks in October 2019 (Velkerri 76 N1) and in August/September 2021 (Amungee NW and Beetaloo W). The aim of the investigations was to provide a baseline assessment of ecological conditions to support Origin's application to the NTG DEPWS to continue exploration activities.

The LCA described the ecological conditions at the site prior to Origin's commencement of exploration within Permit Area EP76 (Velkerri 76 N1) and expansion of exploration lease pads in Permit Areas EP98 (Amungee NW) and EP117 (Beetaloo W). The information obtained during the initial LCA will assist in determining whether at the end of the exploration activities the lease areas have been rehabilitated back to a similar condition.

The proposed exploration program will have a total disturbance area of approximately 36.2 ha and will use 10 km of existing access tracks and proposes to clear an additional 2 km of tracks.

Potential environmental risks and impacts to the environment have been identified based on environmental conditions observed during the field survey. This has facilitated the development of mitigation measures to minimise Origin's impact to the environment.

During the surveys, all proposed exploration lease areas, as well as the areas surrounding the proposed access tracks, were assessed to be in generally good condition with minor evidence of weeds, erosion and disturbance from cattle.

A desktop assessment of threatened species listed under the EPBC and TPWC Acts that potentially occur within the project area has determined that seven species may occur:

- Gouldian Finch *Erythrura gouldiae*
- Grey Falcon *Falco hypoleucos*
- Crested Shrike-tit (northern) *Falcunculus frontatus whitei*
- Painted Honeyeater *Grantiella picta*
- Pale Field-rat *Rattus tunneyi*
- Common Brushtail Possum (northern) *Trichosurus vulpecula arnhemensis*
- Yellow-spotted Monitor *Varanus panoptes*

Due to a scarcity of records and lack of core habitat, it is unlikely that significant populations of these species occur within the Velkerri 76 N1, Amungee NW and Beetaloo W exploration lease areas. It is therefore unlikely that threatened ecological communities or threatened species will be significantly impacted from Origin's proposed exploration activities.

The mitigation measures presented in the water bore drilling EMP will assist in minimising Origin's impact to the environment.

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Appendix A

Flora Atlas Species Records

Appendix A Flora Atlas Species Records

Family	Scientific Name	Common Name	TPWCA	EPBCA
ACANTHACEAE	*Brunoniella australis*	Brunoniella	LC	-
ACANTHACEAE	*Dicliptera armata*	Dicliptera	LC	-
ACANTHACEAE	*Hygrophila angustifolia*	Hygrophila	LC	-
ACANTHACEAE	*Hypoestes floribunda*	Hypoestes	LC	-
ACANTHACEAE	*Hypoestes floribunda var. cinerea*	Hypoestes	LC	-
ACANTHACEAE	*Rostellularia adscendens var. clementii*	Rostellularia, Pinktongues	NE	-
AMARANTHACEAE	*Achyranthes aspera*	Chaff-flower, Chaff Flower	LC	-
AMARANTHACEAE	*Alternanthera denticulata*	Lesser Joyweed	LC	-
AMARANTHACEAE	*Alternanthera nana*	Hairy Joyweed	LC	-
AMARANTHACEAE	*Alternanthera nodiflora*	Common Joyweed	LC	-
AMARANTHACEAE	*Gomphrena flaccida*	Gomphrena, Bunched Gomphrena	LC	-
AMARANTHACEAE	*Ptilotus exaltatus*	Tall Mulla Mulla	INFRA	-
AMARANTHACEAE	*Ptilotus fusiformis*	Pom-pom Bottlebrush	LC	-
AMARANTHACEAE	*Ptilotus polystachyus*	Ptilotus, Long Pussy-tails	LC	-
AMARANTHACEAE	*Ptilotus spicatus*	Ptilotus	LC	-
APOCYNACEAE	*Carissa lanceolata*	Conkerberry, Conkle Berry	LC	-
APOCYNACEAE	*Cynanchum viminale*	Caustic Vine, Milk Vine	LC	-
APOCYNACEAE	*Cynanchum viminale subsp. australe*	Caustic Vine Milk Vine	LC	-
APOCYNACEAE	*Marsdenia australis*	Marsdenia, Bush Banana	LC	-
APOCYNACEAE	*Marsdenia geminata*	Marsdenia	LC	-
APOCYNACEAE	*Marsdenia viridiflora*	Marsdenia, Bush Banana, Native Potato, Green Berry Creeper	LC	-
APOCYNACEAE	*Marsdenia viridiflora subsp. tropica*	Bush Banana	LC	-
APOCYNACEAE	*Secamone elliptica*	Secamone	LC	-
APOCYNACEAE	*Tylophora cinerascens*	Tylophora	LC	-
ASTERACEAE	*Bidens bipinnata*	Cobblers Pegs, Beggars Ticks	LC	-
ASTERACEAE	*Blumea integrifolia*	Blumea	LC	-
ASTERACEAE	*Blumea saxatilis*	Blumea	LC	-
ASTERACEAE	*Eclipta platyglossa subsp. borealis*	Eclipta	LC	-
ASTERACEAE	*Pterocaulon serrulatum*	Pterocaulon, Fruit-salad Bush	LC	-
ASTERACEAE	*Pterocaulon serrulatum var. velutinum*	Fruit-salad Bush, Apple Bush	LC	-
ASTERACEAE	*Pterocaulon sphacelatum*	Apple Bush, Fruit Salad Plant	LC	-
BIGNONIACEAE	*Dolichandrone heterophylla*	Lemon Wood	LC	-

Family	Scientific Name	Common Name	TPWCA	EPBCA
BIXACEAE	*Cochlospermum gregorii*	Kapok Bush, Cotton Tree	LC	-
BORAGINACEAE	*Coldenia procumbens*	Coldenia	LC	-
BORAGINACEAE	*Ehretia saligna*	Peachwood	LC	-
BORAGINACEAE	*Ehretia saligna var. membranifolia*	Ehretia	LC	-
BORAGINACEAE	*Heliotropium ramulipatens*	Heliotropium	LC	-
CAMPANULACEAE	*Lobelia dioica*	Lobelia	LC	-
CAPPARACEAE	*Capparis lasiantha*	Capparis, Split Jack	LC	-
CAPPARACEAE	*Capparis umbonata*	Northern Wild Orange	LC	-
CARYOPHYLLACEAE	*Polycarpaea breviflora*	Polycarpaea	LC	-
CELASTRACEAE	*Denhamia cunninghamii*	Narrow-leaf Maytenus,	LC	-
CELASTRACEAE	*Denhamia obscura*	Denhamia	LC	-
CLEOMACEAE	*Cleome viscosa*	Cleome, Tickweed, Mustard Bush	LC	-
COMBRETACEAE	*Macropteranthes kekwickii*	Macropteranthes, Bullwaddy	LC	-
COMBRETACEAE	*Terminalia canescens*	Terminalia, Bendee, Winged Nut Tree	LC	-
COMBRETACEAE	*Terminalia volucris*	Terminalia, Rosewood, Yellow Wood	LC	-
COMMELINACEAE	*Commelina ciliata*	Commelina, Scurvy Weed	LC	-
COMMELINACEAE	*Cyanotis axillaris*	Cyanotis	LC	-
COMMELINACEAE	*Murdannia graminea*	Blue Murdannia, Pink Swamp Lily	LC	-
COMMELINACEAE	*Murdannia vaginata*	Murdannia	LC	-
CONVOLVULACEAE	*Bonamia pannosa*	Bonamia, Large Bonamia	LC	-
CONVOLVULACEAE	*Evolvulus alsinoides*	Evolvulus, Blue Periwinkle, Tropical Speedwell	INFRA	-
CONVOLVULACEAE	*Ipomoea argillicola*	Ipomoea	NT	-
CONVOLVULACEAE	*Ipomoea diamantinensis*	Desert Cowvine, Desert Cow Vine	LC	-
CONVOLVULACEAE	*Ipomoea eriocarpa*	Ipomoea	LC	-
CONVOLVULACEAE	*Ipomoea gracilis*	Ipomoea	LC	-
CONVOLVULACEAE	*Ipomoea nil*	Ipomoea	LC	-
CONVOLVULACEAE	*Ipomoea plebeia*	Ipomoea, Bellvine	LC	-
CONVOLVULACEAE	*Ipomoea polymorpha*	Ipomoea, Silky Cowvine	LC	-
CONVOLVULACEAE	*Merremia incisa*	Merremia	LC	-
CONVOLVULACEAE	*Polymeria longifolia*	Erect Bindweed, Peak Downs Curse	LC	-
CONVOLVULACEAE	*Xenostegia tridentata*	Xenostegia	LC	-
CUCURBITACEAE	*Cucumis melo*	Bush Cucumber, Native Cucumber	INFRA	-
CYPERACEAE	*Bulbostylis barbata*	Short-leaved Rush, Dainty Sedge	LC	-
CYPERACEAE	*Cyperus carinatus*	Cyperus, Nutgrass	LC	-
CYPERACEAE	*Cyperus cristulatus*	Cyperus, Nutgrass	LC	-
CYPERACEAE	*Cyperus dactylotes*	Cyperus, Nutgrass	LC	-

Family	Scientific Name	Common Name	TPWCA	EPBCA
CYPERACEAE	*Cyperus holoschoenus*	Umbrella Rush, Nutgrass	LC	-
CYPERACEAE	*Cyperus iria*	Cyperus, Variable Sedge, Nutgrass	LC	-
CYPERACEAE	*Cyperus macrostachyos*	Cyperus, Nutgrass	LC	-
CYPERACEAE	*Cyperus pulchellus*	Cyperus, White Button Sedge, Nutgrass	LC	-
CYPERACEAE	*Cyperus tenuispica*	Cyperus, Pink-root Sedge, Nutgrass	LC	-
CYPERACEAE	*Eleocharis atropurpurea*	Eleocharis	LC	-
CYPERACEAE	*Eleocharis brassii*	Eleocharis	LC	-
CYPERACEAE	*Fimbristylis bisumbellata*	Fimbristylis, Fringe-rush	DD	-
CYPERACEAE	*Fimbristylis costiglumis*	Fimbristylis, Fringe-rush	LC	-
CYPERACEAE	*Fimbristylis depauperata*	Fimbristylis, Fringe-rush	LC	-
CYPERACEAE	*Fimbristylis laxiglumis*	Fimbristylis, Fringe-rush	LC	-
CYPERACEAE	*Fimbristylis littoralis*	Fimbristylis, Fringe-rush	LC	-
CYPERACEAE	*Fimbristylis microcarya*	Fimbristylis, Fringe-rush	LC	-
CYPERACEAE	*Fimbristylis oxystachya*	Fimbristylis, Iukarrara	LC	-
CYPERACEAE	*Fimbristylis phaeoleuca*	Fimbristylis, Water Grass	LC	-
CYPERACEAE	*Rhynchospora exserta*	Rhynchospora	LC	-
CYPERACEAE	*Rhynchospora longisetis*	Rhynchospora	LC	-
CYPERACEAE	*Rhynchospora subtenuifolia*	Rhynchospora	LC	-
CYPERACEAE	*Rhynchospora wightiana*	Rhynchospora	LC	-
CYPERACEAE	*Schoenoplectiella dissachantha*	Schoenoplectus	LC	-
CYPERACEAE	*Schoenoplectiella laevis*	Schoenoplectus	LC	-
CYPERACEAE	*Scleria rugosa*	Scleria	LC	-
EBENACEAE	*Diospyros humilis*	Diospyros, Ebony	LC	-
EBENACEAE	*Diospyros rugosula*	Diospyros	LC	-
ELATINACEAE	*Bergia pedicellaris*	Bergia	LC	-
ERIOCAULACEAE	*Eriocaulon cinereum*	Eriocaulon	LC	-
EUPHORBIACEAE	*Euphorbia australis var. subtomentosa*		NE	-
EUPHORBIACEAE	*Euphorbia biconvexa*	Euphorbia	LC	-
EUPHORBIACEAE	*Euphorbia bifida*		LC	-
EUPHORBIACEAE	*Euphorbia crassimarginata*		NE	-
EUPHORBIACEAE	*Euphorbia schultzii var. schultzii*		NE	-
EUPHORBIACEAE	*Euphorbia thelephora var. thelephora*		NE	-
EUPHORBIACEAE	*Excoecaria parvifolia*	Guttapercha, Gutta Percha	LC	-
FABACEAE	*Abrus precatorius*	Abrus, Crab's Eye Vine, Crab's Eyes	LC	-

Family	Scientific Name	Common Name	TPWCA	EPBCA
FABACEAE	*Abrus precatorius subsp. precatorius*	Abrus, Crabs Eye Vine, Crab's Eyes	LC	-
FABACEAE	*Acacia ancistrocarpa*	Fitzroy Wattle	LC	-
FABACEAE	*Acacia calligera*		LC	-
FABACEAE	*Acacia difficilis*	River Wattle	LC	-
FABACEAE	*Acacia hammondii*	Hammond's Wattle	LC	-
FABACEAE	*Acacia lysiphloia*	Turpentine Wattle	LC	-
FABACEAE	*Acacia monticola*	Hill Turpentine	LC	-
FABACEAE	*Acacia shirleyi*	Acacia, Lancewood, Wattle	LC	-
FABACEAE	*Acacia stenophylla*	Acacia, River Cooba, Native Willow	LC	-
FABACEAE	*Aeschynomene indica*	Budda Pea, Kath Sola	LC	-
FABACEAE	*Bauhinia cunninghamii*	Bauhinia, Bean Tree, Lysiphyllum	LC	-
FABACEAE	*Chamaecrista absus*	Chamaecrista, Hairy Cassia	LC	-
FABACEAE	*Chamaecrista absus var. absus*	Chamaecrista, Hairy Cassia	LC	-
FABACEAE	*Crotalaria medicaginea*	Clover-leaf Rattlepod	LC	-
FABACEAE	*Crotalaria montana*	Crotalaria, Rattlepod	INFRA	-
FABACEAE	*Crotalaria montana var. angustifolia*	Crotalaria, Rattlepod	LC	-
FABACEAE	*Desmodium muelleri*	Desmodium, Mueller's Necklace Pea	LC	-
FABACEAE	*Dichrostachys spicata*	Chinese Lantern, Prickly Bush	LC	-
FABACEAE	*Erythrophleum chlorostachys*	Ironwood	LC	-
FABACEAE	*Flemingia parviflora*	Flemingia	LC	-
FABACEAE	*Galactia tenuiflora*	Poison Pea	LC	-
FABACEAE	*Indigofera linnaei*	Birdsville Indigo	LC	-
FABACEAE	*Neptunia gracilis*	Native Sensitive Plant	INFRA	-
FABACEAE	*Neptunia monosperma*	Sensitive Plant	LC	-
FABACEAE	*Petalostylis cassioides*	Butterfly Bush	LC	-
FABACEAE	*Rhynchosia minima*	Native Pea	LC	-
FABACEAE	*Sesbania cannabina var. cannabina*	Yellow Pea-bush, Sesbania Pea	LC	-
FABACEAE	*Sesbania muelleri*	Sesbania, Tall Sesbania Pea	LC	-
FABACEAE	*Tephrosia brachyodon*	Tephrosia, Red Pea-bush	INFRA	-
FABACEAE	*Tephrosia leptoclada*	Tephrosia, Slender Tephrosia	LC	-
FABACEAE	*Tephrosia remotiflora*	Tephrosia	LC	-
FABACEAE	*Vigna lanceolata*	Vigna, Pencil Yam, Maloga Bean	LC	-
FABACEAE	*Vigna lanceolata var. latifolia*	Vigna, Pencil Yam, Maloga Bean, Parsnip Bean	LC	-

Family	Scientific Name	Common Name	TPWCA	EPBCA
FABACEAE	*Vigna sp. McDonald Downs Station*			-
FABACEAE	*Zornia muriculata*	Zornia, Upright Zornia	LC	-
GOODENIACEAE	*Goodenia byrnesii*	Goodenia, Byrne's Goodenia	LC	-
GOODENIACEAE	*Goodenia gracilis*	Goodenia	LC	-
GOODENIACEAE	*Goodenia leiosperma*	Goodenia	LC	-
GOODENIACEAE	*Goodenia minutiflora*	Goodenia	DD	-
GOODENIACEAE	*Goodenia strangfordii*	Goodenia, Wide-leaved Goodenia	LC	-
GOODENIACEAE	*Goodenia viscidula*	Goodenia	LC	-
GOODENIACEAE	*Scaevola browniana subsp. browniana*	Scaevola	LC	-
GOODENIACEAE	*Scaevola ovalifolia*	Scaevola, Bushy Fanflower	LC	-
HAEMODORACEAE	*Haemodorum coccineum*	Bloodroot	LC	-
HYDROLEACEAE	*Hydrolea zeylanica*	Hydrolea	LC	-
LAMIACEAE	*Clerodendrum floribundum*	Smooth Spiderbush, Lollybrush	LC	-
LAMIACEAE	*Premna acuminata*	Premna	LC	-
LORANTHACEAE	*Amyema maidenii subsp. maidenii*	Amyema, Pale-leaf Mistletoe, Mistletoe	LC	-
LORANTHACEAE	*Amyema sanguinea*	Amyema, Blood Mistletoe, Mistletoe	LC	-
LYTHRACEAE	*Ammannia muelleri*	Nesaea	LC	-
LYTHRACEAE	*Ammannia multiflora*	Ammannia, Jerry Jerry	LC	-
LYTHRACEAE	*Rotala diandra*	Rotala	LC	-
MALVACEAE	*Abutilon fraseri*	Abutilon, Dwarf Lantern-bush	LC	-
MALVACEAE	*Abutilon fraseri subsp. fraseri*	Abutilon, Dwarf Lantern-bush	LC	-
MALVACEAE	*Abutilon hannii*	Abutilon, Lantern-flower	LC	-
MALVACEAE	*Abutilon hannii subsp. prostrate*	Abutilon, Lantern-flower	LC	-
MALVACEAE	*Brachychiton paradoxus*	Red-flowered Kurrajong	LC	-
MALVACEAE	*Corchorus aestuans*	Corchorus	LC	-
MALVACEAE	*Corchorus sidoides*	Corchorus, Flannel Weed	LC	-
MALVACEAE	*Corchorus sidoides subsp. sidoides*	Corchorus, Flannel Weed	LC	-
MALVACEAE	*Grewia breviflora*	Grewia	LC	-
MALVACEAE	*Grewia retusifolia*	Dog's Balls	LC	-
MALVACEAE	*Herissantia crispa*	Herissantia	LC	-
MALVACEAE	*Hibiscus meraukensis*	Glabrous Hibiscus	LC	-
MALVACEAE	*Hibiscus pentaphyllus*	Hibiscus, Five-leaflet Hibiscus	LC	-
MALVACEAE	*Hibiscus sturtii*	Sturts Hibiscus	INFRA	-

Family	Scientific Name	Common Name	TPWCA	EPBCA
MALVACEAE	*Hibiscus sturtii var. campylochlamys*	Hibiscus, Sturts Hibiscus, Sturt's Hibiscus, Hill Hibiscus	LC	-
MALVACEAE	*Melhania oblongifolia*	Melhania, Velvet Hibiscus	LC	-
MALVACEAE	*Sida brachypoda*	Sida	LC	-
MALVACEAE	*Sida rohlenae*	Sida, Shrub Sida	INFRA	-
MALVACEAE	*Sida rohlenae subsp. rohlenae*	Sida, Shrub Sida	LC	-
MALVACEAE	*Sida spinosa*	Sida, Spiny Sida, Paddy's Lucerne	LC	-
MALVACEAE	*Triumfetta micracantha*	Triumfetta	LC	-
MALVACEAE	*Waltheria indica*	Waltheria	LC	-
MARSILEACEAE	*Marsilea angustifolia*	Marsilea, Nardoo	LC	-
MENISPERMACEAE	*Tinospora smilacina*	Tinospora, Snake Vine	LC	-
MENYANTHACEAE	*Nymphoides crenata*	Nymphoides, Wavy Marshwort	LC	-
MENYANTHACEAE	*Nymphoides indica*	Fringed Waterlily, Water Snowflake	LC	-
MYRTACEAE	*Corymbia dichromophloia*	Small-fruited Bloodwood	LC	-
MYRTACEAE	*Corymbia ferruginea*	Rusty Bloodwood	LC	-
MYRTACEAE	*Corymbia flavescens*	Scraggy Cabbage Gum	LC	-
MYRTACEAE	*Corymbia grandifolia subsp. grandifolia*	Large-leaf Cabbage Gum	LC	-
MYRTACEAE	*Corymbia polycarpa*	Long-fruited Bloodwood	LC	-
MYRTACEAE	*Corymbia setosa subsp. setosa*	Rough-leaved Bloodwood	LC	-
MYRTACEAE	*Eucalyptus chlorophylla*	Northern Glossy-leaved Box	LC	-
MYRTACEAE	*Eucalyptus cyanoclada*	Eucalyptus	LC	-
MYRTACEAE	*Eucalyptus microtheca*	Eucalyptus, Coolabah, Flooded Box	LC	-
MYRTACEAE	*Eucalyptus pruinosa*	Silver-leaf Box	LC	-
MYRTACEAE	*Eucalyptus pruinosa subsp. pruinosa*	Silver-leaf Box	LC	-
MYRTACEAE	*Eucalyptus pruinosa subsp. tenuata*	Silver Box, Silver-leaf Box	LC	-
MYRTACEAE	*Eucalyptus tectifica*	Darwin Box	LC	-
MYRTACEAE	*Lophostemon grandiflorus*	Northern Swamp Mahogany	LC	-
MYRTACEAE	*Melaleuca acacioides*	Coastal Paperbark, Black Tea-tree	LC	-
MYRTACEAE	*Melaleuca citrolens*	Lemon-scented Paperbark	LC	-
MYRTACEAE	*Melaleuca viridiflora*	Large-leaved Paperbark	LC	-
NYCTAGINACEAE	*Boerhavia coccinea*	Boerhavia, Tar Vine	LC	-
NYCTAGINACEAE	*Boerhavia dominii*	Boerhavia, Tar Vine	LC	-
OLEACEAE	*Jasminum molle*	Jasminum	LC	-
ONAGRACEAE	*Ludwigia perennis*	Ludwigia, Upright Primrose	LC	-
OPILIACEAE	*Opilia amentacea*	Opilia	LC	-

Family	Scientific Name	Common Name	TPWCA	EPBCA
OROBANCHACEAE	*Striga curviflora*	Striga	LC	-
PHRYMACEAE	*Mimulus gracilis*	Mimulus, Slender Monkey-flower	LC	-
PHRYMACEAE	*Peplidium muelleri*	Peplidium	LC	-
PHRYMACEAE	*Uvedalia linearis var. linearis*	Mimulus	LC	-
PHYLLANTHACEAE	*Breynia cernua*	Breynia	LC	-
PHYLLANTHACEAE	*Flueggea virosa*	White Currant	LC	-
PHYLLANTHACEAE	*Flueggea virosa subsp. melanthesoides*	White Currant	LC	-
PHYLLANTHACEAE	*Margaritaria dubium-traceyi*	Margaritaria	LC	-
PHYLLANTHACEAE	*Phyllanthus exilis*	Phyllanthus	LC	-
PHYLLANTHACEAE	*Phyllanthus hebecarpus*	Phyllanthus	LC	-
PHYLLANTHACEAE	*Phyllanthus maderaspatensis*	Phyllanthus, Spurge	LC	-
PHYLLANTHACEAE	*Phyllanthus minutiflorus*	Phyllanthus	LC	-
PHYLLANTHACEAE	*Synostemon rhytidospermus*		NE	-
PHYLLANTHACEAE	*Synostemon trachyspermus*		NE	-
PICRODENDRACEAE	*Petalostigma banksii*	Smooth-leaved Quinine	LC	-
PICRODENDRACEAE	*Petalostigma pubescens*	Quinine Bush	LC	-
PLANTAGINACEAE	*Bacopa floribunda*	Bacopa	LC	-
PLANTAGINACEAE	*Stemodia lathraia*	Stemodia	LC	-
POACEAE	*Acrachne racemosa*	Acrachne	DD	-
POACEAE	*Aristida calycina var. calycina*	Wiregrass	LC	-
POACEAE	*Aristida holathera var. holathera*	Erect Kerosene Grass,	LC	-
POACEAE	*Aristida inaequiglumis*	Unequal Three-awn	LC	-
POACEAE	*Aristida latifolia*	Feathertop Wiregrass	LC	-
POACEAE	*Aristida pruinosa*	Gulf Wiregrass	LC	-
POACEAE	*Aristida queenslandica*	Aristida, Three-awn, Wiregrass	LC	-
POACEAE	*Brachyachne convergens*	Annual Couch	LC	-
POACEAE	*Chloris lobata*	Chloris, Lobed Chloris	LC	-
POACEAE	*Chrysopogon fallax*	Golden Beard Grass	LC	-
POACEAE	*Cymbopogon bombycinus*	Lemon Grass,	LC	-
POACEAE	*Dactyloctenium radulans*	Toothbrush Grass	LC	-
POACEAE	*Dichanthium fecundum*	Gulf Bluegrass	LC	-
POACEAE	*Dichanthium sericeum*	Queensland Bluegrass	LC	-
POACEAE	*Dichanthium sericeum subsp. polystachyum*	Dichanthium, Tassel Bluegrass	LC	-
POACEAE	*Digitaria brownii*	Digitaria, Cotton Panic Grass	LC	-

Family	Scientific Name	Common Name	TPWCA	EPBCA
POACEAE	*Digitaria gibbosa*	Digitaria	LC	-
POACEAE	*Ectrosia agrostoides*	Ectrosia	LC	-
POACEAE	*Ectrosia leporina*	Hare's Foot Grass	LC	-
POACEAE	*Ectrosia scabrida*	Hares-foot Grass	LC	-
POACEAE	*Elytrophorus spicatus*	Spikegrass, Spike Grass	LC	-
POACEAE	*Enneapogon decipiens*	Enneapogon	LC	-
POACEAE	*Enneapogon lindleyanus*	Enneapogon	LC	-
POACEAE	*Enneapogon oblongus*	Rock Nine-awn,	LC	-
POACEAE	*Enneapogon pallidus*	Conetop Nine-awn	LC	-
POACEAE	*Enneapogon polyphyllus*	Limestone Grass	LC	-
POACEAE	*Enneapogon purpurascens*	Purple Nine-awn	LC	-
POACEAE	*Eragrostis cumingii*	Lovegrass	LC	-
POACEAE	*Eragrostis tenellula*	Delicate Lovegrass	LC	-
POACEAE	*Eriachne armittii*	Annual Wanderrie Grass	LC	-
POACEAE	*Eriachne obtusa*	Northern Wanderrie Grass,	LC	-
POACEAE	*Eulalia aurea*	Eulalia, Silky Browntop, Sugar Grass	LC	-
POACEAE	*Heterachne gulliveri*	Heterachne	LC	-
POACEAE	*Heteropogon contortus*	Speargrass, Black Speargrass	LC	-
POACEAE	*Imperata cylindrica*	Imperata, Blady Grass	LC	-
POACEAE	*Iseilema macratherum*	Bull Flinders Grass	LC	-
POACEAE	*Iseilema membranaceum*	Small Flinders Grass	LC	-
POACEAE	*Iseilema vaginiflorum*	Red Flinders Grass,	LC	-
POACEAE	*Mnesithea formosa*	Itchgrass, Silky-top Grass	LC	-
POACEAE	*Oryza australiensis*	Australian Wild Rice	LC	-
POACEAE	*Oryza rufipogon*	Oryza, Red Rice, Rice	LC	-
POACEAE	*Panicum decompositum*	Panicum, Native Millet, Native Panic	LC	-
POACEAE	*Panicum effusum*	Panicum, Hairy Panic	LC	-
POACEAE	*Panicum latzii*	Panicum	DD	-
POACEAE	*Panicum mindanaense*	Panicum	LC	-
POACEAE	*Paspalidium gracile*	Paspalidium	DD	-
POACEAE	*Paspalidium rarum*	Paspalidium, Rare Paspalidium, Bunch Paspalidium	LC	-
POACEAE	*Perotis rara*	Perotis, Comet Grass	LC	-
POACEAE	*Pseudopogonatherum contortum*	Pseudopogonatherum	LC	-
POACEAE	*Schizachyrium fragile*	Firegrass,	LC	-
POACEAE	*Sehima nervosum*	Rats Tail Grass, White Grass	LC	-
POACEAE	*Setaria surgens*	Annual Pigeon Grass	LC	-

Family	Scientific Name	Common Name	TPWCA	EPBCA
POACEAE	*Sorghum plumosum*	Perennial Sorghum	LC	-
POACEAE	*Sorghum plumosum var. plumosum*	Plume Sorghum, Perennial Sorghum	LC	-
POACEAE	*Sorghum timorense*	Annual Sorghum, Annual Canegrass	LC	-
POACEAE	*Sporobolus australasicus*	Australian Dropseed, Fairy Grass	LC	-
POACEAE	*Themeda arguens*	Themeda, Annual Kangaroo Grass	LC	-
POACEAE	*Themeda avenacea*	Swamp Kangaroo Grass	LC	-
POACEAE	*Triodia bitextura*	Triodia, Soft Spinifex, Spinifex	LC	-
POACEAE	*Tripogon loliiformis*	Five-minute Grass	LC	-
POACEAE	*Urochloa holosericea*	Urochloa, Silky-top Armgrass	LC	-
POACEAE	*Urochloa holosericea subsp. velutina*	Urochloa, Silky-top Armgrass	LC	-
POACEAE	*Whiteochloa capillipes*	Whiteochloa	LC	-
POACEAE	*Yakirra pauciflora*	Yakirra	LC	-
POLYGALACEAE	*Polygala barbata*	Polygala	LC	-
POLYGALACEAE	*Polygala longifolia*	Polygala	LC	-
POLYGALACEAE	*Polygala orbicularis*	Polygala	LC	-
POLYGALACEAE	*Polygala pterocarpa*	Polygala	LC	-
PONTEDERIACEAE	*Monochoria cyanea*	Monochoria	LC	-
PORTULACACEAE	*Calandrinia quadrivalvis*	Calandrinia	LC	-
PORTULACACEAE	*Calandrinia uniflora*	Calandrinia	LC	-
PORTULACACEAE	*Portulaca bicolor*	Portulaca, Pigweed	LC	-
PORTULACACEAE	*Portulaca filifolia*	Portulaca, Pigweed	LC	-
PROTEACEAE	*Grevillea parallela*	Silver Grevillea, Silver Beefwood	LC	-
PROTEACEAE	*Hakea arborescens*	Hakea, Yellow Hakea, Common Hakea, Tree Hakea	LC	-
PTERIDACEAE	*Cheilanthes nudiuscula*	Cheilanthes	LC	-
PTERIDACEAE	*Cheilanthes tenuifolia*	Cheilanthes	LC	-
RHAMNACEAE	*Alphitonia excelsa*	Alphitonia, Soap Tree, Red Ash	LC	-
RHAMNACEAE	*Ventilago viminalis*	Ventilago, Supplejack, Vine Tree	LC	-
RUBIACEAE	*Oldenlandia mitrasacmoides*	Oldenlandia	INFRA	-
RUBIACEAE	*Oldenlandia mitrasacmoides subsp. mitrasacmoides*	Oldenlandia	LC	-
RUBIACEAE	*Spermacoce argillacea*	Spermacoce	LC	-
RUBIACEAE	*Spermacoce breviflora*	Spermacoce	LC	-
RUBIACEAE	*Spermacoce dolichosperma*	Spermacoce	LC	-
RUBIACEAE	*Spermacoce stenophylla*	Spermacoce, Blue Heads	LC	-
SANTALACEAE	*Santalum lanceolatum*	Sandalwood	LC	-
SAPINDACEAE	*Atalaya hemiglauca*	Atalaya, Whitewood	LC	-

Family	Scientific Name	Common Name	TPWCA	EPBCA
SAPINDACEAE	*Cardiospermum halicacabum var. halicacabum*	Cardiospermum	LC	-
SAPINDACEAE	*Dodonaea hispidula*	Distichostemon	INFRA	-
SAPINDACEAE	*Dodonaea lanceolata*	Dodonaea, Hopbush, Yellow Hop-bush	LC	-
SAPINDACEAE	*Dodonaea lanceolata var. lanceolata*	Yellow Hop-bush	LC	-
SAPINDACEAE	*Dodonaea physocarpa*	Chinese Lantern Hopbush	LC	-
SAPINDACEAE	*Dodonaea stenophylla*	Dodonaea, Netted Hopbush	LC	-
SOLANACEAE	*Solanum tumulicola*	Solanum, Black-soil Wild Tomato	LC	-
STYLIDIACEAE	*Stylidium adenophorum*	Stylidium	LC	-
VIOLACEAE	*Hybanthus enneaspermus*	Blue Spade Flower, Ladys Slipper	LC	-
VITACEAE	*Cayratia trifolia*	Cayratia	LC	-
ZYGOPHYLLACEAE	*Tribulopis pentandra*	Tribulopis	LC	-
ZYGOPHYLLACEAE	*Tribulus terrestris*	Tribulus, Cat-head, Caltrop, Bindieye, Bindii, Goathead Burr	LC	-
PROTEACEAE	*Hakea arborescens*	Common Hakea, Tree Hakea	LC	-
PTERIDACEAE	*Cheilanthes nudiuscula*	Cheilanthes	LC	-
PTERIDACEAE	*Cheilanthes tenuifolia*	Cheilanthes	LC	-
RHAMNACEAE	*Alphitonia excelsa*	Alphitonia, Soap Tree, Red Ash	LC	-
RHAMNACEAE	*Ventilago viminalis*	Ventilago, Supplejack, Vine Tree	LC	-
RUBIACEAE	*Oldenlandia mitrasacmoides*	Oldenlandia	INFRA	-
RUBIACEAE	*Oldenlandia mitrasacmoides subsp. mitrasacmoides*	Oldenlandia	LC	-
RUBIACEAE	*Spermacoce argillacea*	Spermacoce	LC	-
RUBIACEAE	*Spermacoce breviflora*	Spermacoce	LC	-
RUBIACEAE	*Spermacoce dolichosperma*	Spermacoce	LC	-
RUBIACEAE	*Spermacoce stenophylla*	Spermacoce, Blue Heads	LC	-
SANTALACEAE	*Santalum lanceolatum*	Northern Sandalwood	LC	-
SAPINDACEAE	*Atalaya hemiglauca*	Atalaya, Whitewood	LC	-
SAPINDACEAE	*Cardiospermum halicacabum var. halicacabum*	Cardiospermum	LC	-
SAPINDACEAE	*Dodonaea hispidula*	Distichostemon	INFRA	-
SAPINDACEAE	*Dodonaea lanceolata*	Dodonaea, Hopbush, Yellow Hop-bush	LC	-
SAPINDACEAE	*Dodonaea lanceolata var. lanceolata*	Dodonaea, Hopbush, Yellow Hop-bush	LC	-
SAPINDACEAE	*Dodonaea physocarpa*	Dodonaea, Balloon Hopbush, Chinese Lantern Hopbush	LC	-
SAPINDACEAE	*Dodonaea stenophylla*	Dodonaea, Netted Hopbush	LC	-

Family	Scientific Name	Common Name	TPWCA	EPBCA
SOLANACEAE	*Solanum tumulicola*	Solanum, Black-soil Wild Tomato	LC	-
STYLIDIACEAE	*Stylidium adenophorum*	Stylidium	LC	-
VIOLACEAE	*Hybanthus enneaspermus*	Blue Spade Flower, Ladys Slipper	LC	-
VITACEAE	*Cayratia trifolia*	Cayratia	LC	-
ZYGOPHYLLACEAE	*Tribulopis pentandra*	Tribulopis	LC	-
ZYGOPHYLLACEAE	*Tribulus terrestris*	Cat-head, Caltrop, Bindieye, Bindii	LC	-

Appendix B

Fauna Atlas Species Records

Appendix B Fauna Atlas Species Records

Common Name	Scientific Name	TPWC Act	EPBC Act
Amphibian			
Desert Spadefoot Toad	*Notaden nichollsi*	LC	-
Ornate Burrowing Frog	*Platyplectrum ornatum*	LC	-
Bilingual Froglet	*Crinia bilingua*	LC	-
Desert Froglet	*Crinia deserticola*	LC	-
Stonemason Toadlet	*Uperoleia lithomoda*	LC	-
Blacksoil Toadlet	*Uperoleia trachyderma*	LC	-
Giant Frog	*Cyclorana australis*	LC	-
Green Tree Frog	*Litoria caerulea*	LC	-
Hidden-ear Frog	*Cyclorana cryptotis*	LC	-
Knife-footed Frog	*Cyclorana cultripes*	LC	-
Daly Waters Frog	*Cyclorana maculosa*	LC	-
Pale Frog	*Litoria pallida*	LC	-
Water-holding Frog	*Cyclorana platycephala*	LC	-
Roth's Tree Frog	*Litoria rothii*	LC	-
Red Tree Frog	*Litoria rubella*	LC	-
Cane Toad	*Rhinella marina*	(Int)	-
Reptile			
Freshwater Crocodile	*Crocodylus johnstoni*	LC	-
Cann's Long-necked Turtle	*Chelodina canni*	LC	-
Variable Fat-tailed Gecko	*Diplodactylus conspicillatus*	LC	-
Tessellated Gecko	*Diplodactylus tessellatus*	LC	-
Northern Dtella	*Gehyra australis*	LC	-
Purplish Dtella	*Gehyra purpurascens*	LC	-
Tree Dtella	*Gehyra variegata*	LC	-
Bynoe's Gecko	*Heteronotia binoei*	LC	-
Pale-striped Ground Gecko	*Lucasium immaculatum*	LC	-
Sand-plain Gecko	*Lucasium stenodactylum*	LC	-
Zig-zag Gecko	*Amalosia rhombifer*	LC	-
Western Beaked Gecko	*Rhynchoedura ornata*	LC	-
Northern Spiny-tailed Gecko	*Strophurus ciliaris*	LC	-
Rusty-topped Delma	*Delma borea*	LC	-
Excitable Delma	*Delma tincta*	LC	-
Burton's Legless Lizard	*Lialis burtonis*	LC	-
Western Hooded Scaly-foot	*Pygopus nigriceps*	LC	-

Common Name	Scientific Name	TPWC Act	EPBC Act
Northern Hooded Scaly-foot	*Pygopus steelescotti*	LC	-
Two-spined Rainbow-skink	*Carlia amax*	LC	-
Desert Rainbow-skink	*Carlia triacantha*	LC	-
Metallic Snake-eyed Skink	*Cryptoblepharus metallicus*	LC	-
Clay-soil Ctenotus	*Ctenotus helenae*	LC	-
Bar-shouldered Ctenotus	*Ctenotus inornatus*	LC	-
Black-soil Ctenotus	*Ctenotus joanae*	LC	-
Leonhard's Ctenotus	*Ctenotus leonhardii*	LC	-
Leopard Ctenotus	*Ctenotus pantherinus*	LC	-
Red-sided Ctenotus	*Ctenotus pulchellus*	LC	-
Eastern Striped Ctenotus	*Ctenotus robustus*	LC	-
Barred Wedgesnout Ctenotus	*Ctenotus schomburgkii*	LC	-
Straight-browed Ctenotus	*Ctenotus spaldingi*	LC	-
Night Skink	*Liopholis striata*	LC	-
Northern Narrow-banded Skink	*Eremiascincus intermedius*	LC	-
Northern Mulch-skink	*Glaphyromorphus darwiniensis*	LC	-
Northern Bar-lipped Skink	*Eremiascincus isolepis*	LC	-
North-western Sandslider	*Lerista bipes*	LC	-
Stout Sandslider	*Lerista griffini*	LC	-
Southern Sandslider	*Lerista labialis*	LC	-
North-eastern Orange-tailed Slider	*Lerista orientalis*	LC	-
Common Dwarf Skink	*Menetia greyii*	LC	-
Northern Dwarf Skink	*Menetia maini*	LC	-
Lined Fire-tailed Skink	*Morethia ruficauda*	LC	-
Northern Fire-tailed Skink	*Morethia storri*	LC	-
Kinghorn's Snake-eyed Skink	*Austroablepharus kinghorni*	LC	-
Northern Soil-crevice Skink	*Proablepharus tenuis*	LC	-
Centralian Blue-tongue	*Tiliqua multifasciata*	LC	-
Common Blue-tongue	*Tiliqua scincoides*	DD	-
Frilled Lizard	*Chlamydosaurus kingii*	LC	-
Central Military Dragon	*Ctenophorus isolepis*	LC	-
Central Netted Dragon	*Ctenophorus nuchalis*	LC	-
Arnhem Land Two-lined Dragon	*Diporiphora arnhemica*	LC	-
Two-lined Dragon	*Diporiphora bilineata*	LC	-
Lally's Two-lined Dragon	*Diporiphora lalliae*	LC	-
Yellow-sided Two-lined Dragon	*Diporiphora magna*	LC	-
Gilbert's Dragon	*Lophognathus gilberti*	LC	-

Common Name	Scientific Name	TPWC Act	EPBC Act
Lined Earless Dragon	*Tympanocryptis lineata*	LC	-
Ridge-tailed Monitor	*Varanus acanthurus*	LC	-
Sand Goanna	*Varanus gouldii*	LC	-
Mertens' Water Monitor	*Varanus mertensi*	VU	-
Yellow-spotted Monitor	*Varanus panoptes*	VU	-
Spotted Tree Monitor	*Varanus scalaris*	DD	-
Black-headed Monitor	*Varanus tristis*	LC	-
Northern Blind Snake	*Anilios diversus*	LC	-
Robust Blind Snake	*Anilios ligatus*	LC	-
Claw-snouted Blind Snake	*Anilios unguirostris*	LC	-
Children's Python	*Antaresia childreni*	LC	-
Stimson's Python	*Antaresia stimsoni*	LC	-
Unbanded Shovel-nosed Snake	*Brachyurophis incinctus*	LC	-
Northern Shovel-nosed Snake	*Brachyurophis roperi*	NE	-
Southern Shovel-nosed Snake	*Brachyurophis semifasciatus*	LC	-
Olive Whipsnake	*Demansia olivacea*	DD	-
Greater Black Whipsnake	*Demansia papuensis*	LC	-
Shine's Whipsnake	*Demansia shinei*	LC	-
Orange-naped Snake	*Furina ornata*	LC	-
Mulga Snake	*Pseudechis australis*	NT	-
Speckled Brown Snake	*Pseudonaja guttata*	LC	-
Northern Brown Snake	*Pseudonaja nuchalis*	LC	-
Little Spotted Snake	*Suta punctata*	LC	-
Curl Snake	*Suta suta*	LC	-
Eastern Bandy-bandy	*Vermicella annulata*	LC	-
Birds			
Red-backed Kingfisher	*Todiramphus pyrrhopygius*	LC	-
Sacred Kingfisher	*Todiramphus sanctus*	LC	-
Pheasant Coucal	*Centropus phasianinus*	LC	-
Pallid Cuckoo	*Cacomantis pallidus*	LC	-
Brush Cuckoo	*Cacomantis variolosus*	LC	-
Rainbow Bee-eater	*Merops ornatus*	LC	-
Stubble Quail	*Coturnix pectoralis*	LC	-
Brown Quail	*Coturnix ypsilophora*	LC	-
Emu	*Dromaius novaehollandiae*	NT	-
Magpie Goose	*Anseranas semipalmata*	LC	-
Wandering Whistling-Duck	*Dendrocygna arcuata*	LC	-

Common Name	Scientific Name	TPWC Act	EPBC Act
Plumed Whistling-Duck	*Dendrocygna eytoni*	LC	-
Freckled Duck	*Stictonetta naevosa*	NT	-
Black Swan	*Cygnus atratus*	LC	-
Radjah Shelduck	*Radjah radjah*	LC	-
Australian Shelduck	*Tadorna tadornoides*	NE	-
Australian Wood Duck	*Chenonetta jubata*	LC	-
Pink-eared Duck	*Malacorhynchus membranaceus*	LC	-
Green Pygmy-goose	*Nettapus pulchellus*	LC	-
Australasian Shoveler	*Spatula rhynchotis*	NE	-
Grey Teal	*Anas gracilis*	LC	-
Pacific Black Duck	*Anas superciliosa*	LC	-
Hardhead	*Aythya australis*	LC	-
Australasian Grebe	*Tachybaptus novaehollandiae*	LC	-
Hoary-headed Grebe	*Poliocephalus poliocephalus*	LC	-
Great Crested Grebe	*Podiceps cristatus*	LC	-
Common Bronzewing	*Phaps chalcoptera*	LC	-
Crested Pigeon	*Ocyphaps lophotes*	LC	-
Spinifex Pigeon	*Geophaps plumifera*	LC	-
Diamond Dove	*Geopelia cuneata*	LC	-
Peaceful Dove	*Geopelia placida*	LC	-
Bar-shouldered Dove	*Geopelia humeralis*	LC	-
Tawny Frogmouth	*Podargus strigoides*	LC	-
Spotted Nightjar	*Eurostopodus argus*	LC	-
Australian Owlet-nightjar	*Aegotheles cristatus*	LC	-
Fork-tailed Swift	*Apus pacificus*	LC	-
Australasian Darter	*Anhinga novaehollandiae*	LC	-
Little Pied Cormorant	*Microcarbo melanoleucos*	LC	-
Great Cormorant	*Phalacrocorax carbo*	LC	-
Little Black Cormorant	*Phalacrocorax sulcirostris*	LC	-
Pied Cormorant	*Phalacrocorax varius*	LC	-
Australian Pelican	*Pelecanus conspicillatus*	LC	-
Black-necked Stork	*Ephippiorhynchus asiaticus*	LC	-
Black Bittern	*Ixobrychus flavicollis*	LC	-
White-necked Heron	*Ardea pacifica*	LC	-
Great Egret	*Ardea alba*	LC	-
Intermediate Egret	*Ardea intermedia*	LC	-
Cattle Egret	*Bubulcus ibis*	LC	-

Common Name	Scientific Name	TPWC Act	EPBC Act
Pied Heron	*Egretta picata*	LC	-
White-faced Heron	*Egretta novaehollandiae*	LC	-
Little Egret	*Egretta garzetta*	LC	-
Nankeen Night-Heron	*Nycticorax caledonicus*	LC	-
Glossy Ibis	*Plegadis falcinellus*	LC	-
Australian White Ibis	*Threskiornis molucca*	LC	-
Straw-necked Ibis	*Threskiornis spinicollis*	LC	-
Royal Spoonbill	*Platalea regia*	LC	-
Yellow-billed Spoonbill	*Platalea flavipes*	LC	-
Black-shouldered Kite	*Elanus axillaris*	LC	-
Square-tailed Kite	*Lophoictinia isura*	NT	-
Black-breasted Buzzard	*Hamirostra melanosternon*	LC	-
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	LC	-
Whistling Kite	*Haliastur sphenurus*	LC	-
Black Kite	*Milvus migrans*	LC	-
Brown Goshawk	*Accipiter fasciatus*	LC	-
Collared Sparrowhawk	*Accipiter cirrocephalus*	LC	-
Spotted Harrier	*Circus assimilis*	LC	-
Swamp Harrier	*Circus approximans*	LC	-
Wedge-tailed Eagle	*Aquila audax*	LC	-
Little Eagle	*Hieraaetus morphnoides*	LC	-
Nankeen Kestrel	*Falco cenchroides*	LC	-
Brown Falcon	*Falco berigora*	LC	-
Australian Hobby	*Falco longipennis*	LC	-
Grey Falcon	*Falco hypoleucos*	VU	VU
Black Falcon	*Falco subniger*	LC	-
Peregrine Falcon	*Falco peregrinus*	LC	-
Brolga	*Antigone rubicunda*	LC	-
Purple Swamphen	*Porphyrio porphyrio*	LC	-
Australian Spotted Crake	*Porzana fluminea*	DD	-
Black-tailed Native-hen	*Tribonyx ventralis*	LC	-
Dusky Moorhen	*Gallinula tenebrosa*	LC	-
Eurasian Coot	*Fulica atra*	LC	-
Australian Bustard	*Ardeotis australis*	NT	-
Bush Stone-curlew	*Burhinus grallarius*	NT	-
Pied Stilt	*Himantopus leucocephalus*	LC	-
Red-necked Avocet	*Recurvirostra novaehollandiae*	LC	-

Common Name	Scientific Name	TPWC Act	EPBC Act
Red-capped Plover	*Charadrius ruficapillus*	LC	-
Oriental Plover	*Charadrius veredus*	LC	-
Black-fronted Dotterel	*Elseyornis melanops*	LC	-
Red-kneed Dotterel	*Erythrogonys cinctus*	LC	-
Masked Lapwing	*Vanellus miles*	LC	-
Little Curlew	*Numenius minutus*	LC	-
Common Sandpiper	*Actitis hypoleucos*	LC	-
Common Greenshank	*Tringa nebularia*	LC	-
Marsh Sandpiper	*Tringa stagnatilis*	LC	-
Wood Sandpiper	*Tringa glareola*	NE	-
Sharp-tailed Sandpiper	*Calidris acuminata*	LC	-
Red-backed Button-quail	*Turnix maculosus*	LC	-
Red-chested Button-quail	*Turnix pyrrhothorax*	LC	-
Little Button-quail	*Turnix velox*	LC	-
Oriental Pratincole	*Glareola maldivarum*	LC	-
Australian Pratincole	*Stiltia isabella*	LC	-
Caspian Tern	*Hydroprogne caspia*	LC	-
Whiskered Tern	*Chlidonias hybrida*	LC	-
White-winged Black Tern	*Chlidonias leucopterus*	LC	-
Silver Gull	*Chroicocephalus novaehollandiae*	LC	-
Red-tailed Black-cockatoo (north-western)	*Calyptorhynchus banksii macrorhynchus*	LC	-
Galah	*Eolophus roseicapilla*	LC	-
Little Corella	*Cacatua sanguinea*	LC	-
Sulphur-crested Cockatoo	*Cacatua galerita*	LC	-
Cockatiel	*Nymphicus hollandicus*	LC	-
Red-collared Lorikeet	*Trichoglossus rubritorquis*	LC	-
Varied Lorikeet	*Psitteuteles versicolor*	LC	-
Red-winged Parrot	*Aprosmictus erythropterus*	LC	-
Princess Parrot	*Polytelis alexandrae*	VU	VU
Australian Ringneck	*Barnardius zonarius*	LC	-
Hooded Parrot	*Psephotellus dissimilis*	NT	-
Budgerigar	*Melopsittacus undulatus*	LC	-
Eastern Koel	*Eudynamys orientalis*	LC	-
Channel-billed Cuckoo	*Scythrops novaehollandiae*	LC	-
Horsfield's Bronze-Cuckoo	*Chalcites basalis*	LC	-
Black-eared Cuckoo	*Chalcites osculans*	LC	-
Australian Boobook	*Ninox boobook*	LC	-

Common Name	Scientific Name	TPWC Act	EPBC Act
Azure Kingfisher	*Ceyx azureus*	LC	-
Blue-winged Kookaburra	*Dacelo leachii*	LC	-
Dollarbird	*Eurystomus orientalis*	LC	-
Black-tailed Treecreeper	*Climacteris melanurus*	LC	-
Great Bowerbird	*Chlamydera nuchalis*	LC	-
Red-backed Fairy-wren	*Malurus melanocephalus*	LC	-
White-winged Fairy-wren	*Malurus leucopterus*	LC	-
Variegated Fairy-wren	*Malurus lamberti*	LC	-
Weebill	*Smicrornis brevirostris*	LC	-
Mangrove Gerygone	*Gerygone levigaster*	LC	-
Western Gerygone	*Gerygone fusca*	LC	-
White-throated Gerygone	*Gerygone olivacea*	LC	-
Chestnut-rumped Thornbill	*Acanthiza uropygialis*	LC	-
Inland Thornbill	*Acanthiza apicalis*	LC	-
Red-browed Pardalote	*Pardalotus rubricatus*	LC	-
Striated Pardalote	*Pardalotus striatus*	LC	-
Singing Honeyeater	*Gavicalis virescens*	LC	-
White-gaped Honeyeater	*Stomiopera unicolor*	LC	-
Grey-headed Honeyeater	*Ptilotula keartlandi*	LC	-
Grey-fronted Honeyeater	*Ptilotula plumula*	LC	-
Yellow-tinted Honeyeater	*Ptilotula flavescens*	LC	-
White-plumed Honeyeater	*Ptilotula penicillata*	LC	-
Yellow-throated Miner	*Manorina flavigula*	LC	-
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	LC	-
Bar-breasted Honeyeater	*Ramsayornis fasciatus*	LC	-
Rufous-throated Honeyeater	*Conopophila rufogularis*	LC	-
Crimson Chat	*Epthianura tricolor*	LC	-
Yellow Chat (southern)	*Epthianura crocea crocea*	LC	-
Banded Honeyeater	*Cissomela pectoralis*	LC	-
Brown Honeyeater	*Lichmera indistincta*	LC	-
Black-chinned Honeyeater	*Melithreptus gularis*	LC	-
White-throated Honeyeater	*Melithreptus albogularis*	LC	-
Blue-faced Honeyeater	*Entomyzon cyanotis*	LC	-
Silver-crowned Friarbird	*Philemon argenticeps*	LC	-
Little Friarbird	*Philemon citreogularis*	LC	-
Painted Honeyeater	*Grantiella picta*	VU	VU
Grey-crowned Babbler	*Pomatostomus temporalis*	LC	-

Common Name	Scientific Name	TPWC Act	EPBC Act
Varied Sittella	*Daphoenositta chrysoptera*	LC	-
Ground Cuckoo-shrike	*Coracina maxima*	LC	-
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	LC	-
White-bellied Cuckoo-shrike	*Coracina papuensis*	LC	-
White-winged Triller	*Lalage tricolor*	LC	-
Varied Triller	*Lalage leucomela*	LC	-
Rufous Whistler	*Pachycephala rufiventris*	LC	-
Grey Shrike-thrush	*Colluricincla harmonica*	LC	-
Crested Shrike-tit	*Falcunculus frontatus*	LC	VU
Crested Bellbird	*Oreoica gutturalis*	LC	-
Olive-backed Oriole	*Oriolus sagittatus*	LC	-
White-breasted Woodswallow	*Artamus leucorynchus*	LC	-
Masked Woodswallow	*Artamus personatus*	LC	-
White-browed Woodswallow	*Artamus superciliosus*	LC	-
Black-faced Woodswallow	*Artamus cinereus*	LC	-
Little Woodswallow	*Artamus minor*	LC	-
Grey Butcherbird	*Cracticus torquatus*	LC	-
Pied Butcherbird	*Cracticus nigrogularis*	LC	-
Australian Magpie	*Gymnorhina tibicen*	LC	-
Arafura Fantail	*Rhipidura dryas*	LC	-
Grey Fantail	*Rhipidura albiscapa*	LC	-
Willie Wagtail	*Rhipidura leucophrys*	LC	-
Little Crow	*Corvus bennetti*	LC	-
Torresian Crow	*Corvus orru*	LC	-
Leaden Flycatcher	*Myiagra rubecula*	LC	-
Paperbark Flycatcher	*Myiagra nana*	LC	-
Magpie-lark	*Grallina cyanoleuca*	LC	-
Apostlebird	*Struthidea cinerea*	LC	-
Jacky Winter	*Microeca fascinans*	LC	-
Lemon-bellied Flycatcher	*Microeca flavigaster*	LC	-
Hooded Robin	*Melanodryas cucullata*	LC	-
Buff-sided Robin	*Poecilodryas cerviniventris*	NT	-
Horsfield's Bushlark	*Mirafra javanica*	LC	-
Golden-headed Cisticola	*Cisticola exilis*	LC	-
Australian Reed-Warbler	*Acrocephalus australis*	NT	-
Little Grassbird	*Poodytes gramineus*	LC	-
Rufous Songlark	*Cincloramphus mathewsi*	LC	-

Common Name	Scientific Name	TPWC Act	EPBC Act
Brown Songlark	*Cincloramphus cruralis*	LC	-
Welcome Swallow	*Hirundo neoxena*	LC	-
Fairy Martin	*Petrochelidon ariel*	LC	-
Tree Martin	*Petrochelidon nigricans*	LC	-
Mistletoebird	*Dicaeum hirundinaceum*	LC	-
Gouldian Finch	*Erythrura gouldiae*	VU	EN
Zebra Finch	*Taeniopygia guttata*	LC	-
Double-barred Finch	*Taeniopygia bichenovii*	LC	-
Long-tailed Finch	*Poephila acuticauda*	LC	-
Masked Finch	*Poephila personata*	LC	-
Pictorella Mannikin	*Heteromunia pectoralis*	NT	-
Australasian Pipit	*Anthus novaeseelandiae*	LC	-
Common Gull-billed Tern	*Gelochelidon nilotica*	(NL)	-
Rainbow Lorikeet	*Trichoglossus moluccanum*	(NL)	-
Mammal			
Short-beaked Echidna	*Tachyglossus aculeatus*	LC	-
Western Quoll	*Dasyurus geoffroii*	ER	VU
Long-tailed Planigale	*Planigale ingrami*	LC	-
Common Planigale	*Planigale maculata*	LC	-
Stripe-faced Dunnart	*Sminthopsis macroura*	LC	-
Greater Bilby	*Macrotis lagotis*	VU	VU
Rock Ringtail	*Petropseudes dahli*	LC	-
Common Brushtail Possum	*Trichosurus vulpecula arnhemensis*	LC	VU
Common Brushtail Possum (central and south-eastern)	*Trichosurus vulpecula vulpecula*	EN	-
Spectacled Hare-wallaby	*Lagorchestes conspicillatus*	NT	-
Agile Wallaby	*Notamacropus agilis*	LC	-
Antilopine Wallaroo	*Osphranter antilopinus*	LC	-
Common Wallaroo	*Osphranter robustus*	LC	-
Red Kangaroo	*Osphranter rufus*	LC	-
Northern Nailtail Wallaby	*Onychogalea unguifera*	NT	-
Little Red Flying-fox	*Pteropus scapulatus*	LC	-
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*	LC	-
Northern Free-tailed Bat	*Ozimops lumsdenae*	LC	-
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	LC	-
Hoary Wattled Bat	*Chalinolobus nigrogriseus*	LC	-
Little Broad-nosed Bat	*Scotorepens greyii*	LC	-
Central Short-tailed Mouse	*Leggadina forresti*	LC	-

Common Name	Scientific Name	TPWC Act	EPBC Act
Northern Short-tailed Mouse	*Leggadina lakedownensis*	LC	-
Delicate Mouse	*Pseudomys delicatulus*	LC	-
Western Chestnut Mouse	*Pseudomys nanus*	NT	-
Common Rock-rat	*Zyzomys argurus*	LC	-
Pale Field-rat	*Rattus tunneyi*	VU	-
Long-haired Rat	*Rattus villosissimus*	NT	-
Black Rat	*Rattus rattus*	(Int)	-
Dingo / Wild Dog	*Canis familiaris dingo*	LC	-
Cat	*Felis catus*	(Int)	-
Horse	*Equus caballus*	(Int)	-
Swamp Buffalo	*Bubalus bubalis*	(Int)	-
Cattle	*Bos taurus*	(Int)	-

Appendix C

DAWE Protected Matters Search Report

Appendix C DAWE Protected Matters Search Report

Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report **Velkerri 76 N1**

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

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

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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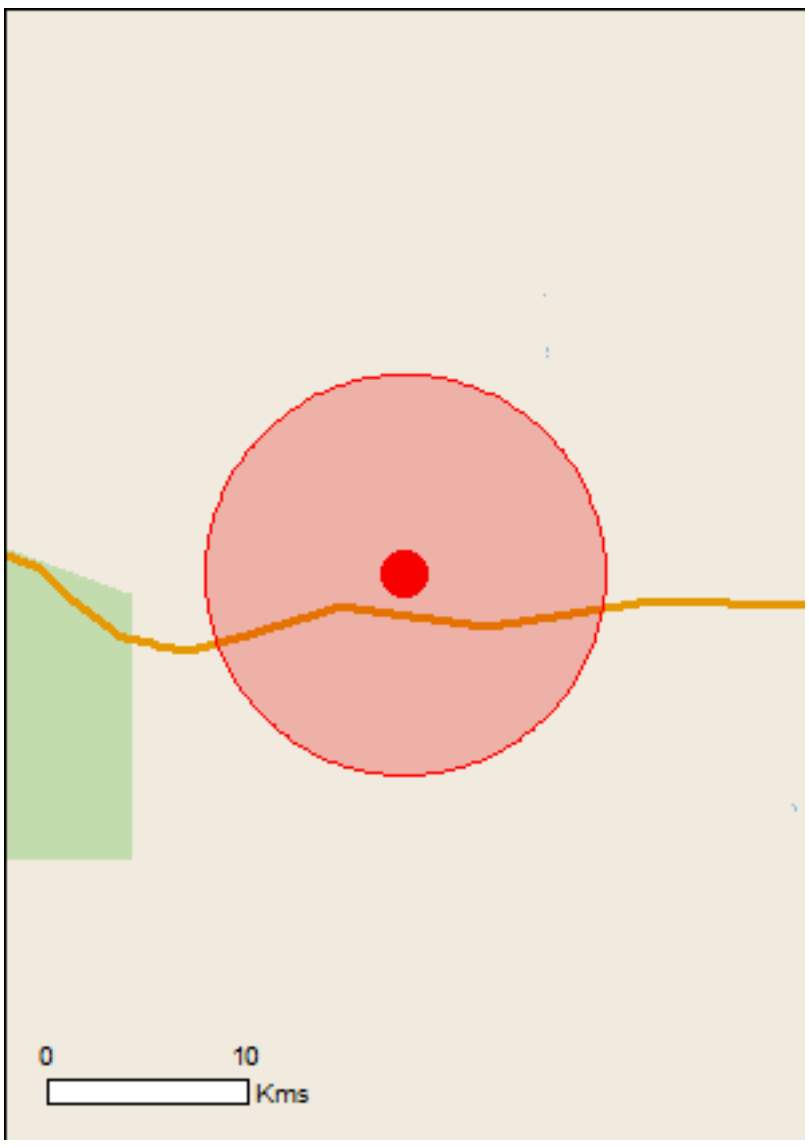

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Coordinates

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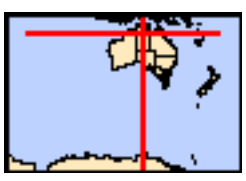

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	12
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

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

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

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	10
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat may occur within area
Mammals		
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat may occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area
Trichosurus vulpecula arnhemensis Northern Brushtail Possum [83091]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Elseya lavarackorum Gulf Snapping Turtle [67197]	Endangered	Species or species habitat may occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Reptiles		
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Bubalus bubalis Water Buffalo, Swamp Buffalo [1]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

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

Coordinates

-16.46859 134.4467

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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

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Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report **Amungee NW**

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

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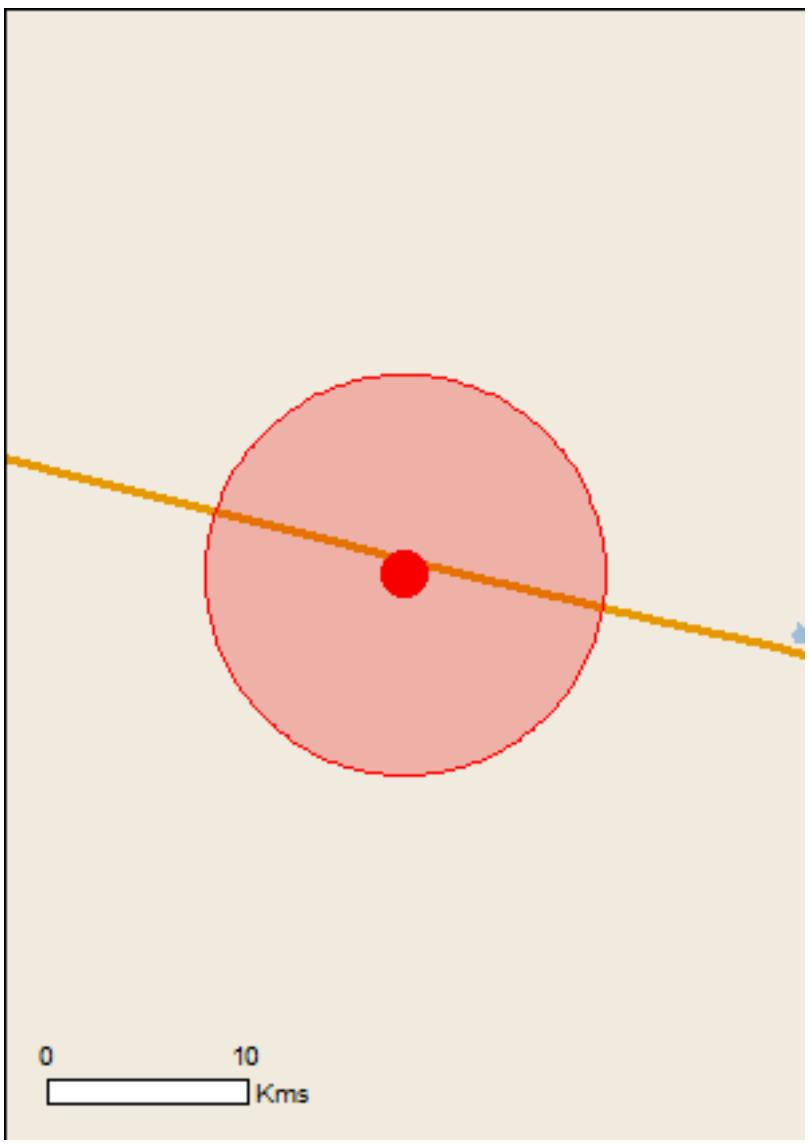

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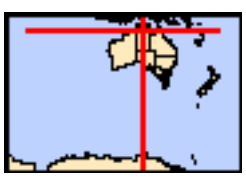

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	11
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

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

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A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	7
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
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Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
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Reptiles		
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Migratory Terrestrial Species		
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-Australian Bird and Bat Banding Scheme
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-Online Zoological Collections of Australian Museums
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-Royal Botanic Gardens and National Herbarium of Victoria
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-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
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-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
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-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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

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Australian Government

Department of Agriculture, Water and the Environment

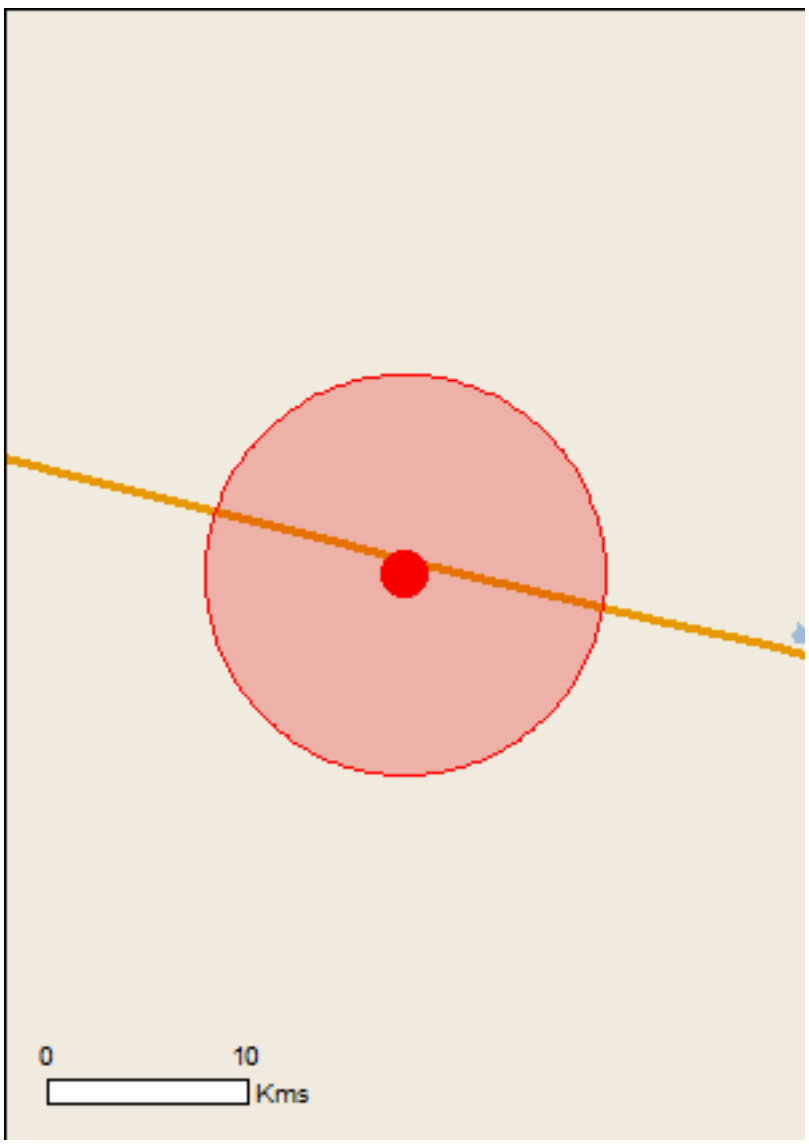
EPBC Act Protected Matters Report **Beetaloo W**

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

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

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 25/08/21 14:14:43



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates

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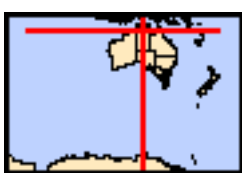

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	11
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

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

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

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	7
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
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APPENDIX K.2

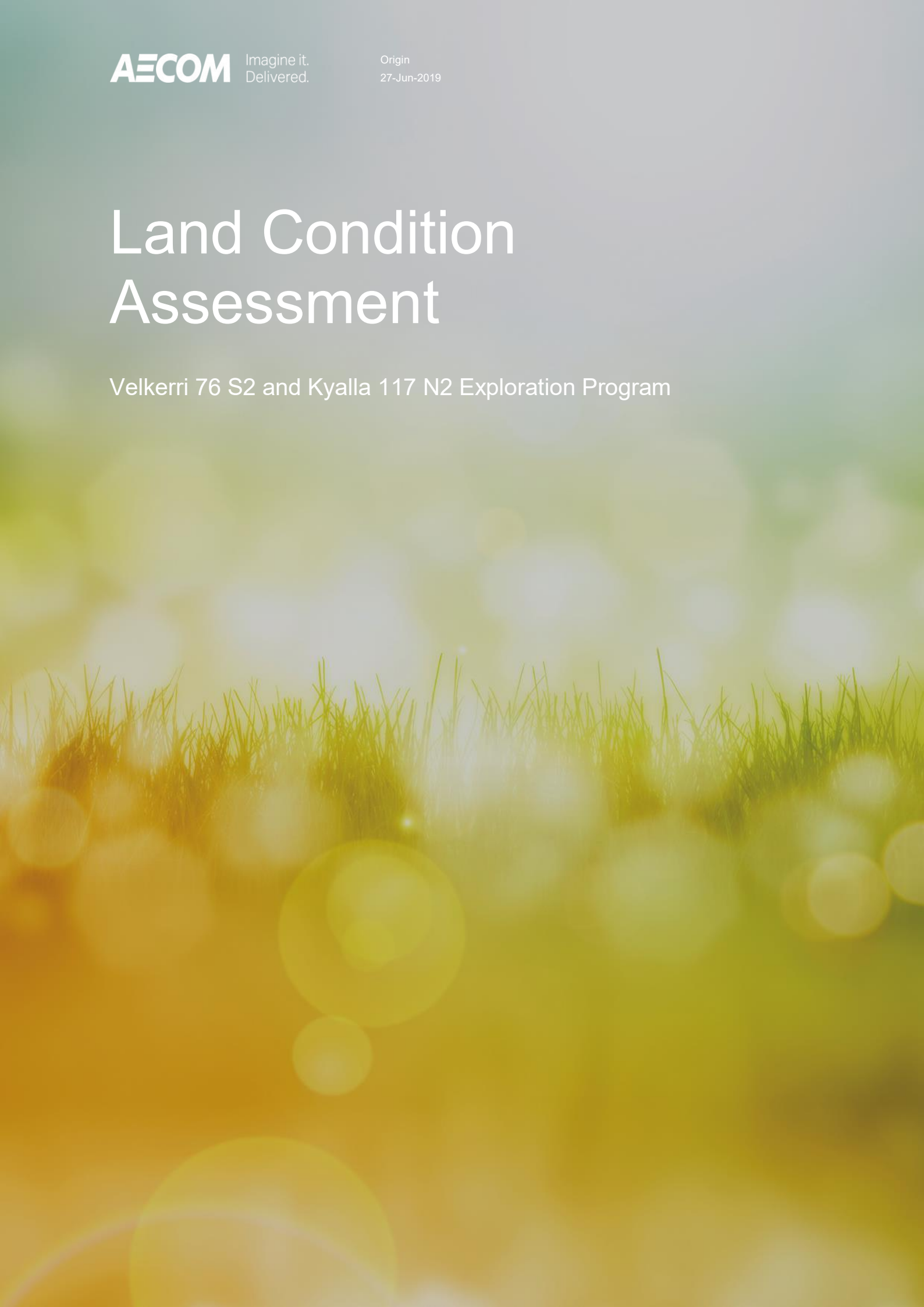
Land Condition Assessment Report (AECOM 2019)

AECOM Imagine it. Delivered.

Origin
27-Jun-2019

Land Condition Assessment

Velkerri 76 S2 and Kyalla 117 N2 Exploration Program



Land Condition Assessment

Velkerri 76 S2 and Kyalla 117 N2 Exploration Program

Client: Origin

ABN: 66 007 845 338

Prepared by

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34 McLachlan Street, Darwin NT 0800, GPO Box 3175, Darwin NT 0801, Australia
T +61 8 8942 6200 F +61 8 8942 6299 www.aecom.com
ABN 20 093 846 925

27-Jun-2019

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

Quality Information

Document	Land Condition Assessment
Ref	60480548
Date	27-Jun-2019
Prepared by	Alana Court
Reviewed by	Abe Francis

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	20-Sep-2018	August 2018 Land Condition Assessment	Alana Court Principal Scientist	
1	5-Mar-2019	Revised for 2019 program	Alana Court Principal Scientist	
2	16-May-2019	Revision 2 for 2019 program	Alana Court Principal Scientist	
3	27-June-2019	Update following DENR comments regarding recently released *Weed Management Planning Guide: Onshore Petroleum Projects June 2019*	Alana Court Principal Scientist	

Table of Contents

List of Plates

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Table of Acronyms

Acronym	Meaning
°C	Degrees Celsius
%	Percentage
AAPA	Aboriginal Areas Protection Authority
ALA	Atlas of Living Australia
AS	Australian Standard
BOM	Bureau of Meteorology
CLA	Cambrian Limestone Aquifer
Cth	Commonwealth
DoH	Department of Health (NT)
DotEE	Department of the Environment and Energy (Cmwlth)
DENR	Department of Environment and Natural Resources (NT)
DPIR	Department of Primary Industries and Resource (NT)
DLPE	Department of Lands, Planning and the Environment (NT)
EPA	Environment Protection Authority (NT)
EP##	Exploration Permit (e.g. EP76, EP98 and EP117)
EMP	Environmental Management Plan
EPBC	Environmental Protection and Biodiversity Conservation
ESCP	Erosion and Sediment Control Plan
GPS	Global Positioning Device
Ha	hectare
IBA	Important Bird Area
ILUA	Indigenous Land Use Agreement
Km	Kilometre
km^2	Square Kilometres
km/hr	Kilometre per hour
LCA	Land Condition Assessment
m	metre
MD	Measured Depth
MNES	Matters of National Environmental Significance
mm	millimetre
NLC	Northern Land Council
NT	Northern Territory
OHS	Occupational Health and Safety
RWA	Restricted Work Area
TO	Traditional Owner
TPWC Act	*Territory Parks and Wildlife Conservation Act*

Acronym	Meaning
WMP	Weed Management Plan
WoNS	Weed of National Significance

1.0 Introduction

1.1 Purpose of this Report

AECOM Australia Pty Ltd (AECOM) conducted a land condition assessment (LCA) to support Origin Energy's (Origin) application to the Northern Territory Department of Environment and Natural Resources (DENR) for an Environmental Management Plan (EMP) for various exploration activities.

The purpose of the LCA was to gather baseline information to provide an environmental condition assessment to support the proposed exploration activities to be carried out by Origin at two proposed lease sites during 2019/2020.

1.2 Project Boundary

Origin are proposing to undertake a series of activities required to expand their exploration program in the Beetaloo Basin. Origin are targeting two sites for the 2019/2020 exploration program, Velkerri 76 S2 and Kyalla 117 N2. The location and proposed disturbance area are presented in Table 1 and Figure 1.

Table 1 Proposed Lease Area for Exploration Activities and Disturbance Area

Exploration Permit	Name	Station	Zone*	Easting	Northing	Disturbance Area (ha)
EP76	Velkerri 76 S2-1	Amungee Mungee	53	435488	8136321	7.2~
EP117	Kyalla 117 N2-1	Hayfield/Shenandoah	53	356175	8137500	9.8~
EP117	Stuart Highway Intersection	Hayfield/Shenandoah	53	332371	8135170	0.5
EP117	Gravel Pit 1	Hayfield/Shenandoah	53	339883	8135005	1.0
EP117	Gravel Pit 2	Hayfield/Shenandoah	53	360366	8135138	1.0
EP117	Gravel Pit 3	Hayfield/Shenandoah	53	362841	8135102	1.0
EP117	Gravel Pit 4 and access track	Hayfield/Shenandoah	53	397906	8136039	1.5
EP117	Gravel Pit 5 and access track	Hayfield/Shenandoah	53	403386	8135809	1.0
EP117	Gravel Pit 6 and access track	Hayfield/Shenandoah	53	405049	8135927	1.0
EP76	Gravel Pit 7	Amungee Mungee	53	435749	8135306	0.5
Total Disturbance Area (Ha)						**24.5 ha**

** Universal Transverse Mercator (UTM) geographic coordinate system is Geocentric Datum of Australia (GDA) 94.*

~Includes well pad, camp lease, stockpile laydown and access track turnin.

For the purpose of this assessment, the project boundaries were defined as the areas which may be affected by the proposed exploration activities, including:

- Construction of a 5.5-ha lease pad at Kyalla 117 N2 and Velkerri 76 S2.
- Construction of a 1.2-ha camp pad at Kyalla 117 N2 and Velkerri 76 S2.
- Construction of a 0.2-ha stockpile area at Kyalla 117 N2 and Velkerri 76 S2.

- Construction of a 0.25-ha helipad and 1-ha wet weather storage area at the Velkerri 76 S2.
- Construct a 650 m long x 8 m wide (0.52-ha) lease pad turn in to Kyalla 117 N2 connecting the proposed lease pad to the existing access track.
- Construct a 1,100 m long x 8 m wide (0.88-ha) lease pad turn in to Velkerri 76 S2 connecting the proposed lease pad to the existing access track.
- Minor intersection upgrade works at the intersection with the Stuart Highway of approximately 0.5-ha in accordance with approved Road Agency approval (2018-0186-D2) and Permit to Work within NT Government Road Reserve.
- Utilise approximately 107 km of existing access track.
- Obtain gravels, as required, for construction of drill pads and sections of the access track at up to seven proposed borrow pits (7 gravel pits up to 1 to 2.1 ha).
- All other activities ancillary to the drilling, stimulation and well testing of an exploration well.

1.3 Scope of works

The scope of work for the LCA involved:

- a review of historical data and reports prepared during the previous Beetaloo onshore oil and gas exploration programs
- a search of the Commonwealth Department of the Environment and Energy (DoTEE) Protected Matters database (27 August 2018)
- a search of the NT Natural Resource Management InfoNet Database (flora and fauna database) (4 September 2018)
- a search of the Atlas of Living Australia (ALA) database for flora and fauna records (2014 and 2016)
- completion of LCA field survey of the proposed exploration lease areas drilling program.
- Preparation of this report.

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8225000 8200000 8175000 8150000 8125000 8100000 8075000 8050000

KALALA
NUTWOOD DOWNS
TANUMBIRINI
Kalala
Daly Waters
CARPENTARIA HWY
EP98
Cooee Hill
EP117
AMUNGEE MUNGEE
Dunmarra
Hayfields
Kyalla 117 N2-1
Vellkerri 76 N2-1
GP1
GP2
GP3
GP4
GP5-
GP6
GP7
HAYFIELD
STUART HWY
BEETALOO STATION
EP76
MURRANJAI
Beetaloo
Newcastle Waters
NEWCASTLE WATERS
Elliott
UCHARONIDGE
Ucharonidge
TANDYIDGEE
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Kilometers

1:570,000 (when printed at A3)

LEGEND

- Proposed Wells 2018
- Homestead
- Place Name
- Populated Place
- Gravel Pits
- Highway
- Tracks
- Access Routes
- Cadastre
- Permit Areas
- Bullwaddy Conservation Reserve

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage -

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Site Location

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VERSION	1

Figure 1

Filename: \\audwn1fp001\Projects\604x\60480548\4. Tech Work Area\4.99 GIS\02_MXDs\LCA\Site_Location.mxd

A3 size

2.0 Assessment Method

2.1 Desktop Review

The existing data collected between 2005 and 2016 for the permit areas was mapped based on image interpretation, with ground-truthing of the proposed exploration areas being completed during the field assessment (refer Section 2.2). This information was reviewed prior to the field work to identify the following:

- terrestrial vegetation types and flora and fauna species occurring within the region and with potential to occur within the project area, using existing documents and aerial / satellite imagery.
- terrestrial Commonwealth or Territory listed threatened species or communities identified within the region and with potential to occur within the project area.
- matters of national environmental significance or other matters protected by the Environment Protection and Biodiversity Conservation Act (EPBC Act) that are likely to occur within the project area.
- existing weeds or feral animals listed under the EPBC Act, *Weeds Management Act* or the *Territory Parks and Wildlife Conservation Act* and with potential to occur within the project area.

Table 2 provides a chronological list of reports previously compiled for the exploration permit area between 2004 and 2016, in relation to environmental approvals and management support for petroleum exploration activities in the Beetaloo Basin, NT.

The extent of work undertaken since 2004 has enabled a good understanding of the natural and cultural environment, which has been used in assessing the proposed exploration areas within the Permit Area.

Table 2 Summary of existing Environmental Assessments and Reports for the Beetaloo Basin (2004 to 2018)

Date	Report
Sweetpea Petroleum	
Jul- Aug 2004	Baseline land condition assessment
	Site database established
Jul 2005	Exploration EMP finalised and approved
Petrohunter Australia (Partner to Sweetpea)	
Dec 2006	Baseline vegetation assessment
Apr 2007	Drill site assessments
Apr 2007	Annual report
Jun 2007	Update of the existing EMP to include the new Exploration Permit areas
Jul 2007	Drill Site maps
Jul 2007	Supplemental Environmental Management Plan, Drilling Program 2007, Beetaloo Basin, NT
Jul 2007	Soil erosion assessment
Jul 2007	Groundwater quality
July 2007	Emergency Maps
Jul 2007	Environment & Heritage Induction Materials
Aug 2007	Site-based Drilling EMP
Falcon Oil and Gas	
Dec 2010	Drill site condition assessments

Date	Report
Jan 2011	Archaeological survey
March 2011	Site-specific drilling EMP
2011	Falcon Shenandoah 1 Stimulation and Testing Groundwater Monitoring
2011/2012	Shenandoah 1 Re-Entry Environment Plan (EP)
July 2012	EP99 Archaeological Survey, Beetaloo Basin
2013	EP99 Seismic Exploration Environmental Management Plan
2013	Sweetpea 2006 Closeout Environmental Survey
Origin	
2015 and 2016	Beetaloo Basin Environmental and Heritage Assessment and preparation of Approval documentation.
October 2018	Land Condition Assessment

2.2 Field assessment and reporting

The LCA of the proposed exploration lease areas, including access tracks, was conducted on 28 to 29 August 2018 by Principal Environmental Scientist, [redacted]. The survey involved helicopter and pedestrian survey of the proposed exploration lease areas and access tracks and was accompanied by the AECOM Principal Heritage Consultant, [redacted] and the Department of Environment and Natural Resource (DENR) Regional Weed Officer (Onshore Shale Gas Development), [redacted]

The LCA used rapid assessment techniques, which allowed for large areas to be surveyed over a relatively small period of time. The helicopter provided a good platform to enable the field team a degree of flexibility by allowing an aerial view of the access tracks and proposed exploration lease areas, as well as the ability to land in otherwise remote locations for ground-truthing.

The primary aim of the LCA was to identify and document site condition prior to the proposed activities occurring in the footprint of the two lease areas and proposed access tracks and inform the preparation of the programs Environmental Management Plan (EMP).

Following the desktop review, AECOM undertook a condition assessment at each of the nominated sites and access tracks to record site-based characteristics, including:

- the presence of drainage lines and the direction of surface flows
- the distance to the nearest sensitive receptors (such as significant vegetation communities or fauna habitats)
- soil characteristics and intactness
- terrestrial vegetation community types (note that the vegetation descriptions would be based on dominant species for each vegetation structural component)
- listed threatened flora species and fauna habitat features, such as hollows, logs and burrows (the fauna habitat quality for each mapped vegetation community type would be assessed)
- incidental fauna sightings
- the presence of weeds and/or feral animals (i.e. indication of scats, tracks, wallows etc.)
- general land use description.

For this assessment, the environmental scouting included a 4-hectare area around the proposed exploration areas, plus an additional 500 m buffer to allow for future flexibility for the proposed Origin exploration activities.

A 250 m buffer each side of an existing access track were scouted to allow for locating camps, gravel pits and water supply bores in the future. Where the access tracks were located on a property boundary, the buffer was 500 m out into the property the track was located on.

It is noted that not all of the nominated areas scouted for the exploration areas and/or access tracks will be affected by site activities, but sufficient size was allowed to provide flexibility in the siting of infrastructure and borrow pits, which in turn can be used to minimise environmental and heritage impacts (e.g. significant tree or habitat avoidance, Sacred Site/archaeological artefact avoidance).

3.0 Land Condition Assessment

The results of the LCA and desktop review has been summarised in the following sections. The area covered during the assessment is shown in Figure 2. During the helicopter survey, two sites proposed for exploration activities were ground-truthed, along with the proposed access tracks (refer Section 1.2). Scoping for the gravel pits was also conducted.

3.1 Climate

The climate of the Origin permit areas can be described as arid to semi-arid, with rainfall decreasing in frequency and quantity from north to south. The climate is monsoon influenced, with a distinctive wet and dry season experienced through the year. The area experiences a wet season during the summer months between October and March, which is dominated by hot and wet conditions. Whilst the dry season during the winter months experiences mild days and cool nights between May to August. September and April are transitional months, with occasional rainfall. The average annual rainfall in the north of the permit area is listed at 680 mm at Daly Waters. The southern portion of the permit area records an average annual rainfall of 535 mm at Newcastle Waters and 608 mm listed at Elliott. Approximately 90% of the rainfall occurs during the Wet Season, and annual totals show moderate variability from year to year.

The maximum rainfall for the permit area occurs during January and February. Daly Waters experience the highest rainfall in the region at this time, with 165 mm during each month, followed by Elliott (133-164 mm during each month) and Newcastle Waters (125-130 mm during each month). July and August experience the least amount of rainfall and are the driest months across all three weather monitoring sites, ranging from one to four mm of rainfall. The annual rainfall pattern within the area is highly variable and becomes increasingly unpredictable the further move away from the coast. Drought conditions are known to occur in the region once every ten years (Holt and Bertram, 1981).

The land condition assessment was undertaken between 28 and 29 August 2018. The timing of the assessment was such that it fell within the dry season. The Daly Water airstrip station recorded a higher than average rainfall of 590 mm between January to April 2018 wet season compared to the mean rainfall from 1939 to 2018 of 482 mm.

The average annual rainfall experienced across the region (which includes the BOM data from Daly Waters Airstrip and Elliot) is shown in Table 3.

Table 3 Annual rainfall 2016-2018

Year	Annual Rainfall (mm)		Months Rain was recorded	
	DW	NW	DW	NW
2016	608	570	12	9
2017	866	607	7	6
2018*	590	270	4	4

DW – Daly Waters Airstrip, NW – Newcastle Waters.

Data sourced from Bureau of Meteorology, Climate Averages for Station 014626 Daly Waters Airstrip recorded from 1939-2018, Station 015131 Elliot recorded from 1949-2018. * note 2018 is only current to date (October 2018)

Due to the timing of the LCA occurring at the end of the dry not all species were able to be identified, however sufficient data was able to be captured to obtain a good understanding of the land condition within the proposed lease areas to help inform required management measures for the protection of the environment.

The proposed lease sites and the short access roads are unlikely to be impacted by the onset of the wet season because they are located outside of the adjacent major flow paths and creeklines within the permit area (refer to Section 3.2).

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KALALA
BIRDUM CREEK
NUTWOOD DOWNS
Kalala
KALALA
TANUMBIRINI
Daly Waters
KALALA
EP98
Cooee Hill
KALALA
EP117
AMUNGEE MUNGEE
TANUMBIRINI
Dunmarra
MILNER LAGOON
Hayfields
Kyalla 117 N2
Vellkerri 76 N2
GP1
GP2
GP3
GP4
GP5-
GP6
GP7
HAYFIELD
BEETALOO STATION
EP76
HAYFIELD
MURRANJAI
EP117
HAYFIELD
Beetaloo
Newcastle Waters
NEWCASTLE WATERS
Elliott
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NEWCASTLE WATERS
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LEGEND

- Homestead
- Place Name
- Populated Place
- Highway
- Minor Road
- Tracks
- Access Tracks
- Cadastre
- Permit Areas
- Bullwaddy Conservation Reserve
- Helicopter Transects
- Gravel Pits

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage -

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Heritage Assessment Transects

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Figure 2

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A3 size

3.2 Topography, Surface Water and Drainage

The permit area is located within three main topographic zones. These are primarily made up of black soil plains in the south, laterite plains in the north and small sections of bedrock hills in the south west and north east of the permit areas (Tickell, 2003). The proposed lease areas occur within the lateritic plains. The topography of the two sites have low relief and surface water flow ultimately drains in a south and south westerly direction.

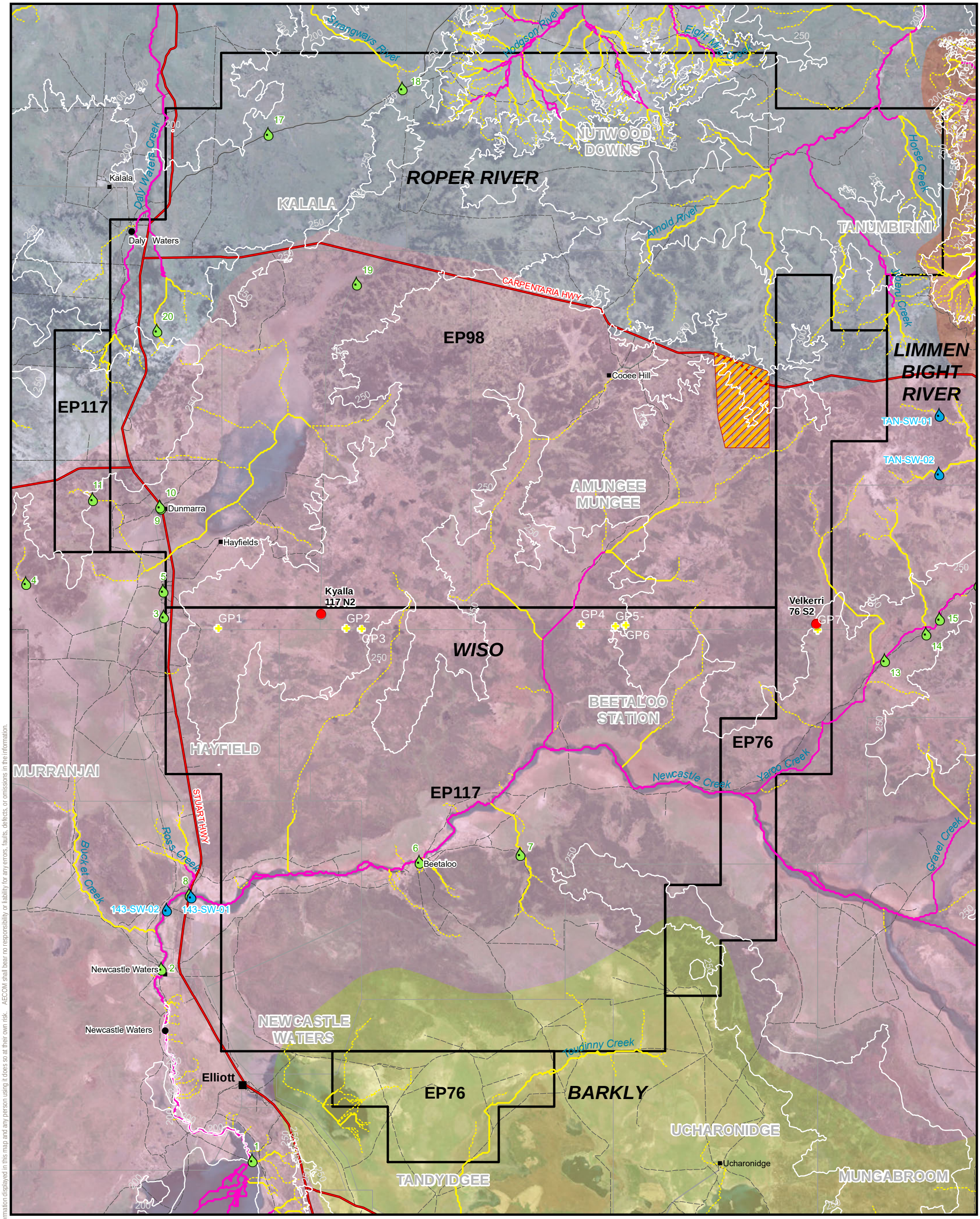
Three main river basins, Roper River Basin to the north, Wiso River Basin in the centre and the Barkly River Basin in the south occur within the exploration permit area (Figure 3). All the proposed lease areas are located within the Wiso River Basin. The Wiso River Basin covers the southern half of EP98 (south of the Carpentaria Highway) and the majority of EP117 and is internally drained by Newcastle Creek and a number of small ephemeral creeks. Newcastle Creek flows into Lake Woods, which is located south of Newcastle Waters Station.

Lake Woods covers an area of inundation of approximately 50,000 ha in normal rainfall years, extending to 80,000 ha in exceptionally wet years, after which it can retain water for several years (AECOM, 2015). Lake Woods is described as a major quasi-permanent surface water body in the region, although some semi-permanent and many ephemeral waterholes are located across the permit area (HLA, 2006b) and is listed as a Site of Conservation Significance by the Department of Environment and Natural Resources (DENR) and is listed on the Directory of Important Wetlands in Australia. Lake Woods is listed as a wetland of national significance in the Directory of Important Wetlands in Australia (DIWA: NT013 Lake Woods). The site meets criteria 1, 2, 3, 4, 5 and includes DIWA wetland types: B1, B6, B10, B13 and B14.

Although Lake Woods is located outside of the Exploration Permit Areas, it is fed principally by surface inflow of Newcastle Creek originating more than 160 km north-east on Amungee Mungee Station (NTG, undated). During the period of inundation, Lake Woods supports over 100,000 waterbirds including internationally significant numbers of Plumed Whistling-Duck. Numerous bird species nest and feed in the diverse wetland habitat, and the conservation group ‘Birdlife International’ nominated Lake Woods as an ‘Important Bird Area’ (IBA). The lake also includes the largest area of lignum swamp in the Northern Territory and in tropical Australia (NTG, undated).

Newcastle Creek (Stream Order 4) and a number of small intermittent streams (Stream Order 1 and 2) are located along the proposed access tracks to Velkerri 76 S2 site (refer Figure 3). The streams only flow for a short period during the wet season, with waterholes forming at the beginning of the dry season. If the wet season is poor, the waterholes will often remain dry, whereas, during heavy wet seasons, large areas of the internal drainage systems are flooded. The stream banks are often lined with a scatter of small trees which highlights them from the surrounding plains.

The two proposed lease pad areas are not located within the major flow pathway of Newcastle Creek and the small intermittent streams. During the wetseason it is likely the region would experience widespread surface flooding, to a depth of 30 cm, which has previously been identified by debris being collected on fence lines (HLA, 2005).



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Kilometers

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LEGEND

- Proposed Well 2018
- Homestead
- Place Name
- Populated Place
- Contours
- Gravel Pits
- Surface Water 2007
- Contours
- Surface Water 2015
- DLRM Surface Water
- Highway
- Minor Road
- Tracks
- Bullwaddy Conservation Reserve
- Cadastre
- Permit Areas

River Basins

- Barkly
- Limmen Bight River
- Roper River
- Wiso

Stream Order

Intermittant Streams
- 1
- 2

Creeks
- 3
- 4

Rivers
- 5
- 6
- 7

LOCATION

Data sources:
Permit Area, Cadastre , Basin - NT Gov 2014.
Places - Aust Gov 2014
Highways, Roads, Drainage - StreetPro 2014

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Surface Water and Stream Order of Permit Area

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Figure 3

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A3 size

3.3 Land System

Land systems are defined because of their distinct differences from the surrounding areas and by the recurring pattern of geology, topography, soils and vegetation. Land system mapping for the permit area developed is a compilation of the Northern Land Systems (scale 1:250 000) and the Southern Land Systems (scale 1:1 000 000) (Department of Land Resource Management 2013). The data set is made up of the following:

- *Land Systems of the Northern Part of the Northern Territory* is an amalgamation of 16 existing Land System surveys with modifications to some of the original interpretations. This land system dataset is the Northern Territory contribution to Australian Soil Resource Information System (ASRIS) national soils database at scale 1:250,000.
- *Land Systems of the Southern Part of the NT* is a compilation of three existing land system surveys and the Atlas of Australian Soils (scale 1:2,000,000). It covers the southern part (approx 70%) of the Northern Territory. Published maps were made digital and edited to accommodate overlaps, gaps and mismatching boundaries. Where possible, the land system descriptions have been extrapolated into areas covered by the broader scale Atlas mapping.

Using the available information, there are 22 different land systems located within the exploration permit areas. The Velkerri 76 S2 and Kyalla 117 N2 proposed lease area and seven proposed gravel pits all occur within the Beetaloo Land System which is characterised by:

- gently undulating lateritic plains and rises
- lateritic red earths and lateritic podzolic soils
- *Acacia shirleyi* (Lancewood) forest.

3.4 Soils

The dominant soils encountered within the permit area have been derived from ancient rock formations and ancestral soils that were formed during the earlier weathering cycles. The soils are deeply weathered and leached (Orr and Holmes, 1984). The soils in the permit area have been influenced by:

- past wetter conditions that formed relict Tertiary plains which comprise highly leached and lateritic soils
- extensive areas of Post-Tertiary Alluvia on which a variety of mature soils formed
- the dissected hilly country that is dominated by skeletal soils or rocky outcrops
- a range of parent materials of residual soils, ranging from basic volcanic and highly calcareous rocks to granitoid rocks and sandstones (Christian *et al*, 1951).

The lateritic plains, located within the permit area, are classed as very strongly leached soils of the Tertiary land surface. The three main soil types located within the permit area, include:

- **Tertiary Lateritic Red Earths**, which occur on the gently undulating topography. The soil profile can be described as:

  A-Horizon Grey-brown sandy loam

  B-Horizon Reddish brown sandy clay loam

  C-Horizon Red-brown to red light clay, overlying heavy ferruginous gravel and massive laterite

- **Tertiary Lateritic Red Sands**, which occur on gently undulating to undulating topography of the Tertiary Lateritic Plain, formed from sandstones and complex parent materials of the deep sandy soils. The soil profile can be described as:

  A-Horizon Grey-brown to brown sand

  B-Horizon Brown sand

C-Horizon Red-brown to yellow-brown sand overlying pisolitic ferruginous gravel and massive laterite. Altered colouring of highly siliceous parent sandstone is only evident in the mottled and pallid zones.

- **Tertiary Lateritic Podzolic Soils**, formed on the gently undulating topography over a variety of rocks. These soils are located in the northern section of the Barkly Basin. The soil profile can be described as:

  A-Horizon Grey sand

  B-Horizon Yellowish-grey sand

  C-Horizon Yellow-grey sandy loam with ferruginous gravel overlying massive laterite, mottled and pallid zones.

Geotechnical investigations have confirmed the proposed lease sites consist of red silty sand with some gravel pieces. Although Velkerri 76 S2 test result indicated a higher percentage of gravel content compared to Kyalla 117 N2 both sites should be characterised as red silty sand. The surface soils collected during the field survey indicated the soils were slightly acidic (ph range of 5.0 to 6.2) across the permit area. A dispersion test was also undertaken on the samples which indicated that the soils were non-dispersive and maintained their shape when submerged in water. Results from the soil testing is provided in Appendix A.

There are also small sections of the proposed access track that may traverse through Black soil plain country. Black Soil Plains are located within the Barkly Tablelands, including EP76, the southern part of EP117 and a small section of EP98. The soils usually crack widely in the upper profile upon drying and have a loose, self-mulching surface. The soils are neutral to alkaline, calcareous and commonly have depths to one metre (Fisher, 2001). The cracking clay soils occur mostly on flat or gently undulating plains (‘downs’) and are associated with the exposure and weathering of sedimentary or basic volcanic rocks. The Black soils also occur on the more recent depositional landscapes in the form of alluvial clays associated with drainage lines and major river systems.

3.4.1 Erosion Susceptibility

Soil erosion susceptibility varies throughout the permit area, dependent upon the soil types, slope and extent of ground disturbance. Apart from the erosive impact of climatic conditions, soil erosion is influenced mainly by the inherent properties of the soils and the processes which occurred during the formation of the landscapes (Aldrick and Wilson, 1992).

Erosion will occur in the permit area if the land is used beyond its capacity, as is seen if land is overstocked or vehicle movements not controlled, for example. The location of proposed lease areas has been examined on the ground, to determine the risk of erosion occurring. Factors considered include the following.

- Soil type – soils with higher clay content are prone to generation of bulldust and are easily eroded by wind and water. Gravelly soils tend to be more robust to disturbance on the scale expected during the exploration program. Both sites reported a soil type of red silty sand.
- Slope – the slope of the site will determine the risk of erosion during rainfall events, with steeply inclined areas a higher risk than small undulations in the landform. All the proposed lease sites were in very flat (low relief) with a slope of <1%. During the program, the crossings of the access track on the small ephemeral streams and Newcastle Creek will require additional controls.
- Aspect – the position of the access track and pads in relation to the direction of the contour should be considered and creation of tracks across (as opposed to parallel with) the contour should be avoided.
- Rainfall – Table 4 present the erosion risk rating based on average monthly rainfall using the rating system provided in the IECA (2008) Table 4.4.2 for Daly Waters. The construction activities for all exploration activities is proposed to be commence following the wet season from April 2019 onwards. Most of the soil disturbance activities will be completed prior to the onset of the wet season in November 2019. As such, based on rainfall during the construction period, the overall risk of erosion is considered very low for the Velkerri 76 S2 and Kyalla 117 N2 sites.

Table 4 Erosion Risk Rating based on average monthly rainfall at Daly Waters

-Item	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	165.4	165.4	120.1	23.6	5.0	5.6	1.5	1.7	4.9	22.5	59.4	110
Erosion Risk*	H	H	H	VL	VL	VL	VL	VL	VL	VL	M	H

** E = Extreme (>225 mm); H = High (100+ to 225 mm); M = Moderate (45+ to 100 mm); L = Low (30+ to 45 mm); VL = Very Low (0 to 30 mm)*

Based on the sites descriptions and the results from the soil samples, the erosion risk for the proposed lease areas is considered None/Slight erosion risk. This was confirmed during the field survey in August 2018 which reported no evidence of erosion within the proposed lease areas.

Certain sections of the proposed access tracks are likely to encounter more erosion susceptible soils, such as the access track to the southern sites and where streams and Newcastle Creek are crossed (refer Section 3.2). Mitigation measures will need to be established to minimise the risk for erosion along the track and are stabilised leading up to the wet season.

Overall, the main issues to be managed in relation to soils during exploration activities in the permit areas include:

- the generation of bull dust along the access tracks. Noting previous observations have indicated bull dust had formed where the surface crust had been disturbed and then subjected to repeated ground disturbance (AECOM 2015). This was primarily in grassland areas.
- The formation erosion gullies along inappropriately placed tracks and fence lines, where a slope was present. Scolding to bedrock has previously been observed in other areas of the permit, as well as pooling of water in areas of compaction and subsidence.

3.5 Biological Environment

3.5.1 Vegetation Communities

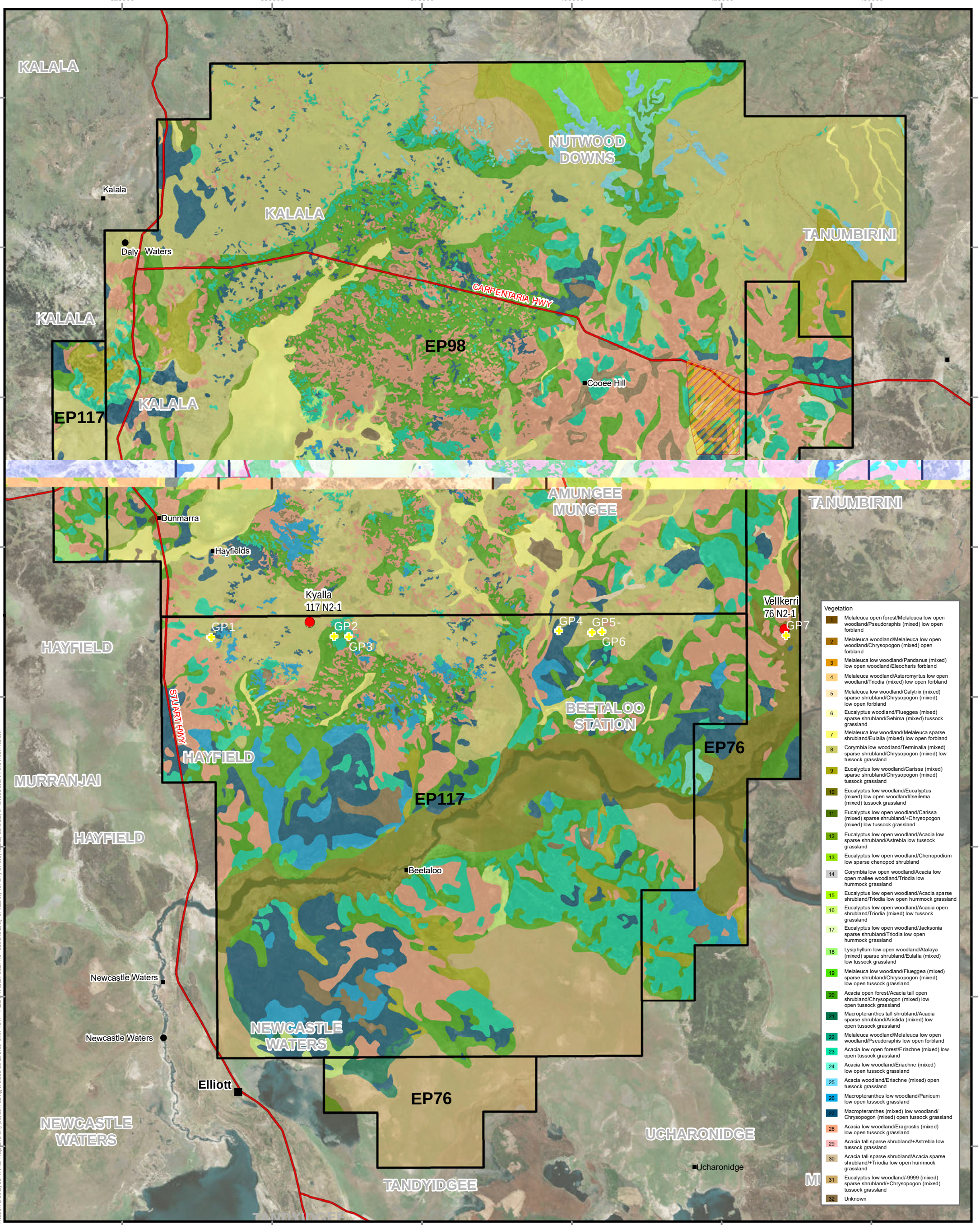
The Interim Biogeographic Regionalisation of Australia is a nationally recognised ecosystem classification system (Environment Australia, 2000). Bioregions are large, geographically distinct ecosystems that are distinguished by broad physical and biological characteristics, which can be further classified into Subregions. These regions and subregions are used as the basis for regional comparisons and conservation of flora and floristic communities.

Of the 85 bioregions mapped nationally, 20 occur within the Northern Territory and only two within the Origin permit areas, the Sturt Plateau bioregion and the Mitchell Grass Downs bioregion. The 2018 proposed lease sites all fall within the Sturt Plateau Bioregion which comprises undulating plains on sandstone, with predominantly neutral sandy red and yellow earth soils. Dominant vegetation associations included extensive areas of Lancewood (*Acacia shirleyi*) - Bullwaddy (*Macropteranthes kekwickii*) vegetation. Land condition in the bioregion is moderate to good but is threatened by impacts from weeds, feral animals, pastoralism and changed fire regimes.

Vegetation communities within the permit areas have been ground-truthed during baseline assessments in 2004, 2006 (HLA, 2006; 2006c), 2010, 2014, 2016 (AECOM, 2011; 2014; 2016) and more recently in August 2018, along with assessments of weeds, habitat, erosion and land condition.

Kyalla 117 N2 vegetation community including the turn-in is described as *Corymbia* spp open woodland with mixed *Terminalia* spp. shrubland over low tussock grassland (*Triodia bitextura*). Whereas, Velkerri 76 S2 vegetation community is described as *Eucalyptus/Corymbia spp.* low open woodland with *Iseilema spp.* mixed tussock grassland. Directly to the west and south of Velkerri 76 S2 there is a large stand of Bullwaddy and Lancewood vegetation community which the proposed access track previously traversed. Following site survey the project has determined that the access track will now be diverted around the Lancewood/Bullwaddy stand to minimise impact on a known sensitive vegetation community.

Figure 4 provides vegetation communities across the entire permit area, while Figure 5 and Figure 6 provides the vegetation communities on the proposed lease sites, Kyalla 117 N2 and Velkerri 76 S2.



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LEGEND

- Proposed Wells 2019
- Homestead
- Place Name
- Populated Place
- Highway
- Permit Areas
- Bullwaddy Conservation Reserve
- Gravel Pits

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage -

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2019 Environmental Management Plan

Vegetation Communities

PROJECT ID	60480548
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Figure 4

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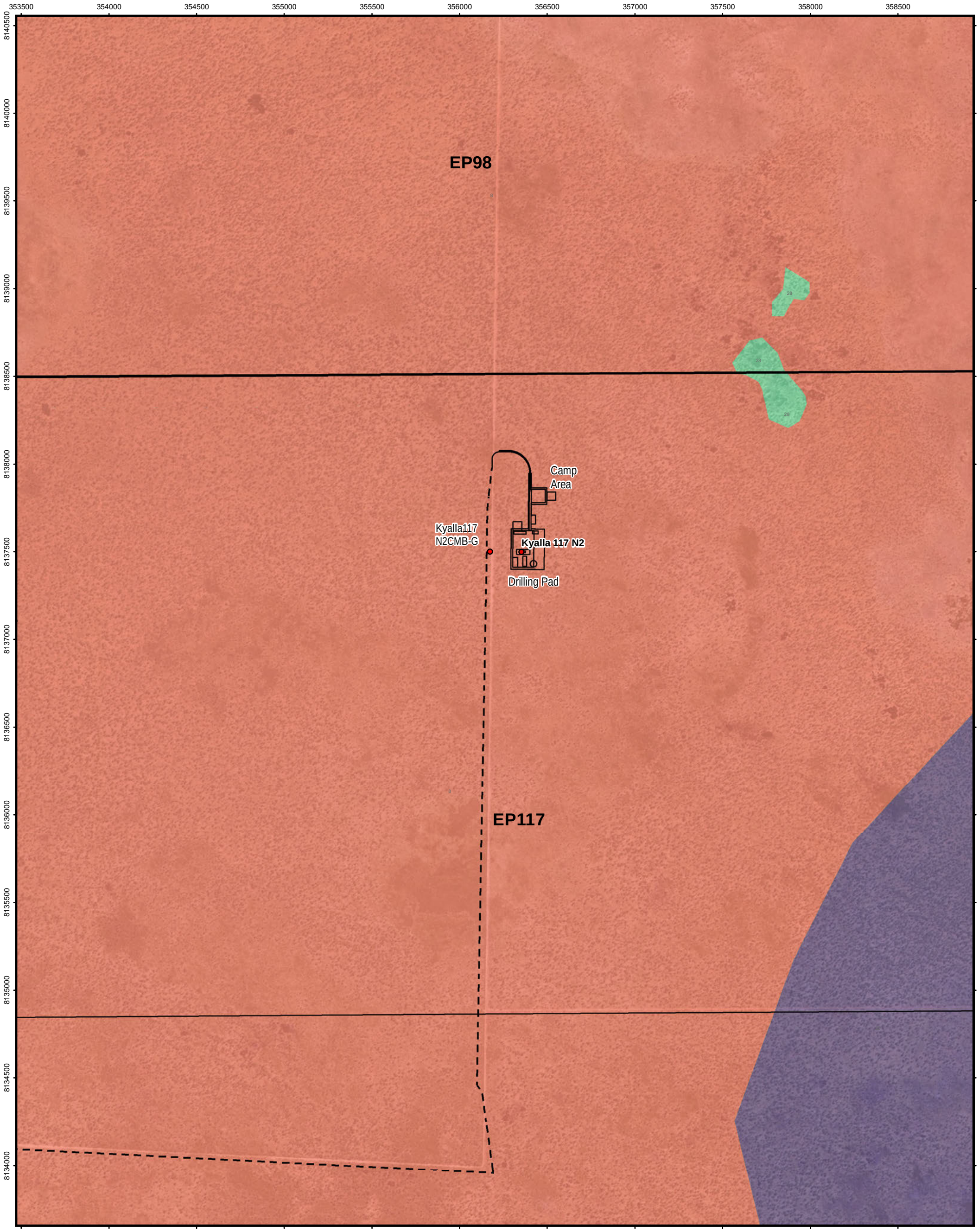

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LEGEND

- KYA117-N2 CMB-G
- Proposed 2019
- Drill Pad and Services Location
- Permit Areas

Vegetation Community

- Acacia low woodland/Eragrostis (mixed) low open tussock grassland
- Acacia open forest/Acacia tall open shrubland/Chrysopogon (mixed) low open tussock grassland
- Corymbia low woodland/Terminalia (mixed) sparse shrubland/Chrysopogon (mixed) low tussock grassland

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage -

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Kyalla 117 N2-1
Vegetation Community

PROJECT ID	60480548
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VERSION	1

Figure
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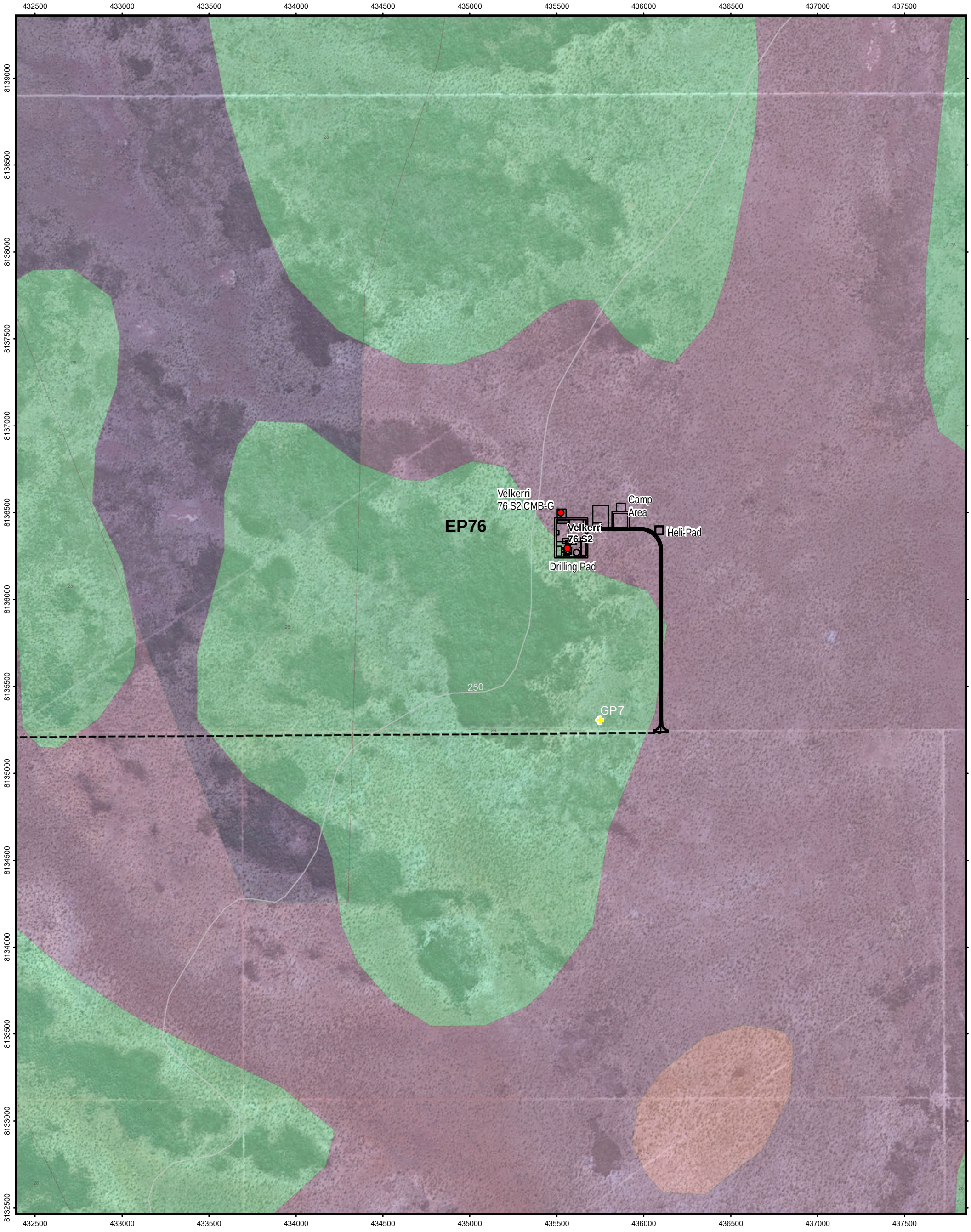

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LEGEND

- Velkerri76 S2 CMB-G
- Velkerri76 S2
- Permit Areas
- Tracks
- Contours
- Gravel Pits

Vegetation

- Acacia low woodland/Eragrostis (mixed) low open tussock
- Acacia open forest/Acacia tall open shrubland/Chrysopogon (mixed) low open tussock grassland
- Eucalyptus low woodland/Eucalyptus (mixed) low open woodland/Iseilema (mixed) tussock grassland
- Macropteranthes (mixed) low woodland/Chrysopogon (mixed) open tussock grassland

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage - StreetPro 2019

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Velkerri 76 S2-1

PROJECT ID	60480548
CREATED BY	jace.emberg
LAST MODIFIED	20-May-2019
VERSION	1

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The approximate 107 km of the existing access track is predominantly surrounded by the same vegetation unit as Kyalla 117 N2, with patches of Bullwaddy and Lancewood, including at the proposed entrance off the Stuart Highway and surrounding some of the Gravel Pits. In addition, there are some areas of minor stands of Melaleuca low open wood and mixed acacia woodlands.

Previous exploration activities in the permit area provided some understanding on how the vegetation communities regenerated following clearing and rehabilitation. The rehabilitation monitoring following previous exploration programs were undertake during 2007 and again in 2013 (HLA, 2007 and 2013). It was noted that in the first year the success of rehabilitation was greatest in communities with grassland understory (primarily due to annual grass growth), whereas woodlands (mainly Lancewood and Bullwaddy) showed low levels of natural regeneration. By 2013, six years after disturbance the origin seismic lines through the Lancewood were such that there was almost no difference in the canopy height to the surrounding Lancewood communities.

The vegetation types described for the identified gravel pit locations are described in Table 5.

Table 5 Gravel Pit Vegetation Description

Gravel Pit	Vegetation Description
GP1	Corymbia low woodland/Terminalia (mixed) sparse shrubland/Chrysopogon (mixed) low tussock grassland
GP2	Acacia open forest/Acacia tall open shrubland/Chrysopogon (mixed) low open tussock grassland
GP3	Acacia open forest/Acacia tall open shrubland/Chrysopogon (mixed) low open tussock grassland
GP4	Macropteranthes (mixed) low woodland/Chrysopogon (mixed) open tussock grassland
GP5	Corymbia low woodland/Terminalia (mixed) sparse shrubland/Chrysopogon (mixed) low tussock grassland
GP6	Corymbia low woodland/Terminalia (mixed) sparse shrubland/Chrysopogon (mixed) low tussock grassland
GP7	Acacia low woodland/Eragrostis (mixed) low open tussock grassland

The vegetation throughout the permit area during the August 2018 survey appeared in very good condition with minimal impacts from grazing, fire and erosion.

3.5.2 Flora

A total of 805 plant species have been recorded within the wider region, during the August 2018 survey 10 dominant flora species were identified at Kyalla 117 N2 and Velkerri 76 S2 (Appendix B). As the survey was conducted during the late dry season, grasses and other annual species were difficult or impossible to identify due to the lack of inflorescence or because they had already died-back.

No Commonwealth or NT threatened plant species were identified as occurring by the Protected Matters Searches (refer Appendix C). One species, the prostrate, herbaceous vine *Ipomoea argillicola*, is listed as Near Threatened under Section 29 of the *Territory Parks and Wildlife Conservation Act 2000* (TPWC Act) and could potentially occur in the project sites, although has not been reported in previous and current surveys. NT flora data base shows that this species has been recorded from the Bullwaddy Conservation Reserve and at locations surrounding the area in previous searches (AECOM, 2015).

The region supports fragmented stands of Bullwaddy, which is listed under the TPWC Act as 'Least Concern', which refers to species that are either widespread or common and cannot be categorised as Critically Endangered, Endangered, Vulnerable, Near Threatened or Data Deficient. However, Bullwaddy is significant in terms of the habitat it provides for a range of native species. The extent of Bullwaddy in the permit area is far more extensive than that indicated by the NT Herbarium records.

3.5.3 Weeds

Weeds remain an increasing threat to the Barkly region's natural assets. This threat is not new and considerable time and effort has already been invested in weed management across the region (Department of Land Resource Management, 2015).

Figure 7 and Table 6 provides a list of weed species that are known to occur or likely to occur within the wider exploration Permit Areas.

This information is based on:

- Mapping data provided by the Weed Management Branch, DENR.
- *Weed Management Planning Guide: Onshore Petroleum Projects* (DENR, June 2019).
- Guidelines for the *Management of the Weeds of Beetaloo 2018* (DLRM et al 2018).
- Department of the Environment and Energy (DotEE) EPBC Act Protected Matters Report database.
- Previous data collected by AECOM in the permit area.

Table 6 NT listed weeds known of likely to occur within the Permit Area

Scientific Name	Common Name	Status	Data Source
Acacia nilotica	Prickly Acacia	Class A and C, WoNS	Weed Management Branch – Mapping data DotEE Protected Matters Report
Alternanthera pungens	Khaki Weed	Class B and C	DLRM databases (DLRM *et al* 2018)
Andropogon gayanus	Gamba Grass	Class A and C, WoNS	Weed Management Branch – Mapping data
Azadirachta indica	Neem	Class B and C	Weed Management Branch – Mapping data
Cenchrus ciliaris	Buffel Grass	Not declared in NT	DotEE Protected Matters Report
Cenchrus echinatus	Mossman River Grass	Class B and C	DLRM databases (DLRM *et al* 2018)
Datura ferox	Fierce Thornapple	Class A and C	DLRM databases (DLRM *et al* 2018)
Hyptis suaveolens	Hyptis	Class B and C	Weed Management Branch – Mapping data DLRM databases (DLRM *et al* 2018)
Jatropha gossypiifolia	Bellyache Bush	Class B and C, WoNS	Weed Management Branch – Mapping data DLRM databases (DLRM *et al* 2018) DotEE Protected Matters Report
Parkinsonia aculeate	Parkinsonia	Class B and C, WONS	Weed Management Branch – Mapping data DLRM databases (DLRM *et al* 2018) DotEE Protected Matters Report

Scientific Name	Common Name	Status	Data Source
Prosopis pallida	Mesquite	Class A and C, WONS	Weed Management Branch – Mapping data DLRM databases (DLRM *et al* 2018)
Sida acuta	Spinyhead sida	Class B and C	Weed Management Branch – Mapping data
Sida cordifolia	Flannel Weed	Class B and C	Weed Management Branch – Mapping data DLRM databases (DLRM *et al* 2018)
Sida rhombifolia	Paddy's Lucerne	Class B and C	DLRM databases (DLRM *et al* 2018)
Tamarix aphylla	Athel pine	Class B and C, WONS	Weed Management Branch – Mapping data
Themeda quadrivalvis	Grader Grass	Class B and C, WoNs	Weed Management Branch – Mapping data
Tribulus terrestris	Caltrop	Class B and C	DLRM databases (DLRM *et al* 2018)
Xanthium occidentale	Noogoora Burr	Class B and C	Weed Management Branch – Mapping data DLRM databases (DLRM *et al* 2018)

Note: Declarations under the Northern Territory Weeds *Management Act 2013*:
- a Class A weed is to be eradicated
- a Class B weed is to have its growth and spread controlled
- a Class C weed is not to be introduced to the NT.
  * All Class A and B weeds are also Class C.

They survey undertaken in August 2018 and June 2019 of the proposed exploration lease areas did not identify any weed species. This suggests that the habitat condition in the areas of the proposed sites and surrounding areas were good.

Previous surveys within the Permit Area in 2014, 2015, 2016, 2018 and 2019 of drill sites and access tracks have also found that the proposed areas had a low number of weed species which suggests the habitat condition was fairly high in and around the Permit Area. Specifically, three listed species, *Parkinsonia aculeate* (Parkinsonia), *Hyptis suaveolens* (Hyptis) and *Calotropis procera* (Rubber Bush) have been recorded.

Rubber Bush (Plate 1) was recorded during the follow up survey conducted June 2019. In addition, Wild Passionfruit (*Passiflora foetida*) (Plate 2) and Stylo (*Stylosanthes* sp.) were observed throughout the area but are not listed as weed under NT legislation.

Rubber Bush (Class B and C) has previously been recorded in close proximity to the Beetaloo access track in 2016 and was also noted during the 2019 survey at the start of the Stuart Highway intersection (Plate 1). This was a patch of adult plants with seedpods.

Parkinsonia is considered a Weed of National Significance (WoNS), which are weed species that are the focus of national management programs for restricting their spread and/or eradicating them from parts of Australia. This species was not recorded within the proposed 2019 exploration area.

It is possible that additional species are present but were present in low abundance or difficult to identify due to stage of growth.

Plate 1 Rubber Bush near the Stuart Highway Intersection on Hayfield/Shenandoah

Plate 2 Wild Passionfruit also located near the Stuart Highway Intersection.

These weed species surveyed within the Permit Area and their corresponding Northern Territory *Weeds Management Act 2013* declarations are listed in Table 7.

Table 7 Species found within the permit area

Scientific Name	Common Name	Declaration	Where located
Hyptis suaveolens	Hyptis	Class B and C	Beetaloo access track Access track to Velkerri 98-E1-1 site Stuart Highway
Parkinsonia aculeate	Parkinsonia	Class B and C, WONS	Beetaloo access track
Calotropis procera	Rubber bush	Class B and C	Close proximity to the Beetaloo access track. At beginning of 2019 Access Track near Stuart Highway Intersection

In addition to these 18 species a range of annual grass weeds are known to occur along road corridors throughout the region. Hyptis (Plate 3), and Buffel Grass (*Cenchrus ciliaris*) (Plate 4) were recorded along the Stuart Highway within the NTG Road Reserves. Buffel Grass is of concern due to its invasive nature and ability to alter ecosystem function. Buffel Grass however was introduced and cultivated for livestock feed and is useful in soil stabilisation.

Plate 3 Hyptis at a road side truck stop on the Stuart Highway

Plate 4 Buffel Grass on top of a Table Drain along Stuart Highway

The *Guidelines for the Management of the Weeds of Beetaloo 2018* (DLRM et al 2018), also identifies a number of introduced plants that have previously been recorded within the proposed permit areas and have been identified as problem weeds in one or more locations across Northern Australia. It is noted that these are not listed under the NT *Weeds Management Act* but could be of concern elsewhere in Australia. Understanding the potential weeds likely to occur within the Permit Area is particularly important when proposed activities include transporting machinery and equipment during the construction process.

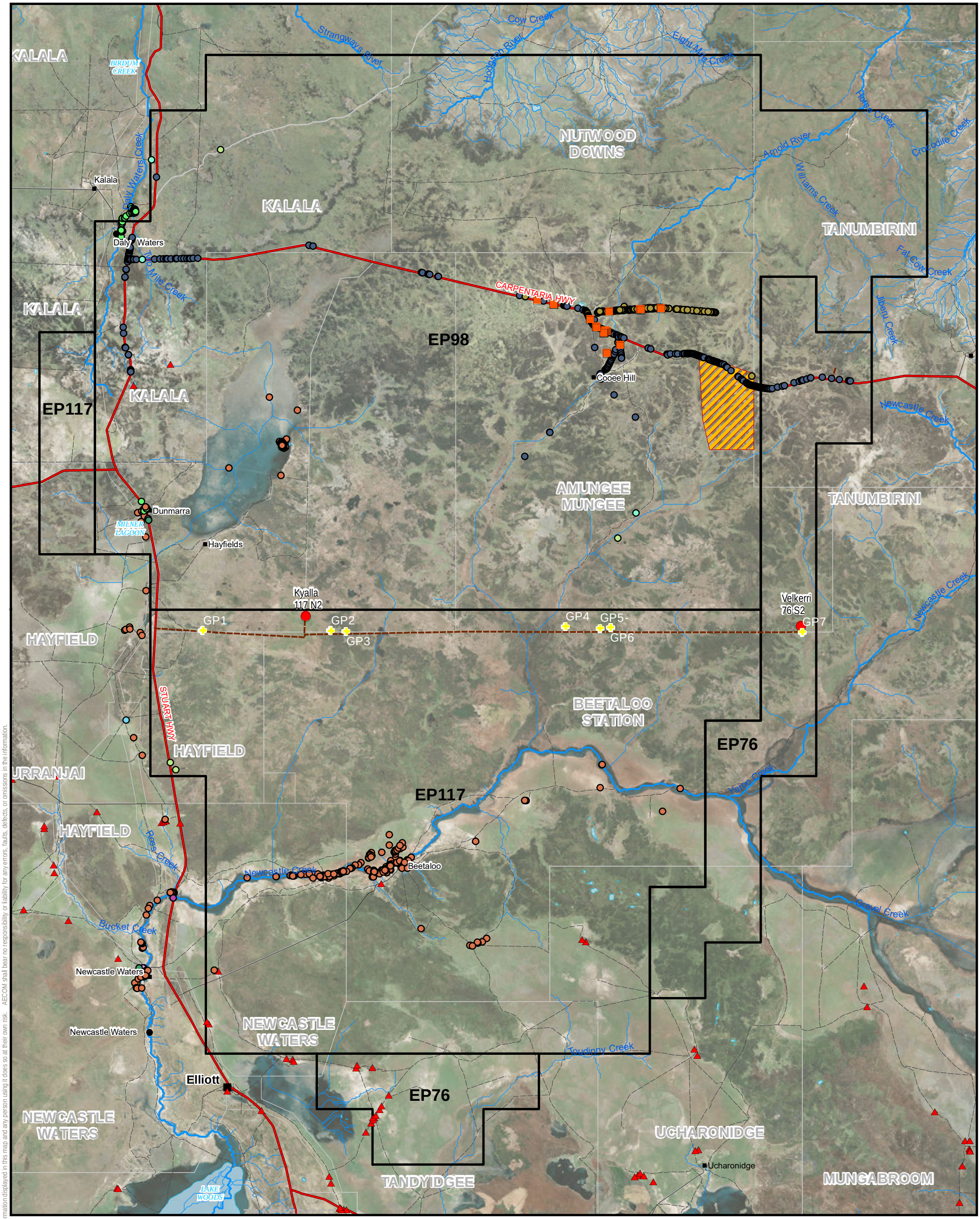
The *Barkly Regional Weed Management Plan* provides additional information on regional weed management priorities and management actions to support landholders in their obligations to manage weeds on their land (DLRM, 2015).

This plan includes a list of alert weed species. These species are not yet naturalised in the region but have the potential to have a high level of impact to the region should they become established. The likelihood of the species naturalising and spreading in the region is perceived to be high (DLRM, 2015).

The alert species identified the *Barkly Regional Weed Management Plan* are listed Table 8. If found the program EMP requires the Weed Management Branch to be contacted for identification and disposal.

Table 8 Alert species identified in the Barkly Region

Scientific Name	Common Name	Declaration
Cenchrus setaceum	Fountain grass	Class B and C
Parthenium hysterophorus	Parthenium	Class A and C, WONS
Cryptostegia grandiflora	Rubber vine	Class A and C, WONS



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GEOCENTRIC DATUM OF AUSTRALIA 94

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LEGEND

- Proposed Wells 2019
- Homestead
- Place Name
- Populated Place
- Major Stream
- Minor Stream
- Access Tracks
- Highway
- Minor Road
- Tracks
- Cadastre
- Permit Areas
- Bullwaddy Conservation Reserve
- Gravel Pits

Weed Name

- Athel pine
- Bellyache bush
- Burr - Noogoora
- Gamba grass
- Grader bush
- Hyptis
- Mesquite
- Neem
- Parkinsonia
- Prickly acacia
- Sida - Flannel weed
- Sida - Spiny head
- Gamba Grass
- Rubberbush

LOCATION

Data sources:
Permit Area, Cadastre - NT Gov 2019.
Places, Vegetation - Aust Gov 2019
Highways, Roads, Drainage - StreetPro 2019

ORIGIN ENERGY RESOURCES LIMITED
2019 Environmental Management Plan

Weeds of the Permit Area

PROJECT ID	60480548
CREATED BY	jace.emberg
LAST MODIFIED	20-May-2019
VERSION	1

Figure 7

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3.5.4 Fauna and Habitat

Previous surveys and database searches indicate that the permit areas are an important area for a diverse array of fauna. The NT Fauna database provides records for the following fauna species (excluding migratory birds): 32 species of mammal, 198 species of birds, 96 species of reptiles and 19 species of frogs. Surveys undertaken elsewhere within the region have recorded:

- 78 bird, 33 reptile, 11 mammal and six frog species in the Bullwaddy Conservation Reserve (PWCNT, 2005)
- 148 bird, 47 reptile, 21 mammal and six frog species in the Junction Stock Reserve and nearby Newcastle Waters (Fleming *et al*., 1983)
- 157 bird species within the project area as determined by a search of the Birds Australia bird atlas database (Birds Australia, 2010).

The proposed exploration sites are all located within similar habitat types consisting primarily of open *Eucalyptus*/*Corymbia* woodland with a tussock grass understorey. There are Bullwaddy/Lancewood communities around the proposed sites and individuals of both species are dispersed throughout. In the wider landscape, including proposed access tracks, additional vegetation types include those associated with drainage lines, grasslands/floodplains and acacia shrublands.

Eucalypt/Corymbia woodland provides habitat for a range of species. The proposed sites had high native grass cover and included numerous species suitable for granivorous birds (seed eaters). Dense leaf litter and numerous logs provide suitable refuge and foraging sites for fauna such as reptiles. Although most of the species found in this vegetation type are widespread in the tropical savannas of the Northern Territory, some such as the threatened Crested Shrike-tit (*Falcunculus frontatus whitei*) are rare and known to utilise this habitat (DoTEE, 2014, Ward, 2008). Many of the sites have a high density of hollow-bearing trees that provide important habitat for many fauna species. Avoiding clearing large hollow-bearing trees will reduce the impact to native wildlife within the permit area.

Savanna grasslands and open woodland provide suitable habitat for species such as Emu (*Dromaius novaehollandiae*) and Australian Bush Turkey (*Ardeotis australis*. Drainage lines and seasonally inundated grasslands may also provide habitat for migratory species during the wet season and are breeding areas for frogs. Limiting disturbances in these areas and avoiding these areas during the wet season would limit impacts on fauna.

3.5.4.1 Threatened Fauna

A search of the DotEE Protected Matters database of nationally significant fauna (PMST), the NT Government fauna database (NRM Infonet), and records from the Atlas of Living Australia (ALA) was undertaken for the proposed lease areas and access tracks. The search results indicate the potential presence of 15 fauna species listed as threatened under the EPBC Act and/or the TPWC Act (Table 9). These included ten birds, eight mammals and two reptiles.

The likelihood assessment of species occurrence is based on the availability of suitable habitat within the permit area, records in the vicinity and distributional data. Therefore many of the threatened and migratory fauna species indicated in databases as ‘occurring’ or ‘likely to occur’ have been assessed as *unlikely to occur* within the proposed exploration lease areas. As some areas in the proposed lease area have not been subject to intensive survey and some species are very cryptic, a conservative approach has been taken to assess species presence. A full description of each species, their distribution and habitat associations are outlined in Table 9 below.

No core habitat for threatened fauna was identified at the sites. However, some species may possibly occur and are known to occur in the wider landscape. Threatened species that may possibly occur include:

- Gouldian Finch *Erythrura gouldiae* (E-EPBC Act, VU-TPWC Act)
- Crested Shrike-tit (northern) *Falcunculus frontatus whitei* (VU-EPBC Act, NT-TPWC Act)

Research has shown that critical components of suitable habitat for the Gouldian Finch include suitable nesting trees during the breeding season (particularly *E. tintinnans*, *E. brevifolia* or *E. leucophloia*), a water source and a diverse range of favoured annual and perennial grasses (DoE,

2015). No nesting habitat was recorded during the surveys and it is unlikely this species breeds in close vicinity of the sites. During the wet season Gouldian Finches move from breeding habitat on hillsides with suitable trees down to lower lying areas where they forage on perennial grasses such as *Triodia* sp., *Alloteropsis semialata*, and *Chrysopogon fallax* (Palmer *et al*. 2012). Some of the perennial grasses were recorded during recent surveys so potential foraging habitat is present; however, there are limited records in the vicinity of the sites suggesting it is not an important area for this species.

The Crested Shrike-tit lives in dry Eucalypt forests and woodland where it feeds on insects from the canopy and also under bark (Ward, 2008). It has been recorded in wet Melaleuca open woodlands, woodlands dominated by Nutwood (*Terminalia arostrata*), Bloodwoods with flaky bark and ironwood (DoE, 2014, Ward, 2008). In the NT, nesting has been recorded from September through to January and nests are built in terminal branches at the top of trees (Ward *et al*., 2009). The stronghold of this species is north of this location and only one old record exists near Borroloola. Although it is possible this species may be present in the area, it is unlikely to represent an important area for this species and the impact of the proposed activities, given their size, would be small.

The Grey Falcon (*Falco hypoleucus*) is a widespread species listed as Vulnerable in the NT that is considered possibly to be present in the study area. The Painted Honeyeater (*Grantiella picta*) has been known to occur in the study area, however, given it does not breed in the NT it would only be present intermittently for foraging. Based on the field assessment there was no breeding habitat recorded, and depending on grass seed and water availability it is unlikely the study area comprises core habitat for this species.

As records of species may be limited in remote areas the precautionary principle has been applied. There are some species that have been assessed as possibly occurring even though their primary habitat is not found within the proposed sites or access tracks. These include species that are associated with ephemeral wetlands, low lying areas that may be seasonally inundated and creeks. During the wet and early dry season these areas may sustain threated species such as wetland birds (including migratory species) and also the Plains Death Adder (*Acanthopis hawkei*).

Table 9 EPBC and TPWC Listed Threatened Species and Likelihood of Occurrence

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
Birds					
Calidris ferruginea Curlew Sandpiper	Marine Migratory	VU	In the NT this species occurs around Darwin, north to Melville Island and Cobourg Peninsula, and east and south-east to Gove. It has been recorded inland from Victoria River Downs and around Alice Springs (Higgins & Davies 1996).	Coastal habitats, inland it has been found around lakes, dams and ephemeral/permanent waterholes.	Unlikely (suitable habitat not present at survey sites but potential sporadic in wider landscape)
Erythrotriorchis radiatus Red Goshawk	VU	-	Found across most of Northern Australia, in the NT most records are from the Top End but there are records from central Australia (Pizzey & Knight, 2012).	Red Goshawks occupy a range of habitats, often at ecotones, including coastal and sub-coastal tall open forest, tropical savannahs crossed by wooded or forested watercourses. In the NT, it inhabits tall open forest/woodland as well as tall riparian woodland (Aumann & Baker-Gabb, 1991).	Unlikely (no records and core habitat absent)
Erythrura gouldiae Gouldian Finch	E	VU	Formerly widespread across northern Australia. In the NT they are found in the Top End south past Daly Waters (Palmer *et al*., 2012).	Gouldian Finches occupy different habitat types in the breeding and non-breeding season. Breeding habitat consist of hillsides with suitable nesting trees. In the non-breeding season they are found in lowland drainages to feed on suitable perennial grasses (Dostine & Franklin, 2002).	Possible (sporadic, foraging only, no recent records)
Falcunculus frontatus whitei Crested Shrike-tit (northern)	VU	NT	This species has a very patchy distribution with records from the Victoria River District to Maningrida. Only one record near Borroloola (1930) (Woinarski & Ward, 2012).	Occupies wet and semi-arid melaleuca and eucalypt open woodlands. May be associated with bloodwoods with flaky bark and ironwood (Ward, 2008).	Possible (no records in vicinity although suitable habitat present, very rare)

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
Falco hypoleucos Grey Falcon	-	VU	This species has a widespread distribution and records for this species exist throughout the NT. However, most records are from arid and semi-arid regions (Pizzey and Knight, 2012).	Grey Falcons inhabit lightly treed inland plains, gibber desserts, sandridges, pastoral lands, timbered watercourses and, occasionally, the driest deserts. (Pizzey and Knight, 2012). Also found also in association with inland drainage systems.	Likely (probably not at proposed lease areas but likely in floodplains across the permit area)
Geophaps smithii Partridge Pigeon	VU	VU	Occurs across the Top End of the NT, declined/disappeared from lower rainfall areas (Woinarski, 2007).	Found predominantly in open eucalypt forest and woodland with grassy understories (Woinarski, 2007).	Unlikely (no records, occurs north of the permit area although some habitat present)
Grantiella picta Painted Honey Eater	VU	VU	This species is found throughout eastern Australia but breeding is known from south-eastern Australia (Pizzey and Knight, 2012). This species is rare.	This species specialises on the fruit of mistletoes although it may also forage on nectar and insects (Garnett *et al.*, 2011). Numerous large tracts of *Acacia shirleyi* with abundant mistletoes were recorded in the vicinity of the Beetaloo sites.	Possible (records from Barkly Tablelands but none in close vicinity, habitat present, foraging only)
Polytelis alexandrae Princess Parrot	VU	VU	Occupies arid lands in Australia where it is patchily distributed (Woinarski, 2007).	Found in sand dune habitat, spinifex with eucalypts, and shrubs such as acacias, hakeas, and eremophilas (Pizzey and Knight, 2012; Woinarski, 2007).	Unlikely (most records from southern arid region, not primary habitat)
Rostratula australias Australian Painted Snipe	CE	VU	In the NT, probably occurs in central and southern area although it also possible occurs in the northern portion of the area (Woinarski *et al*, 2007).	These birds prefer a habitat of recently flooded temporary vegetated wetlands during the non-breeding period and brackish temporary freshwater wetlands with minimum vegetation during breeding periods. Birds usually forage in thick, low vegetated areas during the day (Curtis *et al*, 2012).	Unlikely* (one record, no suitable habitat at drill sites but may be present in the wider landscape during the wet season)
Tyto novvaehollandiae kimberli	VU	VU	Distributed in Northern Australia although not well	This species inhabits tall open eucalypt forest in the NT, especially those associated	Unlikely

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
Masked Owl (northern)			known. In the NT, occurs from Cobourg south to Katherine and the VRD and east to the McArthur River (DOTE, 2014)	with *E. Miniata* and *E. tetrodonta (*Woinarski, 2007*)*. Also found in riparian and monsoonal forest and rainforest (DOTE, 2014)	(primary habitat absent)
Mammals					
Dasyurus hallucatus Northern Quoll	E	CE	Found throughout most of Northern Australia although now restricted to six main areas (Menkhorst & Knight, 2011). In the NT it is found in the Top End as far southeast as Boroloola (DOTE, 2014). One previous record from Shenandoah Pastoral Lease (unknown date).	Northern Quolls do not have highly specific habitat requirements although the most suitable appear to be rocky habitats (Woinarski, 2007). They occur in a variety of habitats across their range, including open forest and woodland. Daytime den sites provide important shelter. Shelter sites include rocky outcrops, tree hollows, hollow logs, termite mounds, goanna burrows and human dwellings.	Unlikely (no recent records, no core habitat)
Pseudantechinus mimulus Carpentarian Antechinus	–	VU	Found in QLD and the NT. In the NT it has been reported from the Sir Edward Pellew Island group, and Pungalina reserve near Borroloola.	This species is distributed in rocky habitat including sandstone boulders and outcrops with hummock grasses (Woinarski, 2004). In QLD, this species has been recorded on rocky ridges and hill-slopes (Lloyd *et al*., 2013).	Unlikely (one record but no suitable habitat)
Isodon auratus Golden Bandicoot	V	E	This species used to be found across northern, central and western Australia but decline after European settlement (Woinarski, 2007). Now only found on Marchinbar Island in the NT and small area of the NW Kimberley (Fisher and Woinarski, 1994; Woinarski, 2007).	Previously inhabiting a range of arid and semi-arid habitats, in the NT it occupies heathland and shrubland and hummock grasslands on sandstone, vine thickets and grassy woodlands (Menkhorst and Knight, 2011; Woinarski, 2007).	Highly unlikely (only persists in NE Arnhemland)

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
Macroderma gigas Ghost Bat	VU	NT	The species' current range in northern Australia ranges from relatively arid conditions in the Pilbara region of Western Australia to humid rainforests of northern Queensland. A large colony occurs in a series of gold mine workings at Pine Creek, NT. This species have also been recorded throughout the mainland Top End north of approximately 17º latitude.	The distribution of this species is influenced by the availability of suitable caves and mines for roost sites (NTG, 2018).	Unlikely (no recent records, no suitable cave located near proposed sites)
Macrotis lagotis Greater Bilby	VU	VU	This species occurs in south-western Queensland and in arid north-western Australia (Western Australia and Northern Territory). This species was previously widespread in arid and semi-arid Australia (Pavey, 2009). The most northern records are from Newcastle Waters and Wave Hill (Southgate & Paltridge, 1998).	In the NT, this species is found on sandy soils dominated by spinifex (Pavey, 2009). Low shrubs such as *Acacias* and *Melaleucas* are also common in this habitat. Also hummock grassland associated with low lying drainage systems and alluvial areas.	Unlikely (no recent records, primary habitat limited in permit area)
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-Tailed Bat	CE	DD	Wide distribution from India through south-eastern Asia to the Solomon Islands, including north-eastern Queensland and the NT. The north-eastern Australian populations are described as the subspecies S. s. nudicluniatus, although it is	Previous specimens have been collected from Open *Pandanus* woodland fringing the sedgelands of the South Alligator River in Kakudu National Park (Friend and Braithwaite, 1986). In the NT, it has also been recorded from eucalypt tall open forests (Churchill, 1998)	Unlikely (no records and primary habitat not present)

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
			not clear whether this should be applied to the NT population (Duncan et al. 1999). There have been very few (<5 confirmed) records since (McKean et al. 1981; Thomson 1991). All confirmed records have been from the Kakadu lowlands.		
Trichosurus vulpecula vulpecula Common Brushtail Possum	–	E	Previously widespread in the NT, this species is now found in isolated locations in the southern NT (Woinarski, 2007).	This species occupies riparian habitat in the vicinity of rocky outcrops or slopes (Kerle *et al*., 1992).	Unlikely (no records in the vicinity of the lease area and no suitable habitat)
Rattus tunneyi Pale Field-rat	–	V	Inhabiting higher rainfall area including the Top End of the NT (Menkhorst and Knight, 2011).	This species favours dense vegetation found along rivers where it occupies burrows in loose colonies (Cole and Woinarski, 2002). However, this species can be found in a variety of habitats including woodlands if a dense understorey of grasses is present (Menkhorst and Knight, 2011)	Unlikely (one record from 1999 in greater area, primary habitat absent)
Reptiles					
Acanthopis hawkei Plains Death Adder	VU	VU	In the NT this species is found in the floodplains of the Adelaide, Mary and Alligator Rivers and the Barkly Tablelands.	Found on flat cracking soils in treeless floodplains where it forages on frogs, reptiles and rats.	Unlikely (no records or suitable habitat)
Varanus Mertensi Mertens Water Monitor	–	V	Distributed throughout coastal and inland waters in northern Australia. In the NT found throughout most of the Top	Semi-aquatic species that inhabits vegetation associated with water such as Pandanus and paperbark. Seldom found far away from water (Mayes, 2006).	Unlikely*(was confirmed during previous surveys along Newcastle

Species	Conservation Status		Distribution	Habitat	Likelihood of Occurrence
	EPBC	NT			
			End. Decrease in NT population attributed to Cane Toads.		Creek, habitat unsuitable at proposed exploration lease sites)

3.5.5 Feral Animals

Feral animals known to occur within the region include:

- Pig (*Sus scrofa*)
- Wild Dog (*Canis lupus familiaris*)
- Feral Cat (*Felis catus*)
- Cane Toad (*Bufo marinus*)
- Horse (*Equus caballus*)
- Donkey (*Equus asinus*)
- Water Buffalo (*Bubalus bubalis*)
- Camel (*Camelus dromedarius*)
- Black Rat (*Rattus rattus*)
- Domestic Cattle (*Bos Taurus*)

During the August 2018 survey evidence of cattle grazing in present or 1-2 years previously was recorded and in previous surveys of the permit area cat tracks were observed as the only non-native species recorded but based on records many species, especially Dogs/Dingo, Pigs and Cane Toads will be present in permit area. The disturbance from cattle within the proposed sites were considered to have resulted in less than 5% damage or no damage at all.

The Cane Toad is known to be present in the permit area and the Commonwealth DoTEE recognises this species as a 'key threatening process' related to their impacts on biodiversity through predation, competition, land degradation and poisoning. In the Northern Territory, the Cane Toad has been implicated in the decline of several species including a large number of reptiles such as the King Brown Snake and water monitors (Smith & Phillips, 2006).

Pest predators such as the Cat are most likely common although their abundance is difficult to assess due to their cryptic nature. Introduced predators such as Cats can impact many vertebrates (e.g. Dickman, 2009 &1996). One of the primary concerns of introduced predators in the site is the impact on EPBC listed species such as reptiles, and ground-dwelling birds. Feral cats are believed to be one of factors that have led to the decline of threatened ground-dwelling bird the Partridge Pigeon (Woinarski *et al*. 2007)

Species could be attracted to the increased activities at the site potentially increasing their abundance in the landscape, and their control should be taken into consideration during the proposed activities on site. It is of key importance during all phases of the project that care is taken to ensure that rubbish is securely contained (i.e. with suitable lids) and removed from the site as soon as possible to discourage attracting any feral animals.

3.5.6 Fire

Fire is a natural occurrence in most Australian ecosystems and plays an important role in their ecology. Fire is generally excluded from Mitchell grasslands by pastoral management in order to maintain forage throughout the dry season (HLA, 2005) whereas fire is more frequent in the Sturt Plateau.

Historically, the majority of dry season fires (June to September) have occurred in the northern half of the permit area, in EP76, EP98 and EP117. At this time of year, the fires are likely to be high intensity (HLA, 2005). Wet season fires (October to May) have occurred within the permit area. These fires are likely to be patchy and of lower intensity, depending on the state of curing of the fuel load.

Bullwaddy and Lancewood communities, which are located throughout the permit area, are fire sensitive and hot fires have the ability to reduce habitat quality for both flora and fauna species. Research suggests that fauna diversity may be impacted by a hot fire, particularly for diurnal reptiles (e.g. Legge *et al*., 2008).

Based on field data, fire disturbance was determined as follows:

- Vekerri 76 S2-1 – Fire Frequency 2-3 years previous, Intensity 1 (minor scars on some trees/shrubs and Height <1m.
- Kyalla 117 N2-1 – Fire Frequency 1-2 years previous, Intensity 4 (some trees and shrubs killed) and Height 1-4 m. It was noted that site appeared to have had a hot fire go through previously with abundance of new Acacia regrowth.

All sites that showed evidence of fire disturbance were showing signs of regrowth and recovery.

3.6 Land Condition Summary

Detailed land condition description and photographs of each of the proposed lease areas (Velkerri 76 S2-1, Kyalla 117 N2-1) are provided in Table 10 and Table 11 below.

Table 10 Velkerri 76 S2 Condition Description

Site ID	Velkerri 76 S2	Habitat photos at central point of survey site (August 2018)
Location	-16°51' 20.13, 134°23' 39.85	   
Landform and soil	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils. Trace of cracking clay soils.	
Habitat type	*Eucalyptus/Corymbia low woodland*	
Vegetation Community	Eucalyptus low woodland/low open tussock grassland This vegetation community is considered regionally extensive and not subjected to extensive clearing.	
Dominant flora species	Canopy dominated by *Corymbia dichromophloia*, *Erythrophleum chlorostachys*. Shrub layer including *Eucalyptus sp*. Ground layer species include *Aristida latifolia, Pterocaulon sphacelatum, Triodia bitextura.*	
Habitat condition	Good condition with evidence of recent grazing. Large hollow bearing trees and logs were common in the area. The large hollows provide suitable nesting and shelter for numerous fauna species including reptiles, arboreal mammals, and nocturnal birds. The habitat contained moderate refuge opportunities in the form of dense leaf litter, dense grass cover, and woody debris. Good continuous cover adjoining adjacent woodland habitat. No evidence of weeds or feral animals.	**Additional Habitat Photos across survey site (August 2018)**  
Potential Listed Threatened Species	Grey Falcon, Northern Shrike-tit, Plains Death Adder, Gouldian Finch.	

Table 11 Kyalla 117 N2-1 Condition Description

Site ID	Kyalla 117 N2-1	Habitat photos at central point of survey site (August 2018)
Location	-16°50' 29.01, 133°39' 0.16	   
Landform and soil	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils	
Habitat type	*Corymbia* low woodland	
Vegetation Community	*Corymbia* low woodland/*Terminalia* (mixed) sparse shrubland/*Chrysopogon* (mixed) low tussock grassland This vegetation community is considered regionally extensive and not subjected to extensive clearing.	
Dominant flora species	Canopy dominated by *Corymbia dichromophloia, Eucalyptus setosa*. Shrub layer including *Acacia ancistrocarpa, Alphitonia pomaderroides, Brachychiton paradoxus.* Ground layer species include *Triodia bitextura*	
Habitat condition	Good condition with evidence of recent grazing. Vegetation appeared to heavily burnt in recent years. No evidence of hollow bearing trees and logs. The habitat contained moderate to high refuge opportunities in the form of dense leaf litter, tussock grass cover, and woody debris. Good continuous cover adjoining adjacent woodland habitat and regionally extenisive. No evidence of weeds or feral animals.	**Additional Habitat Photos across survey site (August 2018)**  
Potential Listed Threatened Species	Grey Falcon, Northern Shrike-tit, Plains Death Adder, Gouldian Finch.	

4.0 Conclusion

During August 2018, AECOM undertook a land condition assessment of the two proposed exploration lease areas and access tracks to provide a baseline assessment of ecological conditions in support of Origin Energy's application to the Northern Territory Department of Environment and Natural Resources, including the preparation of an Environmental Management Plan (EMP) for various exploration activities. Additional weed survey was conducted during June 2019 to further inform conditions at the site.

The purpose of the LCA was to gather baseline information to provide an environmental condition assessment to support the proposed exploration activities to be carried out by Origin at two proposed lease sites during 2019/2020.

The LCA identified the ecological conditions and documented the site condition prior to Origin commencement of exploration within two of their Permit Areas EP76 and EP117. The information obtained during the initial LCA will assist in determining that at the end of the exploration activities that the lease areas have been rehabilitated back to its natural state.

The proposed exploration program will have a total disturbance of approximately 24.5 ha and will utilise 107 km of existing access tracks.

The desktop review and field survey assisted in identifying the potential environmental risks and impacts to the environment based on the conditions identified on site and has allowed the development of mitigation measures to minimise Origin's impact on the environment.

During the survey of the proposed exploration lease areas, as well as the areas surrounding the proposed access tracks were assessed to be in generally good condition with no to low evidence of weeds, erosion and disturbance from cattle.

The likelihood assessment concluded that no EPBC listed threatened ecological communities or threatened species are likely to be significantly impacted from the proposed exploration program activities.

Overall, the impacts of the vegetation clearing for the proposed lease areas and access tracks are considered minor from a landscape perspective. Surrounding habitat is extensive and most species are mobile and will be able to access surrounding habitat.

The mitigation measures presented in the Drilling and Stimulation EMP would assist in minimising the impacts from Origin's activities on EPBC listed species and communities.

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Appendix A

Soil Test Results

Soil Id	Photo	Soil pH	Soil Colour	Dispersion Test Observations
Kyalla N2-1		5.14	1.5YR 4/6	**Initial Observation** • Sample was fully crumbed when submerged in demineralised water. **Final Observation** • Non-dispersive, particles crumble though water remains clear.
Velkeri S2		5.02	10YR 3/4	**Initial Observation** • Sample was fully crumbed when submerged in demineralised water. **Final Observation** • Non-dispersive, particles crumble though water remains clear.
NOTE: Initial Observation - observation made when the sample was submerged in water Final Observation - observation made after 2 hours				

Appendix B

Flora Species Record,
August 2018

Appendix B Flora Species Record, August 2018

Table 12 Flora Species Recorded, August 2018 Field Survey

Family	Genus	Species
Asteraceae	*Pterocaulon*	*sphacelatum*
Caesalpiniaceae	*Erythrophleum*	*chlorostachys*
Combretaceae	*Terminalia*	*canescens*
		arostrata
	Macropteranthes	*kekwickii*
Euphorbiaceae	*Petalostigma*	*pubescens*
Fabaceae	*Acacia*	*ancistrocarpa*
		shirleyi
		sp.
Myrtaceae	*Corymbia*	*dichromophloia*
		drysdalensis
		ferruginea
Poaceae	*Aristida*	*holathera*
	Chrysopogon	*fallax*
	Enneapogon	*lindleyanus*
	Eragrostis	*spartinoides*
	Eriachne	*aristidea*
		ciliata
		nervosa
		sp.
	Heteropogon	*contortus*
	Sarga	*plumosum*
	Schizachyrium	*fragile*
	Sporobolus	*australasicus*
	Themeda	*triandra*
	Triodia	*bitextura*
		sp.
Rhamnaceae	*Alphitonia*	*pomaderroides*
Sterculiaceae	*Brachychiton*	*paradoxum*

Appendix C

DotEE Protected Matters Search Report

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

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

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

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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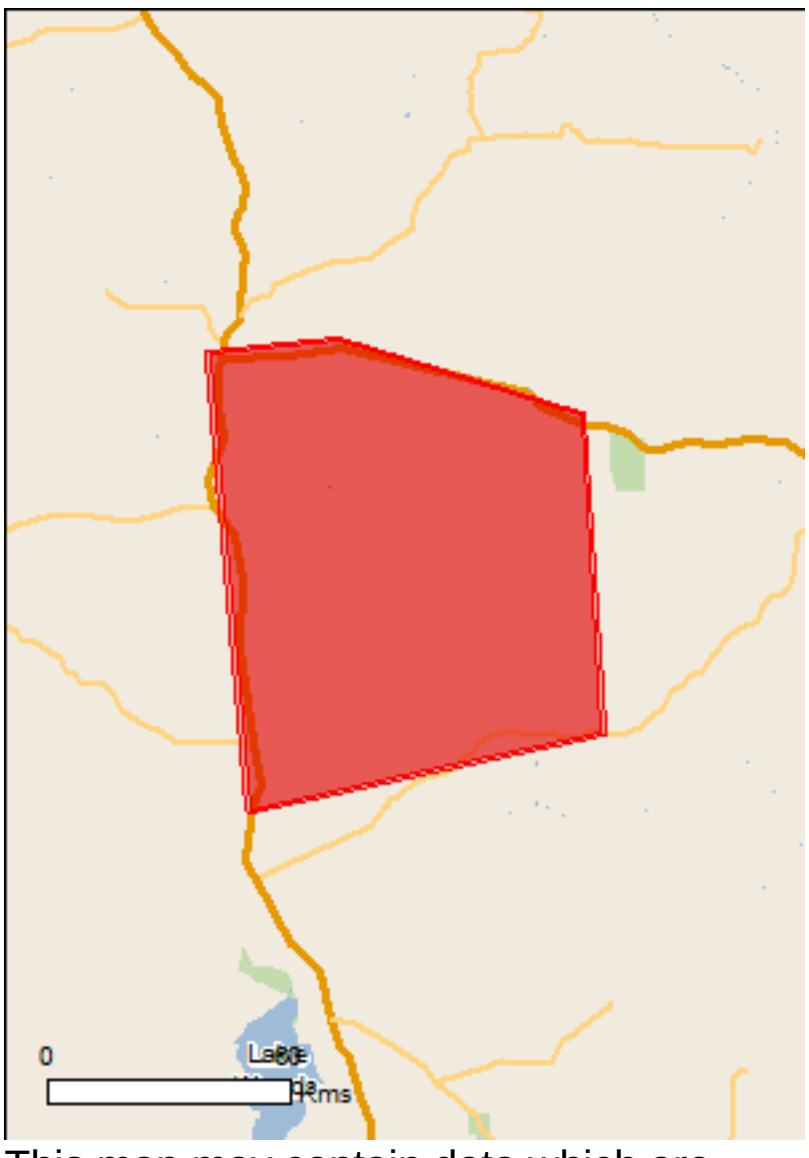

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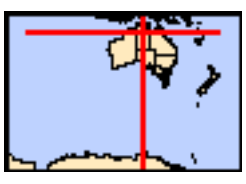

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	12
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

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

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

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	19
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	15
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat likely to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat may occur within area
Mammals		
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat likely to occur within area
Elseya lavarackorum Gulf Snapping Turtle [67197]	Endangered	Species or species habitat may occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Reptiles		
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Frew Ponds	NT

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Bubalus bubalis Water Buffalo, Swamp Buffalo [1]		Species or species habitat likely to occur within area
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Plants		

Name	Status	Type of Presence
Acacia nilotica subsp. indica		
Prickly Acacia [6196]		Species or species habitat may occur within area
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Jatropha gossypifolia		
Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Vachellia nilotica		
Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

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

Coordinates

-16.305477 133.356741,-16.297568 133.356741,-16.269886 133.641013,-16.428018 134.180716,-17.098628 134.226035,-17.263941 133.447379,-16.305477 133.356741

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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

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APPENDIX L

Unexpected Heritage Finds Procedure

Procedure
Doc #: TB2-HSE-PRO-016

Unexpected Heritage Finds Procedure

Beetaloo Sub-basin

EP 76, EP 98 and EP 117

REV	DATE	REASON FOR ISSUE	EDITOR	APPROVER
0	26 Sept 2024	Issued for use	L Pugh	M Kernke
1	17 Feb 2025	Update heritage contacts	A Court	M Kernke

Contents

Figures

1 Purpose

The purpose of this procedure is to set out the actions to be undertaken by Tamboran B2 Pty Ltd (Tamboran) staff and contractors if a suspected find of Aboriginal and non-Aboriginal cultural heritage is made during civil construction and seismic activities.

2 Scope

This procedure covers the requirements associated with:

- The identification of cultural heritage artefacts or areas within the Beetaloo Permit Area – EP 76, EP 98 and EP 117.
- The assessment of the risk and control measures to be taken if a suspected Indigenous and non-Indigenous cultural heritage find is discovered; including investigation, notification, recording and reporting, means of communication, measures to avoid cultural heritage and dispute resolution.

It applies to all fieldwork conducted in the Beetaloo Sub-basin.

3 Responsibility

These personnel are responsible for the following activities:

Vice President (VP) Environment and Permit Approvals	Heritage specialist and regulator engagement
Site Supervisor	Procedure issue and maintenance
Field Operations Manager	Implementation of this procedure
Heritage Specialist	Third party engaged to provide specialist heritage advice
All Tamboran Employees and Contractors	Complying with this procedure

4 Requirements

The following management measures will be implemented for all unexpected heritage finds and are to be included as part of toolbox discussions during civil construction activities.

4.1 Aboriginal cultural heritage

Aboriginal finds can include the following:

- Stone artefacts - sharp edged rocks that have identifiable features demonstrating evidence of human modification.
- Scarred trees - trees with symmetrical scars that might demonstrate evidence of removal of bark for use in coolamons, shields and huts.
- Grindstones - large sandstone items (either fixed in bedrock or mobile) that have manmade grooves in them demonstrating use.
- Stone axes - heavy hatchet head like stone items, typically with the leading edge sharpened
- Bone and shell - potential historical food waste dumps (also known as middens).

4.2 Historical cultural heritage

Historical finds include the following:

- Glass - coloured glass, bottles (complete or fragmentary, etc.).
- Metal - identifiable metallic objects such as cutlery, buckles, framing equipment, woodworking metal equipment, etc.
- Ceramic - plates, cups, ink wells, pipes, etc.
- Wood - identifiable human manufactured wooden items.
- Stone - identifiable human manufactured stone items (Figure 1).
- Bone and shell - potential historical food waste dumps.

Figure 1 Example of silcrete flake and quartz flake

4.3 Unexpected finds procedure

The following procedure is to be followed:

1. If an unexpected heritage find is identified during proposed works within the Project Area, work will stop immediately in the immediate area and the Tamboran Site Supervisor will be notified of the find.

2. A minimum 10 m area radius is to be cordoned off by temporary fencing around the suspected archaeological site.
3. The VP Environment and Permit Approvals should immediately contact the Senior Heritage Officer, NT Heritage Branch on 08 8999 5039 or email heritage.branch@nt.gov.au. **Note that contacting the NT Heritage Branch is compulsory under the NT *Heritage Act* for any finds.**
4. Do not resume work in the exclusion zone until a clearance is given by the Senior Heritage Officer attending.
    a. Before work can recommence, there may also be a further requirement to seek a permit through the Heritage Branch.
    b. A stop work remains in place until after the Heritage Council has made a decision regarding the Application to Carry Out Works.

4.4 Discovery of human remains

In all cases when human remains are located it is important to remember:

- The discovery of any human remains must as soon as possible be reported to the NT Police.
- It is an offence to interfere with human remains, whether buried or not.

The following process should be adhered to:

1. Work is to immediately cease, and a 50 m temporary cordon be established.
2. The Tamboran Site Supervisor and VP Environment and Permit Approvals must be immediately notified of the find.
3. If human remains are suspected, the Site Project Manager must contact the NT Police assistance line on 131 444 to advise them of the presence of human remains.
4. Police will then take control of the site and establish the area as a potential crime scene.
5. Police will undertake appropriate scientific or other procedures to assist the coroner in making an appropriate determination about the remains.
6. Police will contact the Senior Heritage Officer, NT Heritage Branch and the CEO of the Aboriginal Areas Protection Authority if necessary.
7. Resume work only after completion of Police and NT Heritage Branch investigations and appropriate removal of remains according to the NT *Coroners Act.*

5 Records

The following records should be kept and maintained in order to demonstrate compliance with the requirements of this procedure:

- Staff training/induction records.
- Unexpected finds incidents reporting; records of all finds to be kept on file, including correspondence with the relevant Government departments.

6 Definitions

Archaeological places or objects	Archaeological places or objects exist within or in the vicinity of the Tamboran Permit Areas. All such materials are protected under the *Heritage Act 2011 (NT)*.
Aboriginal cultural heritage	Has the same meaning as in the relevant Aboriginal cultural heritage legislation. It includes pre-settlement and post-settlement significant Aboriginal areas, and significant Aboriginal objects.
Aboriginal heritage awareness training	Training may consist of any of: • Briefings on relevant Aboriginal cultural heritage • Briefings on particular arrangements with Aboriginal parties • Identification of aboriginal heritage artefacts • Awareness sessions run for Tamboran staff by traditional owner/custodian groups
Burial sites	Possibility of burial sites located within the Permit Area. Under the Northern Territory Criminal Code and *Coroners Act 1993 (NT)* it is an offence to interfere with remains of a deceased person. Under the *Heritage Act 2011 (NT),* it is an offence to interfere with historical human remains (both Aboriginal and non-Aboriginal) without authorization under this Act.
Cultural heritage duty of care	Has the same meaning as due diligence as defined in Aboriginal Cultural Heritage legislation guidelines applicable to the relevant State in which activities are occurring.
Find	Means a significant Aboriginal object or, evidence of archaeological or historic significance of Aboriginal occupation of an area or Aboriginal human remains, found in the course of undertaking an activity covered by the guidelines.
Traditional custodian	A descendant of an Aboriginal ethnic group that occupied a particular region before European settlement, recognised as being traditionally responsible for cultural heritage of that area.
Traditional owners	A descendant of the Aboriginal ethnic group that occupied a particular region before European settlement, as recognised by Australian law.

7 References

1. *Northern Territory Aboriginal Sacred Sites Act 1989* https://legislation.nt.gov.au/en/Legislation/NORTHERN-TERRITORY-ABORIGINAL-SACRED-SITES-ACT-1989
2. Northern Territory *Heritage Act 2011* https://legislation.nt.gov.au/Legislation/HERITAGE-ACT-2011
3. Aboriginal Areas Protection Authority Certificate

APPENDIX M

Drilling, Stimulation, Completion and Testing Program Environmental Risk Assessment

Risk Matrix

CONSEQUENCE	IMPACT ON ORIGIN OPERATIONS – Conduct Business with Due Care: People	IMPACT ON ORIGIN OPERATIONS – Conduct Business with Due Care: Environment and Community	IMPACT ON ORIGIN OPERATIONS – Create Value: EBIT	Cash flow	NPV	EXTERNAL RESPONSE – Decisions are Subject to Scrutiny: Stakeholder Perceptions	Laws, regulation and civil actions
6 CATASTROPHIC	Multiple fatalities ≥4 or life threatening illness or total permanent disability to a large exposed group (10 or more people)	Extensive permanent damage to endangered species, habitats, ecosystems or area/s of cultural significance Extensive irreversible loss of community livelihood. Long-term social unrest and outrage	>$200m	>$1b	>$1.5b	Multiple stakeholder groups confirming coordinated action, as reflected in media channels with significant reach and influence (eg. scheduled blockade or boycott covered in media for more than 1 week).	Criminal charges against any director or senior executive involving jail or loss of right to manage the company. Public inquiry – requiring considerable resources and Executive Management time. Loss of licence to operate an asset
5 CRITICAL	1 – 3 fatalities or life threatening illness or total permanent disability to a small exposed group (<10 people)	Extensive long term partially reversible damage to vulnerable species, unique habitats, ecosystems or area/s of cultural significance Extensive reversible loss of community livelihood. Prolonged community outrage.	>$50m - $200m	>$250m - $1b	>$375m - $1.5b	Multiple stakeholder groups mobilising and encouraging others to take action, as reflected in media channels with significant reach and influence (eg. social media campaign calling for protest, escalating over several days).	Criminal charges against any director, senior executive or senior manager not involving jail or loss of right to manage the company. Prolonged major litigation – exposure to significant damages / fines / costs. Suspension / restriction to operate an asset.
4 MAJOR	Injury or illness to one or more persons, resulting in permanent partial disability	Long term reversible impacts to listed species, habitats, ecosystems or area of cultural significance Significant impacts to community cost of living, business viability or social wellbeing. High levels of community tension.	>$20m - $50m	>$100m - $250m	>$150m - $375m	More than one stakeholder group's opinion or view influencing other stakeholders, reported through media channels with some reach and influence (eg. government comments in national media or in Parliament).	Criminal charges against any employee (not described above) Major litigation – exposure to damages / fines / costs.
3 SERIOUS	Injury or illness to one or more persons resulting in hospitalisation, 5 or more days lost time or alternative / restricted duties for 1 month or more	Serious medium term reversible impacts to low risk species, habitats, ecosystems or area/s of cultural significance Moderate impacts to community cost of living, business viability or social wellbeing. Moderate levels of community tension.	>$5m - $20m	>$25m - $100m	>$37.5m - $150m	More than one stakeholder group offering an opinion or view, reported through media channels with some reach and influence (eg. state based commentary lasting one 24 hour media cycle across internet, print, television, radio).	Non-compliance with conditions of licence to operate an asset or to conduct an activity. Litigation – exposure to damages / fines / costs.
2 MODERATE	Injury or illness to 1 or more persons resulting in medical treatment, up to 5 days lost time or alternative / restricted duties for up to 1 month	Moderate short term impacts to common regional species, habitats, ecosystems or area of cultural significance Small scale impacts to cost of living, business viability or social wellbeing. Isolated examples of community tension.	>$1m - $5m	>$500k - $25m	>$750k - $37.5m	A single stakeholder group drawing attention to an incident, issue or approach, conveyed though media channels with potential reach and influence (eg. some social media complaints or local media reports).	Moderate non-compliance with external mandatory obligations or breach of contractual or other legal obligations (not described above). Litigation possible.
1 MINOR	Injury or illness requiring first aid to 1 or more persons, or no treatment (record only)	Minor environmental or community impact - readily dealt with	>$100k - $1m	<$500k	<$750k	A person or organisation within stakeholder group signaling an interest in an incident, event or approach, using channels with limited reach or influence (eg. letter of complaint/commendation).	Minor non-compliance with external mandatory obligations or breach of contractual or other legal obligations.

LIKELIHOOD	1 REMOTE	2 HIGHLY UNLIKELY	3 UNLIKELY	4 POSSIBLE	5 LIKELY	6 HIGHLY LIKELY
	<1% chance of occurring within the next year. Only occurs as a '100 year event' or less frequent.	<10% chance of occurring within the next year. Could occur within decades.	<30% chance of occurring within the next year. Could occur within the next few years.	<60% chance of occurring within the next year. Could occur within months to years.	<90% chance of occurring within the next year. Could occur within weeks to months.	Likely to happen multiple times a year
6 CATASTROPHIC	HIGH	HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
5 CRITICAL	MEDIUM	MEDIUM	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
4 MAJOR	MEDIUM	MEDIUM	MEDIUM	HIGH	VERY HIGH	VERY HIGH
3 SERIOUS	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	HIGH
2 MODERATE	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM
1 MINOR	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM

* Cash Flow - change from expectation over the life of the exposure. EBIT change from expectation over 12 – 18 month period.

Ref	Environmental Factor	Risk scenario description	Risk Source	Code of Practice	unmitigated (CoP implemented) Risk Rating			Risk mitigation Measures			Residual Risk Rating			ALARP criteria achieved?	Residual risk ALARP and Acceptable Statement	Acceptablecriteria achieved?	Scientific Uncertainty Ranking
					Consequen	Likelihood	Risk Rating	Prevent	Detect	Recover	Consequen	Likelihood	Risk Rating				
1	**Groundwater**	Changes in aquifer quality from subsurface (drilling and stimulation) activities impacting a receptor (groundwater user or Groundwater Dependent Ecosystem).	Contamination from drilling fluids. Drilling fluids used to drill through the Cambrian Limestone Aquifer (CLA) are water-based with clay inhibition in the form of KCl. This may result in temporary elevated levels of chlorides in the CLA immediately adjacent to the well bore during the drilling of the top hole section of the well. (Path 1)	B.4.10- Drilling fluids B.4.17 Groundwater monitoring	1	5	M	•Drilling fluids used to drill aquifers are low toxic, water-based with addition of bentonite and salt in the form of potassium chloride for clay inhibition. Low toxic synthetic based muds to be used for bore-hole stability from the Hayfield mudstone or below (i.e. synthetic based muds not used to drill through aquifers and all aquifers will be protected behind cemet casing) (Engineering) •Drilling Fluids included in chemical risk assessment and determined to be of low concern through adoption of standard chemical management practices (Administration) •Results of existing exploration well will be used to optimise the drilling of all proposed new wells, with fluid systems modified where fluid loss zones are anticipated (Elimination) •Impacted area likely to be localised around the immediate vicinity of each well bore (Elimination) •Karst system likely to result in rapid dilution (Elimination) •Site selection: No pastoralist extraction bores within 1km. (Elimination) •No major GDE linked to CLA within 100km of extraction point •Depth of aquifers generally below known stygofauna distribution range	•Monitoring of drilling fluid returns to identify fluid losses and modify fluid systems (Engineering) •Impact groundwater monitoring bores constructed within 20m of exploration well, with any changes detected rapidly (Engineering)	•Use of loss of circulation material (such as fibres or dissolvable marbles) to mitigate drilling fluid losses when drilling within aquifers (Engineering) •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	1	3	L	Yes	This risk consequence is managed through the COP requirements that only water based drilling fluids are to be used which will not result in a residual toxic effect to the aquifer. The consequence is anticipated to be "minor", with a locally restricted, rapidly reversible impact. The likelihood is reduced by the type of drilling fluids used to drill through the aquifer, protection of aquifer by cement casing for drilling below aquifer depth, rapid dilution of karst formations and the 4km separation distance from the closest pastoral user. The likelihood of contamination at any receptor is considered remote- with a probability lower than 1%.	Yes	Low
2		Cross flow of formation through inappropriate well barrier design and construction. (Path 1)	B.4.3 Well design and barriers B.4.2 Aquifer Isolation B.4.7 Primary cementing B.4.17 Groundwater monitoring	3	1	L	•Each well designed and constructed with multiple (4) casing barriers and specifically-engineered cement in place to protect aquifers- this includes the 18.625" Conductor casing, 13.75" surface casing, 9.625" intermediate casing and 5.5" production casing. •Casing shoe for the conductor and surface casing section to be located in the base of each aquifer unit, with cement returned to surface •Any impacted area likely to be localised, around the immediate vicinity of the E&A wells. •No driving head between saline formations (below Gum Ridge) and surface aquifers- cross flow potential is limited •No landholder bores within 1km. •No major GDE linked to CLA within 100km of extraction point	•Well Barrier Integrity Validated (WBIV) through casing pressure tests and Casing shoe integrity leak of test during the construction of each casing string •Monitoring of cement returns to surface, with cement volume sand density as per programme •Cement bond logs (CBL) completed on each well prior to stimulation to confirm integrity •Each well designed, with a Well Barrier Integrity Validation report approved by DITT as part of Well Operations Management Plan (WOMP). •Groundwater monitoring bores installed to detect and trigger response in the case of contamination.	•2 stage cement job completed where fluid losses. 1st stage places cement from the casing shoe to the base of the loss zone. 2nd stage places cement 30m above the zone of losses, using an inflatable casing packer coupled with a stage tool assembly. •Cement repair jobs (such as squeeze jobs) to be performed to mitigate poor cement coverage. •Plug and abandonment and re-drilling of new vertical/ horizontal well sections where required.	3	1	L	Yes	The risk of cross formation flow is managed through the COP which provides specific well barrier design and validation requirements to mitigate the risk of aquifer interconnectivity. The well barrier design is submitted to DITT as a part of the WOMP and must be approved prior to the commencement of drilling. The integrity of each well is validated prior to the commencement of hydraulic fracture. the consequence of an interconnectivity event is likely to be "serious", with spatially restricted (to the vicinity of the well), medium term reversible impacts. The Likelihood of multiple casing and cement failures from occurring is considered remote, with a probability lower than 1%. This is confirmed by the NT inquiry that estimated the likely well failure rate (total failure of all barriers) to be less than 0.1%.	Yes	Low
3		Crossflow through fracture growth into aquifer from stimulation activities allowing the migration of fluid and gas. (Path 2)	B.4.3 Well design and barriers B.4.13 Hydraulic Stimulation and Flowback Operations B.4.17 Groundwater monitoring	3	1	L	•Each well designed and constructed with multiple (4) casing barriers and specifically-engineered cement in place to protect aquifers- this includes the 18.625" Conductor casing, 13.75" surface casing, 9.625" intermediate casing and 5.5" production casing. •Casing shoe for the conductor and surface casing section to be located in the base (Aquitard) of each aquifer unit, with cement returned to surface Geomechanical data collected during drilling of existing wells used to understand fracture gradients. •Geomechanical modelling validated from Amgunee NW-1 stimulation results and ensure to appropriate fracture barriers are sufficient to contain the fracture propagation. •Modelling to factor in results of existing wells to optimise stimulation design. •Hydraulic fracture stimulation risk assessment completed prior to stimulation to determine fracture growth. •Minimum 1400m vertical separation distance between target formation and closest aquifer. •Each horizontal well to be at least 2-400m separated, with the separation distance determined through the Mechanical earth model and results from stimulation of existing wells. •Overlying sequences have a higher fracturing pressure reducing the risk of fracture migration out of the target shale.. •Any impacted area likely to be localised, around the immediate vicinity of the E&A wells. •No driving head between saline formations (below Gum Ridge) and surface aquifers- cross flow potential is limited •No landholder bores within 1km. •No major GDE linked to CLA within 100km of extraction point •Depth of aquifers generally below known stygofauna distribution range	•Well Barrier Integrity Validated (WBIV) through casing pressure tests and Casing shoe integrity leak of test during the construction of each casing string •Monitoring of cement returns to surface, with cement volume sand density as per programme •Cement bond logs (CBL) completed on each well prior to stimulation to confirm integrity •A Well Barrier Integrity Validation report approved by DITT as part of Well Operations Management Plan (WOMP). • Real time pressure monitoring of stimulation pressure to determine if a fracture has propagated outside the design operating envelope. •Groundwater monitoring bores installed to detect and trigger response in the case of contamination.	•Stimulation activities to cease and be reviewed where fracture propagation extends beyond the target formation (noting a 1400m separation between the closest regional aquifer). Where fracture growth is suspected to reach an aquifer, Stimulation activity on pad suspended until a go forward plan submitted by Origin and approved by DITT.	3	1	L	Yes	The risk is managed through the COP requirements for well integrity, validation and stimulation modelling. The consequences of aquifer interconnectivity is further reduced through pressure monitoring during stimulation. Any uncontrolled fracture growth is likely to be detected rapidly using pressure monitoring and managed to prevent growth into aquifers. Management of any pressure indicating interconnection would be investigated and could result in a potential repair and/ or abandonment of the well. Contamination is likely to be serious, with impacts locally restricted to the vicinity of the well and reversible over the moderate term (months to years). The likelihood of a fracture growth into an aquifer is controlled by the stress regime of the overburden and the 600m separation distance between the target formation and overlying aquifers. The likelihood is considered "remote", with a probability of <1%.	Yes	Low
4		Stimulation activity induces seismic activity that enables cross formational flow between shallow aquifers. (Path 5)	B.4.13 Hydraulic Stimulation and Flowback Operations B.4.17 Groundwater monitoring	2	1	L	•Wells are located away from known geohazards, with no significant faults within proximity of activity (Elimination) •Amungee NW-1 stimulation completed without inducing seismic activity (Elimination) •Stimulation is not linked to major seismic events (reinjection of wastewater is generally recognised as the main cause). No reinjection of wastewater proposed (Elimination) •Stimulation stages deployment will be away from geohazards to reduce the loss of fluids into any encountered faults (Elimination) • The Beetaloo is not prone to seismic activity and there is no evidence of recent earthquake activity as most faults and the major subsurface structure are confined to Cambrian or older strata. This is supported by the National seismic Hazard Assessments completed by Allen 2018 (Figure 33), which highlight the Beetaloo is located within a low hazard area (Elimination) •Any faults encountered during drilling will be assessed to determine risk of stimulating with appropriate separation distances applied (Elimination). •1400m separation distance between target Velkerri formation and the Gum Ridge Aquifer. (Elimination) •No landholder bores within 1km (Elimination) •Depth of aquifers generally below known stygofauna distribution range (elmination)	•Monitoring of stimulation pressure to detect and respond to anomalies which may indicate fluid being pumped to an open geological structure (Engineering) •Geoscience Australia's Waramungu seismic array located approximately 300km from Amungee NW and Velkerri 76 S2.It is likely that any material seismic events above a 2 Ml will be detected via this array if they occur (Administration) •An induced seismicity traffic light system has been adopted and outlined in the WOMP (Administration)	•Where seismic activity is recorded in Origin's tenure during hydraulic stimulation activities, the actions in the WOMP Traffic Light System will be enacted as summarised below: Green: Local Magnitude (Ml) <2.0- no action required Orange: ML 2.0- <3.5Ml- Report event to DITT and continue operations Red: ML> 3.5- Stimulation activity on pad suspended until a go forward plan submitted by Origin and approved by DITT.	2	1	L	Yes	The consequence of a induced seismicity, based upon evidence from the UK and US, indicates that the consequence is likely to be "moderate", with most events restricted to discrete areas at a size that generally cannot be detected at the surface (below 2 order of magnitude). Larger events are rare and generally a factor of the existing built up stress regime of the area- rather than a factor of the intensity of hydraulic fracturing or wastewater injection. The likelihood of a seismic event is reduced through the geological setting of the Beetaloo Basin itself and the safeguards implemented in the COP requiring geohazard assessment and avoidance. In the Beetaloo, there have been no earthquakes over magnitude 3 measured since records began. The area is not prone to seismic activity and there is no evidence of recent earthquake activity as most faults and the major subsurface structure are confined to Cambrian or older strata. This is supported by the National seismic Hazard Assessments completed by Allen 2018 (Figure 33), which highlight the Beetaloo is located within a low hazard area. The COP requires any geohazard (such as fault) identified prior to drilling (from existing seismic or interpreted data) or encountered during drilling to have a risk assessment to the determine the potential for reactivation. Any faults identified would not be stimulated, with a risk-based buffer applied. Given the number of wells stimulated in the US without issue and geological setting of the Beetaloo basin, the likelihood is considered remote, with a probability less than 0.1%.	Yes	Low

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					Consequen	Likelihood	Risk Rating	Prevent	Detect	Recover	Consequen	Likelihood	Risk Rating				
5			Migration via fractures intersecting with offset wells (including the adjacent horizontal wells) or intersecting an existing geohazard. (Path 2 & 5)	B.4.13 Hydraulic Stimulation and Flowback Operations	2	1	L	•Amungee NW and Velkerri site screened for geohazards using seismic before drilling • Wells are located away from known geohazards, with no significant faults within proximity of activity (Elimination) •Results from existing wells confirm the lack of significant faulting or other geohazards •Amungee NW stimulation completed without any uncontrolled fracture growth (Elimination) •Fracture modelling undertaken to determine maximum fracture growth prior to the commencement of stimulation activities. • Any faults encountered during drilling will be assessed to determine risk of stimulating with appropriate separation distances applied (Elimination). •Stimulation stages deployment will be away from geohazards to reduce the loss of fluids into any encountered faults (Elimination) •Separation of at least 200m between each horizontal well, with final separation distance determined through modelling. (Elimination) •Each adjacent well designed and constructed with multiple (4) casing barriers and specifically-engineered cement in place to protect aquifers- this includes the 18.625" Conductor casing, 13.75" surface casing, 9.625" intermediate casing and 5.5" production casing. (Elimination) •1400m separation distance between target Velkerri formation and the Gum Ridge Aquifer (Elimination) •No landholder bores within 1km (Elimination) •Closest legacy exploration well 10 km (well is abandoned). •No major GDE linked to CLA within 100km of extraction point •Depth of aquifers generally below known stygofauna distribution range (elimination)	•Monitoring of stimulation pressure to detect and respond to anomalies which may indicate fluid being pumped to an open geological structure or migrating away from target zone (Engineering) • Pressure monitoring undertaken on adjacent wells •Groundwater monitoring bores adjacent to exploration wells (Administration)	•Stimulation activities to cease where fracture propagation is suspected to have interacted with an adjacent well. Stimulation activity on pad suspended until a go forward plan submitted by Origin and approved by DITT.	2	1	L	Yes	If an integrity issue was to occur, leakage of gas and flowback would be contained within the inner casing strings of the existing adjacent well , significantly reducing the consequence and likelihood of an event. The likelihood risk is mitigated through the 1) design of adjacent E&A wells which are constructed in accordance with the COP using multiple, verified barriers (Cement and steel casing) 2) the location of the closest historic exploration well is located approximately 20km from the well pad and 3) Geohazards have not been identified during the drilling of the existing Amungee NW and Velkerri 76 S2 exploration well. The likelihood is considered Remote", with a probability lower than 1%.	Yes	Low
6			Crossflow/well integrity caused by the deviation of an E&A well into the adjacent well during drilling	B.4.1 Well Integrity Management B.4.3 Well design and barriers	3	1	L	•Separation distance between adjacent wells: Vertical separation of >10m and horizontal separation of >200m used to ensure appropriate well separation. (Engineering) •Each adjacent well designed and constructed with multiple (4) casing barriers and specifically-engineered cement in place to protect aquifers- this includes the 18.625" Conductor casing, 13.75" surface casing, 9.625" intermediate casing and 5.5" production casing.(Engineering) • 1400m separation distance between target Velkerri formation and the Gum Ridge Aquifer. (Elimination) •Subsurface collision of a well during drilling is unlikely to result in formation cross flow, with collision likely at depth (below Aquifers) and flow restricted to the well being drilled. Well being drilled will have multiple barriers (at least the conductor casing and surface casing) and blow out prevention in place during drilling (Engineering/Elimination) • Origin has conducted multiwell drilling operations across Australia, including the Cooper, Bowen and Surat Basins. Origin and their contractors experience is mature. (Engineering) •No major GDE linked to CLA within 100km of extraction point •Depth of aquifers generally below known stygofauna distribution range (elimination)	•Continuous GPS tracking of the drill bit to detect and respond to vertical and horizontal well deviations during drilling (Engineering) •Pressure monitoring undertaken on adjacent wells (Engineering)	•Well orientation to be actively controlled to prevent deviations into adjacent wells (Engineering) • Wells remediated in accordance with the code of practice (engineering) •Well suspension and abandonment may be required where wells interact during drilling (Engineering)	3	1	L	Yes	The consequence of the vertical or horizontal section of the well deviating into the adjacent well during drilling is primarily a destruction in asset value (potential plug and abandonment of both wells). Any cross flow is likely to be contained within both of the well bores- with casing and cement isolating the relevant aquifers. Given the continuous logging of GPS location of the bit, the likelihood is considered remote, with a probability less than 1%.	Yes	Low
7			Leakage of either flowback, produced water, or hydrocarbons (liquid and gaseous) from suspended or abandoned wells. (Path1)	B.4.1 Well Integrity Management B.4.2 Aquifer Isolation B.4.3 Well design and barriers B.4.15 Well suspension and decommissioning B.4.17 Groundwater monitoring B.4.15.2 D.5.5 Leak Remediation and Notification	3	1	L	•Each well designed and constructed with multiple (4) casing barriers and specifically-engineered cement in place to protect aquifers- this includes the 18.625" Conductor casing, 13.75" surface casing, 9.625" intermediate casing and 5.5" production casing (Engineering) •Casing shoe for the conductor and surface casing section to be located in the base of each aquifer unit, with cement returned to surface (Engineering) •Well design and Well Barrier Integrity Validation reports submitted to DITT as part of Well Operations Management Plan (WOMP). (Administration) •Cement plugs used to isolate hydrocarbon zones from aquifers •Cement plugs to be tagged to test plug integrity •Casing annuli pressure to be monitored to determine successful formation isolation. •Any impacted area likely to be localised, around the immediate vicinity of the E&A wells. (Elimination) •No landholder bores within 1km. (Elimination) •No major GDE linked to CLA within 100km of extraction point	•Integrity of isolation validated before and after stimulation and maintained throughout well life (Engineering) •Monitoring of cement returns to surface, with cement volume sand density as per programme (Engineering) •Cement bond logs (CBL) completed on each well prior to stimulation to confirm integrity (Engineering) •A Well Barrier Integrity Validation report approved by DITT as part of Well Operations Management Plan (WOMP) (Administration) •Routine (6 monthly) monitoring of well integrity in accordance with code of Practice (Engineering) •Routine (6 monthly) well leak detection on all wells.	•Any contamination event to be characterised and have remediation plans developed and executed immediately in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	3	1	L	Yes	The risk is primarily reduced through the stringent well barrier design, construction and verification requirements outlined in the COP. If an integrity issue was to occur, leakage of gas and flowback would be contained within the inner casing strings significantly reducing the consequence and likelihood of an event. A contamination event is likely to result in "serious", reversible moderate impacts (months to years) restricted to the vicinity of the lease pad. The likelihood is reduced by the presence of multiple casing strings, likely low leakage rate and rapid dilution of any contamination. The NT Inquiry concluding the likelihood of this scenario being very low, typically less than 0.1%. This likelihood of this risk is therefore considered to be "remote".	Yes	Low
8	**Groundwater**	Contamination of aquifer from surface activities (chemical and waste storage, handling and spills) impacting a receptor (groundwater user or GDE).	Surface contamination from storage and disposal of drilling fluids, additives, muds and cuttings on-site. (Path 3 & 7)	A.4.7 Containment of Contaminants B.4.13 Hydraulic Stimulation and Flowback Operations C.5.1 Drilling Materials C.5.2 Management of produced water from petroleum wells C.8.2 Spill Management Plan C.8.1 Wastewater Management Plan	2	2	L	•Each well cellar to be concrete lined to contain drilling fluids with pumps to prevent overflow • Synthetic based mud tanks and equipment to be located within secondary containment with all spills capture and recovered. • Specialised pressure rated hoses and valves utilised to reduce risk of leaks during transfer of synthetic based muds • Air dryer used to recover synthetic based muds from cuttings, eliminating onsite disposal of muds •Drill cuttings and muds are not expected to contain high NORMs levels- with validation testing undertaken in accordance with the COP •Open wastewater evaporation tanks and drill sumps to have a 1:1000ARI wet season freeboard (wet season freeboard 1.3m). •Drilling sumps to be lined with an impermeable coletanche liner with a permeability of less than 6 x10-14 m/s . •Drilling sump to be designed and operated to handle the drilling of multiple wells •Sump solid levels to be periodically removed from the sump between wells to maintain sump capacity •Any removed drilling muds and cuttings from the sump will be stored on an impermeable liner with a permeability of less than 6 x10-14 m/s- any fluid captured and directed to the wastewater tank •Drill cuttings and muds to be tested and either disposed of onsite in accordance with the Code of Practice or disposed of at a licenced waste management facility.. •Storage areas to be lined with an impermeable liner (with a permeability of less than 6 x10-14 m/s to prevent contamination •Separation between sump and aquifer over 70m, with interbedded clays present. •Nearest landholder extraction bore 1km. •No major GDE linked to CLA within 100km of extraction point	•Inspections of storages to be undertaken daily during the wet season and weekly at other times to identify potential liner issues. • Groundwater monitoring bores installed at Amungee NW and Velkerri 76 S2 to detect any potential contamination. •Groundwater monitoring completed quarterly to detect changes in groundwater quality.	•Any damage to sump liner to be repaired as soon as practicable. •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering) • Any spills of drilling fluid and muds to be cleaned up as soon as practicable	2	2	L	Yes	In accordance with the COP, the onsite storage and disposal of drilling fluids and cuttings can only occur if the activity does not represent an unacceptable environmental hazard. All drilling fluids, muds and cutting will be stored in a lined sump, with testing undertaken prior to final disposal. Sump liner failure is considered to be a low consequence event, with contamination likely to be restricted to the immediate vicinity of the sump due to a lack of hydrological head. Onsite disposal will only occur if determined to be safe by an independent third party. The consequences are therefore likely to be restricted to a Moderate- short term reversible impacts. The likelihood of contamination through drilling fluid, mud and cuttings storage and failure is considered highly unlikely, with the probability below 10%. This is largely due to the separation distance between the underlying aquifer, use of lined sumps and third party disposal suitability assessments.	Yes	Low

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9			Storage, handling and transportation of produced hydrocarbons (condensate). (Path 3)	A.4.7 Containment of Contaminants C.8.2 Spill Management Plan	2	1	L	•Tanks to be compliant with AS 1692 and double-lined •Spill Management Plan implemented to prevent, detect and respond to spills. •Separation between condensate storages and closest aquifer over 70m, with interbedded clays likely to limit any contaminant migration. • Any condensate transportation to be undertaken by licenced transporters (for Dangerous goods or wastes) •Flare pit to be lined and freeboard maintained to prevent contaminant releases or overflows. •Nearest landholder extraction bore 1km. •Impact and control groundwater monitoring bores installed to of to detect any potential contamination. •Spills and leaks to be cleaned up immediately. •No major GDE linked to CLA within 100km of extraction point	•Weekly inspections to identify any potential leaks or spills from storage and handling areas. •Daily level monitoring during production •Quarterly groundwater monitoring	•Spill management plan implemented outlining leak classification, response and reporting requirements •All leaks to be cleaned up as soon as practicable •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	2	1	L	Yes	The regulatory regime legislating the storage, handling and transportation of dangerous goods and combustible liquids within Australia is mature. Double lined tanks will be used which will reduce the potential for spills/ leaks. Any spillage is likely to be locally restricted, small and rapidly detected. Consequences are considered moderate, with impacts spatially restricted to the lease pad, primarily located on the surface (condensate has low mobility) an likely to be of a short term (days to weeks). The likelihood of contamination is influenced by the lack of mobility of condensate, separation distance between aquifer and the surface and likely rapid detection of any spills. The likelihood of a groundwater event from condensate management is considered remote with a <1% probability	Yes	Low
10			Surface spills from storage, handling and transportation of flowback water. (Path 3 & 7)	A.4.7 Containment of Contaminants B.4.13 Hydraulic Stimulation and Flowback Operations C.5.2 Management of produced water from petroleum wells C.8.2 Spill Management Plan C.8.1 Wastewater Management Plan	2	1	L	•Tanks to be double-lined with impermeable liners with impermeable membrane with coefficient of permeability of less than 10-9 m/s •Leak detection to be located within the interstitial space between the primary and secondary liner to detect any potential leaks. •Chemical storage and handling areas to have secondary containment, with an impermeable membrane with coefficient of permeability of less than 10-9 m/s . • The leases is compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s • The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. •The earthen bund is constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied. •The site earthen bund has a bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual bund capacity at Amungee NW and Velkerri 76 S2 is 10ML, approximately 200% the largest wastewater tank volume. •Licenced waste transporters to be used for all listed waste transportation •Based on the Amungee NW-1H well, NORM levels are not anticipated to be significant.- with characterisation of levels within drilling wastewater and flowback undertaken to validate. •Separation between chemical storages and closest aquifer over 70m, with interbedded clays likely to limit any contaminant migration. • Nearest landholder extraction bore 1km. •No major GDE linked to CLA within 100km of extraction point •Depth of aquifers generally below known stygofauna distribution range (elimination)	•Leak detection to be located within the interstitial space between the primary and secondary liner to detect any potential leaks. • Leak detection alarms to identify when a leak is potentially identified •Daily inspections during wet season and weekly inspections during the dry season to identify any potential leaks. •Impact and control groundwater monitoring bores installed within 20m of exploration wells to detect any potential contamination •Quarterly groundwater monitoring •Sampling for NORMs to characterise and assess levels within drilling wastewater and flowback undertaken.	•Liner leaks to be investigated and liners repaired as soon as practicable •Spills and leaks to be cleaned up and rectified immediately •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	2	1	L	Yes	The consequence and likelihood of groundwater contamination are reduced by the duration of the activity, separation of underlying aquifer units for the surface, mandated use of double lined tanks with continuous leak detection and secondary containment for all chemical storage areas. Any spill onsite is therefore likely to be small, restricted to the chemical storage areas and rapidly detected. The potential consequence of ground water contamination event is likely to be "moderate", with potential spill consequences likely to be locally restricted, moderate-short term and reversible. The likelihood is reduced down to remote with a probability of less than 1%. This is primarily influenced by the lack of spill sources, separation distance between aquifers and the surface and spill management plan that will rapidly detect any spills.	Yes	Low
11			Storage, handling and transportation of chemicals, fuels and wastes. (Path 3)	A.4.7 Containment of Contaminants C.3.3 Wastewater management legislative requirements C.8.2 Spill Management Plan	2	2	L	•All chemical, fuel and waste storage, inlcuding synthetic based mud tanks and equipment, and high risk spill handling areas are to have secondary containment, with an impermeable liner with coefficient of permeability of less than 10-9 m/s •Licenced waste transporters to be used to transport listed wastes. •Chemicals to be transported in accordance with the Australian Dangerous Goods Code and NT Dangerous Goods Act. •No chemical or wastewater transportation during wet season, unless a risk assessment determined the activity is safe and low risk •Leases to be compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s •The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. •Site earthen bunding will have a minimum bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual Amungee NW and Velkerri 76 S2 bund capacity is 10ML, approximately 200% the largest wastewater tank volume. •The earthen bund will be constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied. •All transportation of listed wastes and dangerous goods to be undertaken via licenced contractors. •Area is remote with major urban areas to be avoided during the transportation of dangerous goods and wastes in accordance with the NT Dangerous Goods Act.. •Separation between chemical stores and closest aquifer over 70m, with interbedded clays likely to limit any potential contaminant migration. •Nearest landholder extraction bore 1km. •Origin has completed 100,000's of chemical and wastewater trucking movements in QLD without significant incident causing material environmental harm	•Daily inspections during wet season and weekly thereafter to identify and respond to any potential leaks. •Impact and control groundwater monitoring bores installed around exploration wells to detect any potential contamination. •Groundwater monitoring of control and impact monitoring bores on a quarterly basis,	•Liner leaks to be investigated and liners repaired as soon as practicable •Spills and leaks to be cleaned up and rectified immediately •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	2	2	L	Yes	The storage, handling and management of chemicals is a standard activity that is managed through a mature nationally uniform regulatory setting. The COP further reduces the likelihood/consequence of chemical spills and contamination, through the mandated use of secondary containment, a spill management plan and groundwater monitoring. Any spills are likely to be locally restricted and rapidly detected (hours to days). The consequence of a spill/ leak is therefore considered to be "moderate", with moderate short term (days). Given the requirement for a spill management plan, secondary containment requirements and 70m separation distance to aquifers, the likelihood of a spill/leak reaching an aquifer is considered remote with a probability of less than 1%.	Yes	Low

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12			Overtopping of drilling sumps and flowback tanks (including during wet season) (Path 7)	A.4.7 Containment of Contaminants C.6 Monitoring mandatory requirements C.8.2 Spill Management Plan	**2**	**1**	**L**	•Drilling sump to be designed and operated to handle the drilling of multiple wells •Sump solid levels to be periodically removed from the sump between wells (or as required) to maintain sump capacity •Covered tanks to be used to manage flowback storage, with enough enclosed storage onsite to manage all stored flowback. •Results from Amungee NW-1H well testing have been used to optimise available tank capacity to allow for multiple wells •Additional tank capacity to be installed as required, with new tank capacity taking less than 14 days •Open wastewater evaporation tanks and drill sumps to have a 1:1000ARI wet season freeboard (wet season freeboard 1.3m). •All flowback wastewater to be transferred to enclosed tanks prior to the onsite of a "significant rainfall event (>300mm of forecasted rain over a 4 day periodic) •Sufficient pumps available onsite to meet volume transfer requirements, with available pump redundancy in case of mechanical issues. •Leases to be compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s •The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. •Site earthen bunding will have a minimum bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual Amungee NW and Velkerri 76 S2 bund capacity is 6ML, >110% largest wastewater tank volume. •The earthen bund will be constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied. •Site is manned at all times or have telemetered level logging during wastewater storage, with helicopters to be used to fly in staff when road access is prevented	•Daily monitoring of tank and sump levels (along with available storage space) during the wet season and weekly at all other times •Daily significant rainfall monitoring during the wet season. •Spill Management Plan implemented to prevent, detect and respond to spills. •Impact and control groundwater monitoring bores installed within 20m of exploration wells to detect any potential contamination, with monitoring completed quarterly	•Drilling fluids to be transferred to wastewater tanks or removed from site where maximum freeboard is exceeded •New wastewater tanks to be constructed onsite if wastewater storage is insufficient •Flowback to be transferred to enclosed tanks 8 hours before the onset of a significant rainfall event (defined as >30mm of rain over a 4 day period) •Operations (flowback and drilling) to cease if insufficient wastewater (sump or flowback storage) is available to meet freeboard and enclosed tank availability requirement. •Spill Management Plan implemented to prevent, detect and respond to spills. implemented- this includes regular inspections of containment facilities. •In the event of a major spill, a site assessment in accordance with the National Environmental Protection (Assessment of Site Contamination) Measure, including the assessment of NORMs will be undertaken	**2**	**1**	**L**	Yes	The COP provides onerous regulatory requirements that essentially eliminate the risk of wastewater storage overtopping events. The consequences of an overtopping event are limited through the construction of earthen bunds and compaction of the lease pad. A wastewater management plan, spill management plan and emergency response plan is implemented to further ensure any overtopping events are prevented, detected and responded to. In the event of an overtopping incident, such spill is likely to be contained onsite and rapidly responded to. The consequence of an overtopping event is therefore considered to be "moderate", with moderate short term (weeks-months) contamination. Given the requirements for enclosed tanks and a1"1000 wet season freeboard, the potential for overtopping are considered remote, with a probability less than 1%.	Yes	Low
13			Failure of flowback storage tank. (Path4 & 7)	A.4.1 Site selection and planning c.5.2 Management of produced water from petroleum wells C.8.2 Spill Management Plan	**3**	**1**	**L**	•Wastewater Management Plan implemented in accordance with the Codes of Practice to mitigate the risk associated with wastewater generation and management. •Spill Management Plan implemented to prevent, detect and respond to spills-including requirements for daily wastewater tank inspections during the wet season and weekly at all other times. •Tanks designed and engineered to AS3990 Mechanical Equipment- Steel Work, AS 1170.1 Hydrostatic loading, AS1170.2 Wind Rating (cyclonic wind rating) •Wastewater tank liner with impermeable membrane with coefficient of permeability of less than 10-9 m/s permeability, 120N picture resistance and 49N tear resistance •Covered wastewater tanks and condensate tanks to have vents to prevent pressure build up. •Sufficient pump capacity available to recover any spilled wastewater. •Leases to be compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s •The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. •Site earthen bunding will have a minimum bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual bund capacity is 6ML at Amungee NW and 10ML at Velkerri 76 S2. •The earthen bund will be constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied. •Separation between lease pad and closest aquifer over 70m, with interbedded clays likely to limit any potential contaminant migration. •Nearest landholder extraction bore 1km. •No major GDE linked to CLA within 100km of extraction point •Depth of aquifers generally below known stygofauna distribution range (elimination)	•Weekly wastewater tank integrity inspections during wastewater storage to detect •Impact and control groundwater monitoring bores installed within 20m of exploration wells to detect any potential contamination. •Quarterly groundwater monitoring completed to detect potential contamination.	•Wastewater tank structural defects to be rectified as soon as practicable. •Wastewater to be transferred from defective tanks to alternative tanks onsite until repairs completed. •Pumps located onsite to recover fluid and transfer into existing tanks, with spills and leaks to be cleaned up and rectified immediately •Earth moving equipment available regionally to clean up spills •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering	**3**	**1**	**L**	Yes	The consequences of a tank failure are negated through the use of double lined, engineered above ground tank which have continuous leak detection and alarms. Tanks and their liners are designed with sufficient structural integrity to withstand cyclonic winds, extreme temperatures and loading stress forces under a range of conditions. A spill management pan is in force to detect, prevent and respond to potential spills of wastewater. If a storage failure was to occur, the wastewater would be restricted to the lease pad. Flowback would be pumped into available enclosed and open tank storage, with contaminated soil removed from site. the consequences are likely to be "serious", being locally restricted, moderate duration (weeks) and reversible. The likelihood is reduced by the COP requirements , tank design separation distances to the underlying aquifer. The likelihood is considered Remote, withe a probability less than 1%	Yes	Low
14	**Surface Water**	Contamination of surface water from surface activities.	Failure of flowback storage tank. (Path4 & 7)	A.4.1 Site selection and planning c.5.2 Management of produced water from petroleum wells C.8.2 Spill Management Plan	**3**	**1**	**L**	•Wastewater Management Plan implemented in accordance with the Codes of Practice to mitigate the risk associated with wastewater generation and management. •Spill Management Plan implemented to prevent, detect and respond to spills-including requirements for daily wastewater tank inspections during the wet season and weekly at all other times. •Tanks designed and engineered to AS3990 Mechanical Equipment- Steel Work, AS 1170.1 Hydrostatic loading, AS1170.2 Wind Rating (cyclonic wind rating) •Wastewater tank liner with impermeable membrane with coefficient of permeability of less than 10-9 m/s permeability, 120N picture resistance and 49N tear resistance •Covered wastewater tanks and condensate tanks to have vents to prevent pressure build up. •Leases to be compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s •The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. • Site earthen bunding will have a minimum bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual bund capacity is 6ML at Amungee NW and 10ML at Velkerri 76 S2. •The earthen bund will be constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied. • Separation between lease pad and closest major watercourse is ~13km. • No major wetlands, with closest ~100km away (Lake Woods).	•Weekly wastewater tank integrity inspections during wastewater storage to detect •Routine level monitoring and alarms	•Wastewater tank structural defects to be rectified as soon as practicable. •Wastewater to be transferred from defective tanks to alternative tanks onsite until repairs completed. •Pumps located onsite to recover fluid and transfer into existing tanks, with spills and leaks to be cleaned up and rectified immediately •Earth moving equipment available regionally to clean up spills •Emergency response plan implemented. • Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	**3**	**1**	**L**	Yes	The consequence and likelihood of a containment failure are negated through onerous wastewater management requirements stipulated in the COP. The lease pad is bunded, preventing the offsite release of wastewater in the event of a failure. A spill management plan is required to be implemented to prevent, detect and respond to spills to prevent offsite releases. The spill is therefore likely to be smaller, with any spillage restricted to the lease pad. The consequence of a spill is therefore considered to be "serious", with moderate short term (weeks-months) contamination. The area is not in close proximity to major watercourse with a 13km separation distance. Given the separation distance and bunding, the likelihood is considered remote, with the probability of occurring less than 1% .	Yes	Low

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					Consequen	Likelihood	Risk Rating	Prevent	Detect	Recover	Consequen	Likelihood	Risk Rating				
15			Overtopping of drilling sumps and flowback tanks (including wet season operations) (Path 4 & 7)	A.4.7 Containment of Contaminants C.6 Monitoring mandatory requirements c.5.2 Management of produced water from petroleum wells C.8.2 Spill Management Plan	**3**	**1**	**L**	•Drilling sump has been designed to accommodate the anticipated drilling waste volumes of multiple wells. •Sump solids (cuttings and muds) to be periodically removed from the sump between the drilling of wells (or as required) to maintain sump capacity to prevent overflows • Spill Management Plan implemented to prevent, detect and respond to spills- this includes daily inspections during wet season and weekly inspections during dry season. •Covered wastewater tanks to be used to manage flowback storage- with enough capacity onsite to deal with •Open wastewater evaporation tanks and drill sumps to have a 1:1000ARI wet season freeboard (wet season freeboard 1.3m). • Monitoring of tank and sump levels daily when operational. •Results from existing well testing have been used to optimise available tank capacity to allow for multiple wells •Leases to be compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s •The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. •Site earthen bunding will have a minimum bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual capacity is 6ML at Amungee NW and 10ML at Velkerri 76 S2.. •The earthen bund will be constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied. •Site is manned at all times or have telemetered level logging during wastewater storage, with helicopters to be used to fly in staff when road access is prevented. • Area is flat with the separation between lease pad and closest major watercourse ~ 13km	•Daily monitoring of tank and sump levels (along with available storage space) during the wet season and weekly at all other times •Daily significant rainfall monitoring during the wet season	•Drilling fluids to be transferred to wastewater tanks or removed from site where maximum freeboard is exceeded •New wastewater tanks to be constructed onsite if wastewater storage is insufficient flowback to be transferred to enclosed tanks 8 hours before the onset of a significant rainfall event (defined as >30mm of rain over a 4 day period) •Operations (flowback and drilling) to cease if insufficient wastewater (sump or flowback storage) is available to meet freeboard and enclosed tank availability requirement. • Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	**2**	**1**	**L**	Yes	The consequence and likelihood of a wastewater storage overflowing are minimised through the onerous wastewater management requirements stipulated in the COP. This includes lease pad bunding, tank level alarms, tank freeboard requirements and use of a wastewater management plan. Any overflow is likely to be restricted to the lease pad, rapidly detected and promptly cleaned up. The use of enclosed tanks, freeboard and lease pad bunding essentially eliminates the likelihood potential for a wastewater storage tank to overflow. Given the onerous regulatory requirements, the likelihood of an overtopping event is considered Remote, with a <1% probability of occurring.	Yes	Low
16			Transportation accident releasing chemical or wastewater (drilling fluid and flowback).	A.4.7 Containment of Contaminants C.8.2 Spill Management Plan	**3**	**1**	**L**	•Risk assessment completed for all wet season transportation of chemicals and wastes •All wastes to be transported in accordance with the NT Waste Management and Pollution Control Act. •All dangerous goods to be transported in accordance with the NT Dangerous Goods Act and Australian Dangerous Goods Code. •Transportation route to avoid major urban areas •All drivers to be appropriately licenced •Fatigue management plan implemented, requiring journey management plans and drivers to rest every 2 hours •Strict drug and alcohol policy implemented, with routine testing and 0 zero tolerance policy to alcohol (0.00% limit) and drugs •Area is remote with major urban centres to be avoided. •Risk to any receptor is identical to that of normal diesel or petroleum tankers. •Training of Origin supervisors regarding chain of responsibility requirements to minimise the risk of driver fatigue •Origin has completed 100,000's of chemical and wastewater trucking movements in QLD without significant incident causing material environmental harm •The transportation of waste and chemicals across Australia is a standard practice with mature codes and legislation in place. the transportation of fuels, chemicals and wastes occurs every year in the NT to support existing industry's during the wet season.	•Transport incident statistics collected and monitored. •Onsite assurances and fit for work assessments completed periodically on transport companies.	•Spill Management Plan and Emergency Response Plan implemented to prevent, detect and respond to spills. •Contractor performance reviews completed where breaches in requirements are escalated and actions implemented to rectify defects.	**3**	**1**	**L**	Yes	The transportation of wastes and chemicals is a tightly controlled industry with mature practices designed to prevent, detect and respond to transportation spills. Any accident is likely to be restricted to road corridors and result in "serious", short term (days-weeks) reversible impacts. All contractors must be appropriately licenced, with National uniform legislation in place to offer a high level of regulatory protection. This risk is considered identical to that of bulk diesel and other dangerous goods transportation- a common activity throughout Australia. Fuel and chemical transport accidents are rare given the number of transportation movements in Australia. The likelihood of an event occurring is therefore considered "remote", what a probability of less than 1%.	Yes	Low
17			Storage and handling of chemicals and fuel. (Path 4)	A.4.7 Containment of Contaminants C.8.2 Spill Management Plan	**2**	**2**	**L**	•All areas where chemicals and fuels are stored, inlcuding area for synthetic based mud tanks and equipment, will have secondary containment with a coefficient of permeability of less than 10-9 m/s • Secondary containment to be maintained in a good working order •Spill Management Plan implemented to prevent, detect and respond to spills. implemented. •Leases to be compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s •The site is earthen bunded to prevent offsite release of contaminants, with all stormwater directed to an onsite retention pond for testing prior to offsite release •The earthen bund will be constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied. •Area is remote with closest receptor approximately 30km away.	•Daily inspections will be implemented during the wet season and spills rectified immediately	•All spills to be cleaned up as soon as practicable (within the shift that spill was observed) •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	**2**	**1**	**L**	Yes	The storage, handling and management of chemicals is a standard activity that is managed through a mature regulatory setting. The COP further reduces the likelihood and consequence of chemical spills and contamination, through the mandated use of secondary containment, a spill management plan and groundwater monitoring. A spill event is likely to result in moderate, short term reversible impacts restricted to the existing lease pad. The likelihood is further reduced down to remote (<1% probability of occurring) based on the 13km separation distance to the closest watercourse.	Yes	Low
18			Release of stormwater from activities to surface water.	A.4.1 Site selection and planning A.4.3 Erosion and sediment control and hydrology	**1**	**3**	**L**	•Erosion and Sediment Controls implemented around the sites to minimise erosion and sediment releases (Engineering) •Stockpiled debris to be used to discourage water concentration. (Engineering) •Lease pad to be earthen bunded to prevent offsite release of stormwater from exposed surfaces (Engineering) •Sites to be maintained, with vegetation cover on exposed bunds/ stockpiles established and erosion and sediment controls kept in working order (Elimination) •Contaminated stormwater to be retained on-site, treated and disposed off-site at a licenced disposal facility (Administration/ Engineering) •A sediment sock to be used to reduce sediment levels within stormwater releases. (Engineering) •Clean stormwater to be reused or released off-site in a manner that reduces the risk of erosion (Elimination) •Lease pad located away from watercourses or regional flow paths. (Elimination) •Area is remote with closest major watercourse approximately 13km away.(Elimination)	•Pre-wet season site assessment completed to identify any maintenance requirements (Administration) •Stormwater captured in sediment basin to be tested and released offsite in a controlled manner (Engineering)	•Maintenance to be undertaken on erosion and sediment controls to ensure ongoing functionality (Engineering)	**1**	**1**	**L**	Yes	All stormwater retained onsite during well testing will be collected in a purpose built sediment basin and tested prior to release. Releases must comply with the stipulated criteria to ensure contaminants are not released from site. The release of stormwater will also be via a "Sediment sock", with a reasonable consequence of minor, localised reversible impacts. The likelihood is reduced down to remote (<1% probability of occurring) based on the 13km separation distance to the closest watercourse and routine testing requirements..	Yes	Low
19			Runoff from sewage treatment irrigation areas.	A.4.1 Site selection and planning	**1**	**2**	**L**	•Irrigation areas located away from watercourses (Elimination) •A wastewater suitability acceptance assessment has been completed and a design approval for wastewater disposal received in accordance with the NT Department of Health code of Practice for On-site Wastewater Management (July 2014) (Engineering) •Wastewater irrigation to comply with DOH requirement (Engineering) •Areas appropriately sized to accommodate irrigation volume (Engineering) •Area is remote with closest major watercourse approximately 13m away (Elimination)	•Wastewater system performance to be monitored in accordance with the manufacturers requirements (Administration)	•Where wastewater specifications are exceeded, corrective actions will be implemented to ensure wastewater is returned back into specification (Engineering)	**1**	**1**	**L**	Yes	The management of sewerage and greywater is mature with various NT wastewater management guidelines. Due to the temporary nature of the activity, the maximum contamination resulting from sewerage and grey water irrigation is likely to be minor, with any impacts locally restricted and temporary in nature. The closest watercourse is approximately 13km, with the potential contamination of these features considered remote (probability <1%).	Yes	Low

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20	**Surface Water**	Changes in surface water hydrology resulting vegetation dieback from ponding and diversions away from natural surface systems with environmental and cultural value.	Infrastructure located on regional flow path resulting in changes to surface water flow.	A.4.1 Site selection and planning A.4.3 Erosion and sediment control and hydrology	1	2	L	•No clearing of vegetation proposed at Velkerri 76 S2. Small area to be cleared at Amungee NW (12.74ha) (Elimination) •Lease pad located away from watercourses and regional flow paths. (Elimination) •Lease pads designed to divert stormwater around, without impeding natural surface water flows (Engineering) •Stockpiled debris to be used to discourage water concentration, with vegetation establish on stockpiles to reduce exposed surfaces •Area is remote with closest major watercourse located 13km away (Elimination) •The lease area is flat, with water to be diverted around the perimeter of the site. (Elimination)	•Erosion and Sediment Control Plan in place with routine pre and post wet season inspection and maintenance (administration)	•Maintenance to be undertaken on erosion and sediment controls to ensure ongoing functionality (Engineering)	1	2	L	Yes	No clearing is proposed for the Velkerri 76 S2 site, however up to 6.74ha . Due to the lack of major water courses, and impact is likely to "minor", locally restricted and reversible. The likelihood is reduced down to highish unlikely (probability <10%) due to the absent of watercourses and controls implemented in accordance with NT Land Clearing Guidelines to avoid changes in the hydrological setting.	Yes	Low
21			Changes to terrestrial ground surface levels associated with seismic activity.	B.4.13 Hydraulic Stimulation and Flowback Operations	1	1	L	•Wells are located away from known geohazards, with no significant faults within proximity of activity (Elimination) • Amungee NW-1H stimulation completed without inducing seismic activity (Elimination) •Stimulation is not linked to major seismic events (reinjection of wastewater is generally recognised as the main cause). No reinjection of wastewater proposed (Elimination) •Stimulation stages deployment will be away from geohazards to reduce the loss of fluids into any encountered faults (Elimination) •The Beetaloo is not prone to seismic activity and there is no evidence of recent earthquake activity as most faults and the major subsurface structure are confined to Cambrian or older strata. This is supported by the National seismic Hazard Assessments completed by Allen 2018 (Figure 33), which highlight the Beetaloo is located within a low hazard area (Elimination) •Any faults encountered during drilling will be assessed to determine risk of stimulating with appropriate separation distances applied (Elimination). •Any induced seismicity likely to be minor(<3 Ml) and not at a level capable of altering earths surface.	•Monitoring of stimulation pressure to detect and respond to anomalies which may indicate fluid being pumped to an open geological structure (Engineering) •Geoscience Australia's Waramungu seismic array located approximately 300km of the sites. It is likely that any material seismic events above a 2 Ml will be detected via this array if they occur (Administration) •An induced seismicity traffic light system has been adopted and outlined in the WOMP (Administration)	•Where seismic activity is recorded in Origin's tenure during hydraulic stimulation activities, the actions in the WOMP Traffic Light System will be enacted as summarised below: Green: Local Magnitude (Ml) <2.0- no action required Orange: Ml 2.0- <3.5Ml- Report event to DITT and continue operations Red: Ml> 3.5- Stimulation activity on pad suspended until a go forward plan submitted by Origin and approved by DITT.	1	1	L	Yes	The consequence of a induced seismicity, based upon evidence from the UK and US, indicates that the consequence is likely to be "minor", with most events restricted to discrete areas at a size that generally cannot be detected at the surface (below 2 order of magnitude). This limits the potential for changes in terrestrial surface level. Larger events are rare and generally a factor of the existing built up stress regime of the area- rather than a factor of the intensity of hydraulic fracturing or wastewater injection. The likelihood of a seismic event is reduced through the geological setting of the Beetaloo Basin itself and the safeguards implemented in the COP requiring geohazard assessment and avoidance. In the Beetaloo, there have been no earthquakes over magnitude 3 measured since records began. The area is not prone to seismic activity and there is no evidence of recent earthquake activity as most faults and the major subsurface structure are confined to Cambrian or older strata. This is supported by the National seismic Hazard Assessments completed by Allen 2018 (Figure 33), which highlight the Beetaloo is located within a low hazard area. The COP requires any geohazard (such as fault) identified prior to drilling (from existing seismic or interpreted data) or encountered during drilling to have a risk assessment to the determine the potential for reactivation. Any faults identified would not be stimulated, with a risk-based buffer applied. Given the number of wells stimulated in the US without issue and geological setting of the Beetaloo basin, the likelihood is considered remote, with a probability less than 0.1%.	Yes	Low
22	**Water usage**	Unsustainable groundwater extraction impacts landholders and groundwater dependent ecosystems.	Over extraction of groundwater for civils, drilling and stimulation activities.	B.4.17 Groundwater monitoring	3	1	L	•Groundwater extraction for activities to be restricted to the minimum water required (220ML per site (110ML per well)). (Elimination) •All water take licenced in accordance with NT Water Act under Water Extraction Licence (WEL) GRF 10285 (Administration) •Drawdown from activity and other users assessed by DEPWS as a part of WEL; impacts to closest receptor not anticipated (Administration/ Elimination) Karst system is under allocated, with sufficient available capacity to support proposed water extraction requirements. (Elimination) •Closest pastroal bore is ~4km from extraction point (Elimination)	•Continuous flow meters to monitor take and water balance implemented to ensure compliance with WEL (Administration) •Groundwater monitoring completed to identify impacts associated with water extraction (Engineering)	•Groundwater extraction to cease where sustained drawdown post pumping exceeds 1 m (Administration)	3	1	L	Yes	The extraction of groundwater for the proposed activities requires all take to be licenced. The proposed take is assessed as a part of the licence application, with the assessment considering current and future water take levels. Based on this assessment, it was determined that the extraction rate would not impact upon adjacent users. The risk consequence is determined to be "serious"- given any impact is likely to cause pastoralist and broader community concern. The likelihood of such a consequence from occurring is considered remote (probability <1%) due to the quality of the Cambrian limestone aquifer, separation distance from surrounding users and under utilisation of the targeting aquifer.	Yes	Low
23	**Soil**	Loss in long-term soil productivity and viability.	Soil compaction from access tracks and leases.	A.4.1 Site selection and planning	1	3	L	•No Land Clearing proposed at Velkerri 76 S2. (Elimination) • Clearing at Amungee NW limited to minimum necessary to extend well lease pad, camp lease and install helipad, laydown yard and fence line/ firebreak (12.74ha total) (Engineering) •Extended Amungee NW lease pad to be stripped of topsoil (Elimination) •Areas to be rehabilitated to reduce impacts associated with compaction (Engineering) •Disturbance area is small (less than 0.005% of total tenure area) (Elimination)	•Rehabilitation monitoring to assess soil productivity impacts (Administration)	•Areas with poor rehabilitation will be maintained to reduce impact (Engineering)	1	3	L	Yes	During the construction/operation of lease pads, access tracks , camp pads etc., these sites will be compacted. Long term impacts of this compaction will be addressed during the rehabilitation of the sites. A loss of productivity is anticipated in the earlier stages of rehabilitation, returning back to pre-disturbed state within ~10 years. This will be accelerated through removal of hard stand areas, ripping and scarifying compacted surface. the consequences is likely to be "moderate", being locally restricted, with a moderate- long (years) recovery time. The likelihood of long term productivity impairment is considered "unlikely" (probability <30%), given the observed rehabilitation from previous disturbance activities.	Yes	Low
24			Soil erosion from cleared areas (access tracks, lease pads and camp pads).	A.4.3 Erosion and sediment control and hydrology	1	5	M	•No Land Clearing proposed at Velkerri 76 S2 (Elimination) •Clearing at Amungee NW limited to minimum necessary to extend well lease pad, camp lease pad and install helipad, laydown yard and fence line/firebreak (12.74ha total) (Engineering) •Erosion and Sediment Control Plan in place and maintained in functioning condition (Engineering) •Sites to be maintained, with erosion and sediment controls kept in working order (Engineering) •Stockpiled debris to be used to discourage water concentration. (Engineering) •Areas to be rehabilitated to reduce impacts associated with compaction (Engineering)	•Pre and post wet season erosion and sediment control inspections. •Rehabilitation monitoring to assess soil productivity impacts (Administration)	•Maintenance completed on areas where erosion is occurring or where the controls are defective (Engineering) •Areas with poor rehabilitation will be maintained to reduce impact (Engineering)	1	3	M	Yes	The erosion and sediment release from cleared area is a well documented impact. The consequences of sediment releases are likely to be minor, a function of the low risk nature of the site soils types, design of lease pads and ongoing inspection and maintenance programs. The likelihood of these minor locally restricted releases of sediment is considered likely (Probability 90%) .	Yes	Low

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					Consequen	Likelihood	Risk Rating	Prevent	Detect	Recover	Consequen	Likelihood	Risk Rating				
25	Soil	Soil contamination due to spills and leaks of chemicals, wastes or wastewater.	Spills/leaks from the on-site storing and handling of fuels. Condensate, hydrocarbons, drilling additives, stimulation additives, flowback fluid, solid wastes, storage and transportation of wastes	A.4.7 Containment of Contaminants c.5.2 Management of produced water from petroleum wells C.8.2 Spill Management Plan	2	2	L	•All chemical, fuel and waste storage, including synthetic based mud tanks and equipment, and high risk spill handling areas are to have secondary containment, with an impermeable liner with coefficient of permeability of less than 10-9 m/s •Licenced waste transporters to be used to transport listed wastes. •Chemicals to be transported in accordance with the Australian Dangerous Goods Code and NT Dangerous Goods Act. •No chemical or wastewater transportation during wet season, unless a risk assessment determined the activity is safe and low risk •Leases to be compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s •The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. •Site earthen bunding will have a minimum bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual bund capacity is 6ML •The earthen bund will be constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied. •All transportation of listed wastes and dangerous goods to be undertaken via licenced contractors. •Area is remote with major urban areas to be avoided during the transportation of dangerous goods and wastes in accordance with the NT Dangerous Goods Act. •Origin has completed 100,000's of chemical and wastewater trucking movements in QLD without significant incident causing material environmental harm	•Daily inspections during wet season and weekly thereafter to identify and respond to any potential leaks.	•Liner leaks to be investigated and liners repaired as soon as practicable •Spills and leaks to be cleaned up and rectified immediately •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	2	2	L	Yes	The storage, handling and management of chemicals is a standard activity that is managed through a mature regulatory setting. The COP further reduces the likelihood and consequence of chemical spills and contamination, through the mandated use of secondary containment, a spill management plan and groundwater monitoring. A spill event is likely to result in moderate, short term reversible impacts restricted to the existing lease pad. The likelihood is further reduced down to highly unlikely(<10% probability of occurring) based on the use of secondary containment, rapid spill detection and rehabilitation requirements..	Yes	Low
26			Drill sump and flowback tank overtopping.	A.4.7 Containment of Contaminants C.5.1 Drilling Materials C.5.2 Management of produced water from petroleum wells C.6 Monitoring mandatory requirements C.8.2 Spill Management Plan	2	1	L	•Drilling sump has been designed to accommodate the anticipated drilling waste volumes of multiple wells. (Engineering) •Sump solids (cuttings and muds) to be periodically removed from the sump between the drilling of wells (or as required) to maintain sump capacity to prevent overflows (Engineering) •Covered wastewater tanks to be used to manage flowback storage- with enough capacity onsite to deal with (Engineering) •Open evaporation tank and drilling sump freeboard to accommodate a 1:1000 ARI total wet season (Engineering) • Monitoring of tank and sump levels daily when operational. (Administration) •Results from Amungee NW-1H well testing to be used to optimise available tank capacity to allow for multiple wells (Engineering) •Leases to be compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s (Engineering) •The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. (Engineering) • Site earthen bunding will have a minimum bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual bund capacity is 6ML at Amungee NW and 10ML at Velkerri 76 S2 (Engineering) •The earthen bund will be constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied (Engineering) •Sufficient transfer pump capacity onsite to transfer fluids prior to the onset of a significant rainfall event or major wastewater release •Site is manned at all times or have telemetered level logging during wastewater storage, with helicopters to be used to fly in staff when road access is prevented. (Administration)	•Daily monitoring of tank and sump levels (along with available storage space) during the wet season and weekly at all other times (Administration/ Engineering) •Daily significant rainfall monitoring during the wet season (Administration/ Engineering)	•Drilling fluids to be transferred to wastewater tanks or removed from site where maximum freeboard is exceeded (Engineering) •New wastewater tanks to be constructed onsite if wastewater storage is insufficient (engineering) •flowback to be transferred to enclosed tanks 8 hours before the onset of a significant rainfall event (defined as >30mm of rain over a 4 day period) (Engineering) •Operations (flowback and drilling) to cease if insufficient wastewater (sump or flowback storage) is available to meet freeboard and enclosed tank availability requirement (Elimination) •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	2	1	L	Yes	The consequence and likelihood of a wastewater storage overflowing are minimised through the onerous wastewater management requirements stipulated in the COP. This includes lease pad bunding, tank level alarms, tank freeboard requirements and use of a wastewater management plan. Any overflow is likely to be restricted to the lease pad, rapidly detected and promptly cleaned up. The use of enclosed tanks, freeboard and lease pad bunding essentially eliminates the likelihood potential for a wastewater storage tank to overflow. Given the onerous regulatory requirements, the likelihood of an overtopping event is considered Remote, with a <1% probability of occurring..	Yes	Low
27			Chemical and waste transportation accident.	A.4.7 Containment of Contaminants C.8.2 Spill Management Plan	3	1	L	•Risk assessment completed for all wet season transportation of chemicals and wastes (Administration) •All wastes to be transported in accordance with the NT Waste Management and Pollution Control Act. (Administration) •All dangerous goods to be transported in accordance with the NT Dangerous Goods Act and Australian Dangerous Goods Code.(Administration) •Transportation route to avoid major urban areas •All drivers to be approximately licenced (Administration) • Fatigue management plan implemented, requiring journey management plans and drivers to rest every 2 hours (Administration) •Access track maintained to allow periodic wet weather access •Strict drug and alcohol policy implemented, with routine testing and 0 zero tolerance policy to alcohol (0.00% limit) and drugs (Administration) •Area is remote with major urban centres to be avoided. (Elimination) •Risk to any receptor is identical to that of normal diesel or petroleum tankers. •Training of Origin supervisors regarding chain of responsibility requirements to minimise the risk of driver fatigue (Administration) •Origin has completed 100,000's of chemical and wastewater trucking movements in QLD without significant incident causing material environmental harm (elimination) •The transportation of waste and chemicals across Australia is a standard practice with mature codes and legislation in place. the transportation of fuels, chemicals and wastes occurs every year in the NT to support existing industry's during the wet season. (Engineering)	•Transport incident statistics collected and monitored. (Administration) •Onsite assurances and fit for work assessments completed periodically on transport companies (Administration)	•All transport spills to be cleaned up immediately (engineering) •Contractor performance reviews completed where breaches in requirements are escalated and actions implemented to rectify defects. (administration)	3	1	L	Yes	The transportation of wastes and chemicals is a tightly controlled industry with mature practices designed to prevent, detect and respond to transportation spills. Any accident is likely to be restricted to road corridors and result in "serious", short term (days-weeks) reversible impacts. All contractors must be appropriately licenced, with National uniform legislation in place to offer a high level of regulatory protection. This risk is considered identical to that of bulk diesel and other dangerous goods transportation- a common activity throughout Australia. Fuel and chemical transport accidents are rare given the number of transportation movements in Australia. Origin has completed 100,000's of chemical and wastewater trucking movements in QLD without significant incident causing material environmental harm The likelihood of an event occurring is therefore considered ""highly unlikely", what a probability of less than 10%.	Yes	Low
28			On-site disposal of drill muds and cuttings.	C.5.1 Drilling Materials	2	2	L	• Drilling muds, water based and synthetic based are low residual toxicity. (Elimination) • Synthetic based drilling muds to be recovered from drill cuttings for reuse and removed from site for further reuse, removing the need for onsite disposal. Residual drill cuttings to be disposed of in sump (Engineering) • Sodium and Chloride levels to be reduced through segregation of drilling fluids from muds and mixing with clean material onsite •Drilling muds and cuttings from the sump maybe transferred and stored in a pit/sump on site that is compliant with C.4.1.2 for the storage of drilling muds and cuttings to dry the cuttings and reduce waste volumes. •Drilling muds (water-based) to be tested and a disposal strategy developed by a suitably qualified third-party in a manner that minimises the risk to the environment. •Drilling muds (water-based) removed from site where onsite disposal is unsafe. •DEPWS engaged to confirm final disposal strategy. • Rehabilitation monitoring to monitor ongoing site rehabilitation	•Drilling muds (water based) to be tested and a disposal strategy developed by a suitably qualified third-party in a manner that minimises the risk to the environment. Rehabilitation monitoring completed on all disposal areas	•Additional rehabilitation actions implemented where rehabilitation objectives are not being met.	2	2	L	Yes	In accordance with the COP, the onsite storage and disposal of drilling fluids and cuttings can only occur if the activity does not represent an unacceptable environmental hazard. Aside from synthetic based drilling muds which will be recovered and reused, all drilling fluids, muds and cuttings will be stored in a lined sump, with testing undertaken prior to final disposal. Onsite disposal will only occur if determined to be safe by an independent third party. The consequences are therefore likely to be restricted to a Moderate- short term reversible impacts. The likelihood of contamination through drilling fluid, mud and cuttings storage and failure is considered highly unlikely, with the probability below 10%. This is largely due to the separation distance between the underlying aquifer, use of lined sumps and third party disposal suitability assessments.	Yes	Low

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					Consequen	Likelihood	Risk Rating	Prevent	Detect	Recover	Consequen	Likelihood	Risk Rating				
29			Failure of a flowback tank.	A.4.1 Site selection and planning A.4.7 Containment of Contaminants C.8.2 Spill Management Plan	**3**	**1**	**L**	•Tanks designed and engineered to AS3990 Mechanical Equipment- Steel Work, AS 1170.1 Hydrostatic loading, AS1170.2 Wind Rating (cyclonic wind rating) •Wastewater tank liner with impermeable membrane with coefficient of permeability of less than 10-9 m/s permeability, 120N picture resistance and 49N tear resistance •Covered wastewater tanks and condensate tanks to have vents to prevent pressure build up. •Leases to be compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s •The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. •Site earthen bunding will have a minimum bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual bund capacity is 6ML at Amungee NW and 10ML at Velkerri 76 S2. •The earthen bund will be constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied.	•Weekly wastewater tank integrity inspections during wastewater storage to detect •Routine level monitoring and alarms	•Wastewater tank structural defects to be rectified as soon as practicable. •Wastewater to be transferred from defective tanks to alternative tanks onsite until repairs completed. •Pumps located onsite to recover fluid and transfer into existing tanks, with spills and leaks to be cleaned up and rectified immediately •Earth moving equipment available regionally to clean up spills •Emergency response plan implemented. •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	**3**	**1**	**L**	Yes	The consequences of a tank failure are negated through the use of double lined, engineered above ground tank which have continuous leak detection and alarms. Tanks and their liners are designed with sufficient structural integrity to withstand cyclonic winds, extreme temperatures and loading stress forces under a range of conditions. A spill management pan is in force to detect, prevent and respond to potential spills of wastewater. If a storage failure was to occur, the wastewater would be restricted to the lease pad. Flowback would be pumped into available enclosed and open tank storage, with contaminated soil removed from site. the consequences are likely to be "serious", being locally restricted, moderate duration (weeks) and reversible. The likelihood is reduced by the COP requirements , tank design separation distances to the underlying aquifer. The likelihood is considered Remote, withe a probability less than 1%.	Yes	Low
30		Soil contamination from the drift of saline wastewater offsite from mechanical evaporation units.	Wastewater evaporation mist transported offsite during wastewater treatment.	A.4.1 Site selection and planning	**2**	**2**	**L**	•Automated wind speed and direction cut offs to be implemented to prevent drift (Engineering) •Evaporators located within the wastewater tank considering the predominant wind direction (from the SE) to avoid offsite drift (Engineering) •Drift likely to be restricted to within the lease pad (Elimination) •No homesteads, sacred sites or sensitive environmental areas in the vicinity of the proposed lease pad (Elimination)	•Daily monitoring to detect drift (Engineering)	•Evaporation units to cease operation where drift identified (Engineering) •Evaporators to be modified/ repositioned to control drift (Engineering)	**2**	**2**	**L**	Yes	The use of enhanced evaporators to manage wastewater is a well-known technology used through multiple mining and wastewater treatment industries. Evaporators were used successfully on the Amungee NW-1H well to reduce fluid levels decreasing offsite trucking volumes. Offsite release of wastewater drift is restricted through wind speed and direction cut offs and the location of the evaporator within the wastewater storage. The sites are continuously manned during well testing, thus the risk of drift and associated impacts is anticipated to be moderate, with short term, reversible impacts. Given the aforementioned controls, the likelihood of moderate impacts is reduced to Highly unlikely, with a potential of lower than 10%	Yes	Low
31		Soil contamination from the disposal of greywater and sewerage from camp activities.	Greywater and sewerage disposal (camps).	C.4.2 Management of flowback water	**1**	**2**	**L**	•Sewerage wastewater irrigated as per Department of Health code of Practice for On-site Wastewater Management (July 2014) (Engineering)(Elimination) •A wastewater suitability acceptance assessment has been completed and a design approval for wastewater disposal received in accordance with the NT Department of Health code of Practice for On-site Wastewater Management (July 2014) (Engineering) •Wastewater irrigation to comply with DOH requirement (Engineering) •Areas appropriately sized to accommodate irrigation volume (Engineering) • Area is remote with closest watercourse approximately 13km away (Elimination)	•Wastewater system performance to be monitored in accordance with the manufacturers requirements (Administration)	•Where wastewater specifications are exceeded, corrective actions will be implemented to ensure wastewater is returned back into specification (Engineering)	**1**	**2**	**L**	Yes	The management of sewerage and greywater is mature with various NT wastewater management guidelines. Due to the temporary nature of the activity, the maximum contamination resulting from sewerage and grey water irrigation is likely to be minor, with any impacts locally restricted and temporary in nature. The closest watercourse is approximately 13km, with the potential contamination of these features considered remote (probability <1%).	Yes	Low
32	**Flora and fauna**	Impact to listed threatened habitats and listed threatened flora and fauna through exploration activities.	Activity (vehicle and machinery) noise and lighting on well pads and access tracks.	A.4.1 Site selection and planning A.4.2 Noise	**1**	**3**	**L**	•Site location avoids areas of high conservation value as a priority (Elimination) •Areas are not considered high conservation value, are not threatened/endangered and not fragmented, with impacts unlikely to result in significant disturbance to threatened/endangered species. (Elimination) •Impacts likely to be temporal, with fauna able to move to adjacent areas to escape impacts. (Elimination) •Fauna monitoring at Amungee NW has not identified any impacts, with fauna identified in areas around operations. (Engineering) .	•Anecdotal evidence form pastoralists and Traditional Owners (Administration) •Impacts are likely to be temporal, with detection extremely difficult.	•Where impacts are identified, practices will be reviewed and modified to reduce impact on fauna (Administration/ engineering) .	**1**	**3**	**L**	Yes	Fauna may be disturbed through transport movements along access tracks and drilling, stimulation and well testing activities around the lease pad. The consequence of activity nuisance is anticipated to be minor, with localised, short term impacts to areas immediately adjacent to access tracks. The likelihood of the risk is reduced through the isolated location (lack of sensitive receptors), regionally extensive vegetation communities (good outside refuge away from access tracks and limited transport movements during the evenings . The impact to fauna is considered highly unlikely given the ability of fauna to move to other areas of refuge away from E&A activities	Yes	Low
33			Failure of flowback storage tanks.	A.4.1 Site selection and planning A.4.7 Containment of Contaminants c.5.2 Management of produced water from petroleum wells C.8.2 Spill Management Plan	**3**	**1**	**L**	•Tanks designed and engineered to AS3990 Mechanical Equipment- Steel Work, AS 1170.1 Hydrostatic loading, AS1170.2 Wind Rating (cyclonic wind rating) (Engineering) •Wastewater tank liner with impermeable membrane with coefficient of permeability of less than 10-9 m/s permeability, 120N picture resistance and 49N tear resistance (Engineering) •Covered wastewater tanks and condensate tanks to have vents to prevent pressure build up. (Engineering) •Leases to be compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s (Engineering) •The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. (Engineering) •Site earthen bunding will have a minimum bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual bund capacity is 6ML at Amungee NW and 10ML at Velkerri 76 S2(Engineering) •The earthen bund will be constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied.(Engineering)	•Weekly wastewater tank integrity inspections during wastewater storage to detect (administration) •Routine level monitoring and alarms (Engineering)	•Wastewater tank structural defects to be rectified as soon as practicable. (Engineering) •Wastewater to be transferred from defective tanks to alternative tanks onsite until repairs completed. (Engineering) •Pumps located onsite to recover fluid and transfer into existing tanks, with spills and leaks to be cleaned up and rectified immediately (Engineering) •Earth moving equipment available regionally to clean up spills (Engineering) •Emergency response plan implemented (Administration) •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	**3**	**1**	**L**	Yes	The consequences of a tank failure are negated through the use of double lined, engineered above ground tank which have continuous leak detection and alarms. Tanks and their liners are designed with sufficient structural integrity to withstand cyclonic winds, extreme temperatures and loading stress forces under a range of conditions. A spill management pan is in force to detect, prevent and respond to potential spills of wastewater. If a storage failure was to occur, the wastewater would be restricted to the lease pad. The consequences are likely to be "serious", being locally restricted, moderate duration (weeks) and reversible. The likelihood is reduced by the COP requirements , tank design, separation distances to sensitive places and the lease pad bunding.. The likelihood is considered Remote, with a probability less than 1%.	Yes	Low
34			Introduction and spread of weeds in the area.	A.4.5 Weed management	**2**	**3**	**M**	•All equipment and vehicles to be washed-down and to have a Biosecurity Declaration Certificate prior to access to site (Elimination) •Areas of proposed exploration have been surveyed and are deemed to have low weed abundance (elimination) •Activity will be restricted to defined lease pads and camp pads (Elimination)	•6 monthly monitoring implemented around infrastructure to detect the spread/ introduction of weed species (administration) •Origin assurance activities to target equipment wash-down certificates to ensure standards are being met. (Administration)	•Where weed outbreaks are identified associated with Origin's activities, infestations will be treated in accordance with the Weed Management Plan. (elimination) •Corrective actions implemented where ongoing biosecurity breaches are identified.	**2**	**3**	**M**	Yes	The area in the vicinity sites is free of weeds. Weeds are present across the broader property. Any introduction of weeds is likely to result in localised impact, with weed management requirements likely to reduce the consequence down to "moderate, short term. Due to the inherent nature of weed prevention the risk likelihood is considered unlikely, with a probability less than <30%	Yes	Low

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					Consequen	Likelihood	Risk Rating	Prevent	Detect	Recover	Consequen	Likelihood	Risk Rating				
35			Accidental ignition of fire from exploration activities (drilling, stimulation, flaring and general access).	A 4.6 Fire management	3	2	M	•Bushfire management plan implemented to prevent and respond to bushfires- including establishment of communication and fire response protocols with pastoralists (Administration) •Bushfire awareness included in site inductions. (Administration) •Designated smoking areas on-site (Elimination) •Firefighting equipment to be available to deal with fires (Engineering). •Fire breaks have been constructed around the lease and camp pads (Engineering) •Minimum of 45m separation distances between flares and surrounding vegetation (Engineering) •Ignition sources placed outside of the hazardous area. (Elimination) •Intrinsically safe equipment used in hazardous area. (Elimination) •Hazardous area drawing will provide classification of hazardous zones while drilling. (Elimination) •No flaring during periods of total fire ban (Elimination) •Activities will comply with landholder and regional bushfire management plans. (Elimination) •Area in the vicinity of leases have had recent (within 1-2 years) fire activity, reducing the fuel load (Elimination)	•Annual fire preparedness assurance activities completed where activities are proposed during high fire risk periods (administration) •Daily monitoring of bushfires in the region during periods of high fire danger (administration) •Annual fire frequency mapping using the Northern Australia Fire Information fire history database (administration)	•Fire hazard reduction strategies (such as back burning) to be implemented to reduce the risk of fire ignition/ impact as required (Elimination) •Where a bushfire is started and cannot be controlled, Origin to engage with pastoralist to coordinate response activities	3	2	M	Yes	Fire is a common occurrence within the Barkly Region. A fire is likely to have a serious impact, with moderate term reversible impacts (years). With the appropriate controls, such as separation distances, firebreaks, and adherence to total fire bans, the likelihood of causing a fire from drilling, stimulation and well testing is anticipated to be highly unlikely, with a predicted occurrence of <10%	Yes	Low
36			Poor rehabilitation of the site reduces regional habitat and promotes weed invasions	A.4.8 Rehabilitation	1	3	L	•A site specific Rehabilitation Plan has been developed and will be implemented progressively (Engineering) •Areas will have infrastructure and wastes removed, sumps and pits backfilled, topsoil respread and vegetation re-introduced. (Engineering) •Rehabilitation timing will consider seasonal constraints, with rehab completed prior to the wet season to maximise revegetation chance (Engineering)	•Rehabilitation monitoring to be undertaken to track rehabilitation progress (Administration)	•Maintenance will be undertaken periodically to fix any defects (Engineering)	1	3	L	Yes	Risks associated with rehabilitation are well known. Knowledge of rehabilitation within the Beetaloo Basin has been gained, based on previous seismic line rehabilitation programs.	Yes	Low
37			Trapping and drowning of fauna in storage tanks and sumps.	C.5.1 Drilling Materials	2	2	L	•Wastewater tank walls are 2m high with minimal risk of animals accessing tanks (elimination) •Lease pads fenced to prevent stock access (engineering) •Sump coletanche liner is rough, with fauna able to climb out of sump (Engineering) •Sump fenced when not in use in a manner to reduce fauna access to sump (Engineering) •Limited habitat for threatened fauna in area surrounding site (Elimination) •Wastewater saline, with freshwater tanks to be preferred by birds • Fauna cameras installed around lease pad have not detected significant wildlife presence in and around operating sites. (Elimination)	•Weekly inspections during wastewater storage. •Monitoring of fauna interaction with wastewater	•Where ongoing fauna interactions with wastewater are identified through monitoring, additional controls shall be implemented as appropriate (such as additional fencing, deterrents etc.) (Engineering)	2	2	L	Yes	Risks associated with potentially trapping and drowning fauna in storage tanks and sumps are well understood. Origin has extensive experience in managing sumps, ponds and tanks to prevent fauna ingress.	Yes	Low
38			Contaminants in water and soil pass through the food chain and bioaccumulate in fauna causing detrimental impacts to local species and communities	A.4.7 Containment of Contaminants C.5.2 Management of produced water from petroleum wells C.8.2 Spill Management Plan	1	2	L	•All chemicals stored in designated areas with secondary containment (Engineering) • Synthetic based drilling muds and equipment stored in secondary containment, with all spills captured and recovered (Engineering) • Specialised pressure rated hoses and valves utilised to reduce risk of leaks during transfer of synthetic based muds (Engineering) • Air dryer used to recover synthetic based drilling muds from cuttings and removed from site by drilling contractor for further reuse meaning no onsite disposal (Engineering/Elimination) •Chemical risk assessments with no chemicals considered above low concern levels when used in accordance with standard procedures and controls (Elimination) •The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. (Engineering) •Site earthen bunding will have a minimum bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual bund capacity is 6ML at Amungee NW and 10ML at Velkerri 76 S2. (Engineering) •The earthen bund will be constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied. (Engineering) •Wastewater evaporation to have drift controls to prevent offsite release (engineering) •No offsite wastewater discharge (elimination) •Chemical mixing units and operating procedures designed to mitigated the formation of chemical airborne particulate matter (Engineering/ Administration) •Onsite burial of drilling waste can only occur where no material impacts to flora and fauna are anticipated (engineering) •Salt is the main hazard and does not bioaccumulate- UV and oxidation of organic compounds and metals in wastewater likely to degrade chemicals	•Routine weekly inspections to identify poor chemical handling or wastewater storage practices (engineering) •Monitoring of fauna interaction with wastewater tanks and area surrounding the site (Administration)	•Where ongoing fauna interactions with wastewater or chemicals are identified through monitoring, additional controls shall be implemented as appropriate to reduce the potential for exposure (such as additional fencing, deterrents etc.) (Engineering)	1	1	L	Yes	A chemical risk assessment and flowback characterisation program for the Amungee NW 1H well ensures all potential chemicals that are persistent, bio accumulative and toxic at high concentrations are identified and appropriate management strategies implemented. The risks associated with fauna ingestion of chemicals is well known and measures to prevent ingestion (such as fences and separation distances to activity) are deployed as standard practice. Origin has extensive operational experience in drilling and stimulating 1000s of conventional and unconventional petroleum wells with no evidence of impacts on biota from chemicals.	Yes	Low
39			Vehicle and machinery collisions with fauna during civil and maintenance activities – fauna mortality results in a localised impact to listed threatened species	A.4.4 Biodiversity protection	1	5	M	•Vegetation clearing at Amgunee NW (12.74ha) to be conducted with visual checks to identify fauna/fauna habitat during clearing •Vehicle speed limited to 60km/hr to be reduced around areas of high risk of fauna collision (Administration) •Vehicle movements to avoid driving at night (Elimination) •Fauna collisions observed during the existing activities have been minimal, with collision restricted to several wallabies along access track (Elimination) • Absence of listed threateend species identified in the vicinity of the Lease apd and access tracks.	•Fauna mortality data is collected as part of Origin's incident and observation management procedures (Administration)	•Where ongoing fauna collisions are reported, additional controls shall be investigated, such as reduced speed limits in high risk areas will be implemented.(Administration)	1	3	L	Yes	Fauna collisions with vehicles are a commonly associated with roads. It is anticipated that a small number of fauna collisions will be experienced during the activity (1-2 animals per month), with minor, short term, reversible impacts to local fauna species. The likelihood of causing a localised decline in species abundance is considered remote.	Yes	Low
40			Encouragement of feral animals and other pest species increases leading to competition with native species. This includes the introduction of cane toads.	A.4.4 Biodiversity protection	1	3	L	•Camp wastes to be storage to be animal proof (Engineering) •All food scraps to be removed from site and disposed of at a licenced facility (Elimination) •Food scraps to be frozen and stored within freezer during wet season (Elimination) •Experience from existing activities has not detected increased feral animal prevalence, with only 1 feral dog identified in 6 months of camp operations. (Elimination)	•Feral fauna observation data is collected as part of Origin's incident and observation management procedures (Administration)	•Where ongoing feral animal presence is detected, additional controls will be investigated in consultation with the pastoralist (such as fencing, removal of water sources etc.) (Engineering)	1	3	L	Yes	Feral animals may be increased through the provision of access to water, food (camps) and hunting habitat (such as road corridors). The use of the existing site and access tracks limits the additional risk associated with provision of additional hunting habitat. Food scraps and waste will be frozen and disposed of offsite which will reduce the food availability for pests. Wastewater is too saline for cane toads to survive, with the design of the tanks likely to restrict toad habitat. The anticipated consequence is minor, with the potential pest species increase anticipated to be small. The likelihood is determined to be unlikely, with a probability of less than 30%.	Yes	Low

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					Consequen	Likelihood	Risk Rating	Prevent	Detect	Recover	Consequen	Likelihood	Risk Rating				
41	**Cultural Heritage and Sacred Sites**	Disturbance of sacred site or culturally sensitive area and decline in environmental value of area used for hunting, foraging and enjoyment.	Sites disturbed directly by exploration activities	A.4.1 Site selection and planning	**3**	**1**	**L**	•Exploration Agreements with Determined Traditional owners covering all proposed exploration activities. •All areas of the proposed activity to be cleared by NLC. (Elimination) •AAPA certificates for proposed work program have been granted (Elimination) •The location of infrastructure has considered proximity to sacred sites (Elimination) •Areas of cultural heritage to be avoided during construction (Elimination) •Areas of cultural significance are not within 7km of the proposed area of activity (Elimination) •Implementation of the unexpected finds protocol (Administration).	•Origin completes 6 monthly assurance programs to confirm access to sacred sites has not occurred.	•N/A- no access to sacred sites anticipated. (Elimination)	**3**	**1**	**L**	Yes	All sites of the proposed activity must have Traditional Owner clearance via the NLC. AAPA certificates are required for all activities to ensure sacred sites are not impacted by activities. The remote location of the activity, lack of sacred sites in the vicinity of the sites and contractual requirements prohibiting access reduce the likelihood down to "highly unlikely", with a probability lower than 10%.	Yes	Low
42			Accidental ignition by site activities (civil works, drilling, grinding) or site personnel.	A 4.6 Fire management	**3**	**2**	**M**	•Bushfire management plan implemented to prevent and respond to bushfires- including establishment of communication and fire response protocols with pastoralists (Administration) •Bushfire awareness included in site inductions. (Administration) •Designated smoking areas on-site (Elimination) •Firefighting equipment to be available to deal with fires (Engineering). •Fire breaks have been constructed around the lease and camp pads (Engineering) •Minimum of 45m separation distances between flares and surrounding vegetation (Engineering) •Ignition sources placed outside of the hazardous area. (Elimination) •Intrinsically safe equipment used in hazardous area. (Elimination) •Hazardous area drawing will provide classification of hazardous zones while drilling. (Elimination) •No flaring during periods of total fire ban (Elimination) •Activities will comply with landholder and regional bushfire management plans. (Elimination) •Area in the vicinity of Amungee NW has had recent (within 2-3 years) fire	•Annual fire preparedness assurance activities completed where activities are proposed during high fire risk periods (administration) •Daily monitoring of bushfires in the region during periods of high fire danger (administration) •Annual fire frequency mapping using the Northern Australia Fire Information fire history database (administration)	•Fire hazard reduction strategies (such as back burning) to be implemented to reduce the risk of fire ignition/ impact as required (Elimination) •Where a bushfire is started and cannot be controlled, Origin to engage with pastoralist to coordinate response activities	**3**	**2**	**M**	Yes	Fire is a common occurrence within the Barkly Region. A fire is likely to have a serious impact, with moderate term reversible impacts (years). With the appropriate controls, such as separation distances, firebreaks, and adherence to total fire bans, the likelihood of causing a fire from drilling, stimulation and well testing is anticipated to be highly unlikely, with a predicted occurrence of <10%	Yes	Low
43			Flowback tank structural failure.	A.4.1 Site selection and planning A.4.7 Containment of Contaminants C.5.2 Management of produced water from petroleum wells C.8.2 Spill Management Plan	**3**	**1**	**L**	•Tanks designed and engineered to AS3990 Mechanical Equipment- Steel Work, AS 1170.1 Hydrostatic loading, AS1170.2 Wind Rating (cyclonic wind rating) (Engineering) •Wastewater tank liner with impermeable membrane with coefficient of permeability of less than 10-9 m/s permeability, 120N picture resistance and 49N tear resistance (Engineering) •Covered wastewater tanks and condensate tanks to have vents to prevent pressure build up. (Engineering) •The leases is compacted to above 100kpa to achieve a permeability of approximately 1x10m-7/s (Engineering) •The site is earthen bunded to prevent offsite release of flowback. This is considered an additional level of containment, as the primary and secondary containment is the principle spill risk control. (Engineering) •The site earthen bund has a minimum bund wall height of 300mm capable of managing at least 110% of the largest wastewater tank volume. The actual bund capacity is 6ML at Amungee NW and 10ML at Velkerri 76 S2. (Engineering) •The earthen bund is constructed in a manner to withstand a tank failure scenario with appropriate compaction and stabilisation applied.(Engineering) •Sacred sites 7km away from lease pads, areas mapped as restricted work areas with no access permitted (Elimination, Administration)	•Weekly wastewater tank integrity inspections during wastewater storage to detect (administration) •Routine level monitoring and alarms (Engineering)	•Wastewater tank structural defects to be rectified as soon as practicable. (Engineering) •Wastewater to be transferred from defective tanks to alternative tanks onsite until repairs completed. (Engineering) •Pumps located onsite to recover fluid and transfer into existing tanks, with spills and leaks to be cleaned up and rectified immediately (Engineering) •Earth moving equipment available regionally to clean up spills (Engineering) •Emergency response plan implemented (Administration) •Any contamination event to be characterised and have remediation plans developed and executed in accordance with the process outlined in schedule A of the National Environmental Protection (Assessment of site Contamination) Measures (Engineering)	**3**	**1**	**L**	Yes	The consequences of a tank failure are negated through the use of double lined, engineered above ground tank which have continuous leak detection and alarms. Tanks and their liners are designed with sufficient structural integrity to withstand cyclonic winds, extreme temperatures and loading stress forces under a range of conditions. A spill management pan is in force to detect, prevent and respond to potential spills of wastewater. If a storage failure was to occur, the wastewater would be restricted to the lease pad, limiting the impact on adjacent pastoral activities and community.. Flowback would be pumped into available enclosed and open tank storage, with contaminated soil removed from site. The consequences are likely to be "serious", being locally restricted, moderate duration (weeks) and reversible (requiring rehabilitation). The likelihood is reduced by the COP requirements , tank design separation distances to the underlying aquifer. The likelihood is considered Remote, with a probability less than 1%.	Yes	Low
44			Personnel unauthorised access to sacred site.	A.4.1 Site selection and planning	**2**	**2**	**L**	•Restricted work areas are not located in close proximity to explorational activities (Elimination) •All staff to be inducted covering restricted work areas and cultural heritage (Administration) •Access off lease not permitted. (Elimination)	•Origin completes 6 monthly assurance programs to confirm access to sacred sites has not occurred.	• N/A- no access to sacred sites anticipated. (Elimination)	**2**	**2**	**L**	Yes	All sites of the proposed activity must have Traditional Owner clearance via the NLC.. AAPA certificates are required for all activities to ensure sacred sites are not impacted by activities. The remote location of the activity, lack of sacred sites in the vicinity of the sites and contractual requirements prohibiting access reduce the likelihood down to "highly unlikely", with a probability lower than 10%.	Yes	Low
45	**Community impact**	Loss of visual amenity, experience and sense of place for landholder, community members and tourists.	Industrialisation of landscape.	A.4.1 Site selection and planning A.4.1.1 Well pad specific site selection	**1**	**1**	**L**	•Existing location used to reduce footprint, with multi- well pads needed to minimise the impact of a future development (if feasible) •Site is located away from sensitive receptors and not clearly visible: slight glow may be experienced during well testing (similar to a small town) (Elimination) •Level of clearing for infrastructure is small (Elimination) •Progressive rehabilitation to occur when sites are no longer required for future operations (engineering) •Activity intensity is restricted to specific periods, with most activity restricted to the lease pad. •Workers are flown in and out of Daly waters from Darwin. Buses are used to limit vehicle transport movements between the Daly Waters airport and remote camps- there is limited Drive In/Drive Out workers into the Beetaloo- except where local or regional contractors are utilised. •Camps utilised to minimise impact on local accommodation and tourism.	•Ongoing community engagement to monitor performance and identify potential impacts from activity on local amenity.	•N/A- site location and activity intensity is unable to be changed.	**1**	**1**	**L**	Yes	The proposed explorational activities are located away from major transport routes, homesteads and communities. The consequences of activities may result in minor changes in to aesthetics through visibility of exploration activities (flare glows at night, presence of workers and vehicles). The probability that the activity will result in an industrialisation of the landscape is considered remote, with a probability less than 1%.	Yes	Low
46			Increased traffic.	A.4.1 Site selection and planning	**2**	**1**	**L**	•Traffic impact assessment completed assessing the increased traffic levels as negligible: reflective of limited size and scope of activity. •Traffic impacts are expected to small and temporary with Rig located onsite or moved via internal road. •Access route is away from Copee Hill and Hayfields Homesteads. •Capacity of road and level of service will not be impacted materially. •Workers are flown in and out of Daly waters from Darwin. Busses are used to limit vehicle transport movements between the Daly Waters airport and remote camps- there is limited Drive In/Drive Out workers into the Beetaloo- except where local or regional contractors are utilised. •Traffic issues were not identified during the well drilling and stimulation campaigns for the existing wells.	•Ongoing community engagement to monitor performance and identify potential impacts from activity on traffic.	•Complaints regarding traffic will be dealt through Origins complaint resolution process. Where valid complaints are received, additional controls will be implemented to address community complaints (such as changes to vehicle load movements etc.)	**2**	**1**	**L**	Yes	The increased traffic from the activity is likely to be short term and within the Level of service of the existing roads. Increases in traffic are anticipated to have a "moderate" consequence (increase in traffic observable, but temporary). The likelihood of causing a loss of experience from the E&A activities is considered "Highly unlikely", with an anticipated probability of less than 10%.	Yes	Low
47			Light emissions impact on sensitive receptor (such as pastoralist)	A.4.1 Site selection and planning	**1**	**1**	**L**	•Sites are located 27-50km away the nearest homestead (Copee Hill) with Amungee NW located adjacent to Carpentaria Highway and Velkerri 76 S2 40km away. Some light may be visible during flaring. This is likely to be consistent with a small town and only visible during the night. (Elimination) •Flaring is of short duration, generally less than 90 days. (Elimination) No complaints received from Amungee NW-1 flaring.	•Ongoing pastoralist engagement to monitor performance and identify potential impacts from activity on local amenity. (Administration)	•Complaints regarding light emissions will be dealt through Origins complaint resolution process. Where valid complaints are received, additional controls will be implemented to address community complaints (such as shrouds, Changes to flare configuration etc.)	**1**	**1**	**L**	Yes	The remote location and separation distances between receptors is likely to result in minor light emissions. Light may be visible from activities (such as flaring), but will not be of sufficient intensity to cause any material impact to the health and wellbeing of community members. The likelihood of impacts is a function of separation distance and is therefore predicted to be remote, with a probability less than 1%	Yes	Low

Ref	Environmental Factor	Risk scenario description	Risk Source	Code of Practice	unmitigated (CoP implemented) Risk Rating			Risk mitigation Measures			Residual Risk Rating			ALARP criteria achieved?	Residual risk ALARP and Acceptable Statement	Acceptablecr iteria achieved?	Scientific Uncertainty Ranking
					Consequen	Likelihood	Risk Rating	Prevent	Detect	Recover	Consequen	Likelihood	Risk Rating				
48			Influx of workers to region		2	1	L	•Work temporary in nature and utilises existing regional contractors where available (Elimination) •Engagement with the pastoralists and directly affected community completed to communicate scope of work (administration) •Site camps utilised to minimise workers within local community (Elimination)	•Ongoing community engagement to monitor performance and identify potential impacts from activity on local communities.	•Complaints regarding work influx are unlikely and will be dealt through Origins complaint resolution process. Where valid complaints are received, additional controls will be implemented to address community complaints.	2	1	L	Yes	The limited scope and duration of activities reduces the risk and uncertainty associated with risk. Most workers will be located away from communities, meaning there is unlikely to be a major increase in people.	Yes	Low
49			Noise emissions from activities.	A.4.1 Site selection and planning A.4.2 Noise	1	1	L	•Sites are located 27-50km away the nearest homestead (Copee Hill) with Amungee NW located adjacent to Carpentaria Highway and Velkerri 76 S2 40km away. Noise impacts will not reach sensitive receptors, with QLD experience on rig and stimulation noise indicating noise levels approaching background levels approximately<2km from the activity. (Elimination) •No complaints received from Amungee NW-1 flaring (Administration).	•Ongoing pastoralist engagement to monitor performance and identify potential impacts from activity on local amenity. (Administration)	•Complaints regarding noise emissions will be dealt through Origins complaint resolution process. Where valid complaints are received, additional controls will be implemented to address community complaints (such as shrouds, changes to flare configuration etc.)	1	1	L	Yes	The remote location and separation distances between receptors is likely to result in "minor" noise impacts. The likelihood of impacts is a function of separation distance and is therefore predicted to be remote, with a probability less than 1%	Yes	Low
50		Reduction in land productivity.	Introduction and spread of weeds in the area.	A.4.5 Weed management	2	3	M	•All equipment and vehicles to be washed-down and to have a Biosecurity Declaration Certificate prior to access to site (Elimination) •Areas of proposed exploration have been surveyed and are deemed to have low weed abundance (elimination) •Activity will be restricted to defined lease pads and camp pads (Elimination)	•6 monthly monitoring implemented around infrastructure to detect the spread/ introduction of weed species (administration) •Origin assurance activities to target equipment wash-down certificates to ensure standards are being met. (Administration)	•Where weed outbreaks are identified associated with Origin's activities, infestations will be treated in accordance with the Weed Management Plan	2	3	M	Yes	The area in the vicinity of the sites is free of weeds. Weeds are present across the broader property. Any introduction of weeds is likely to result in localised impact, with weed management requirements likely to reduce the consequence down to "moderate, short term. Due to the inherent nature of weed prevention the risk likelihood is considered unlikely, with a probability less than <30%	Yes	Low
51			Over extraction of groundwater.	A.4.1.1 Well pad specific site selection requirements B.4.17 Groundwater monitoring	1	1	L	•Groundwater extraction for activities to be restricted to the minimum water required. (Elimination) •Groundwater bores are metered for groundwater take. (Engineering) •All water take licenced in accordance with NT Water Act under Water Extraction Licence (WEL) GRF 10285 (Administration) •Drawdown from activity and other users assessed by DEPWS as a part of WEL; impacts to closest receptor not anticipated (Administration/ Elimination) •Karst system is under allocated, with sufficient available capacity to support proposed water extraction requirements. (Elimination) •Closest receptor is ~4km from extraction point (Elimination)	•Continuous flow meters to monitor take and water balance implemented to ensure compliance with WEL (Administration) • Groundwater monitoring completed to identify impacts associated with water extraction (Engineering)	•Groundwater extraction to cease where sustained drawdown post pumping exceeds 1 m (Administration)	1	1	L	Yes	The extraction of groundwater for hydraulic fracturing activities requires all take to be licenced. The proposed take is assessed as a part of the licence application, with the assessment considering current and future water take levels. Based on this assessment, it was determined that the extraction rate would not impact upon adjacent users. The risk consequence is determined to be "serious"- given any impact is likely to cause pastoralist and broader community concern. The likelihood of such a consequence from occurring is considered remote (probability <1%) due to the quality of the Cambrian limestone aquifer, separation distance from surrounding users and under utilisation of aquifer.	Yes	Low
52			Impact to surface hydrology changes water flows impacting the land use/productivity	A.4.3 Erosion and sediment control and hydrology A.4.1 Site selection and planning	1	1	L	•No clearing of vegetation proposed at Velkerri 76 S2. Small amount of clearing at Amungee NW 76 (12.74ha) (Elimination) •Lease pad located away from watercourses and regional flow paths. (Elimination) •Lease pads designed to divert stormwater around, without impeding natural surface water flows (Engineering) •Stockpiled debris to be used to discourage water concentration, with vegetation establish on stockpiles to reduce exposed surfaces •Area is remote with closest watercourse approximately 13km away. (Elimination) •The lease area is flat, with water to be diverted around the perimeter of the site. (Elimination)	•Erosion and Sediment Control Plan in place with routine pre and post wet season inspection and maintenance (administration)	•Maintenance to be undertaken on erosion and sediment controls to ensure ongoing functionality and the controls are adequate (Engineering)	1	1	L	Yes	The existing lease pad will be utilised for all activities, with no additional construction required. The existing lease pad has been located outside the major regional flow paths and designed to divert stormwater around the infrastructure. The consequence is anticipated to be minor, with the likelihood remote (based on the site being existing)..	Yes	Low
53			Bushfire from accidental ignition by site activities (civil works, drilling, flaring grinding) or personnel.	A 4.6 Fire management	3	2	M	•Bushfire management plan implemented to prevent and respond to bushfires- including establishment of communication and fire response protocols with pastoralists (Administration) •Bushfire awareness included in site inductions. (Administration) •Designated smoking areas on-site (Elimination) •Firefighting equipment to be available to deal with fires (Engineering). •Fire breaks have been constructed around the existing lease and camp pads and willl be constructed around the expanded Amungee NW lease pad (Engineering) •Minimum of 45m separation distances between flares and surrounding vegetation (Engineering) •Ignition sources placed outside of the hazardous area. (Elimination) •Intrinsically safe equipment used in hazardous area. (Elimination) •Hazardous area drawing will provide classification of hazardous zones while drilling. (Elimination) •No flaring during periods of total fire ban (Elimination) •Activities will comply with landholder and regional bushfire management plans. (Elimination) •Area in the vicinity of Amungee NW lease has had recent (within 1-2 years) fire activity, reducing the fuel load (Elimination). Last fire at Velkerri 76 S2 was 2018	•Annual fire preparedness assurance activities completed where activities are proposed during high fire risk periods (administration) •Daily monitoring of bushfires in the region during periods of high fire danger (administration) •Annual fire frequency mapping using the Northern Australia Fire Information fire history database (administration)	•Fire hazard reduction strategies (such as back burning) to be implemented to reduce the risk of fire ignition/ impact as required (Elimination) •Where a bushfire is started and cannot be controlled, Origin to engage with pastoralist to coordinate response activities	3	2	M	Yes	Fire is a common occurrence within the Barkly Region. A fire is likely to have a serious impact, with moderate term reversible impacts (years). With the appropriate controls, such as separation distances, firebreaks, and adherence to total fire bans, the likelihood of causing a fire from drilling, stimulation and well testing is anticipated to be highly unlikely, with a predicted occurrence of <10%	Yes	Low
54			Poor rehabilitation of exploration infrastructure.	A.4.8 Rehabilitation	2	2	L	•A site specific Rehabilitation Plan has been developed and will be implemented progressively Engineering) •Areas will have infrastructure and wastes removed, sumps and pits backfilled, topsoil respread and vegetation re-introduced. (Engineering) •Rehabilitation timing will consider seasonal constraints, with rehab completed prior to the wet season to maximise revegetation chance (Engineering)	•Rehabilitation monitoring to be undertaken to track rehabilitation progress (Administration)	•Maintenance will be undertaken periodically to fix any defects (Engineering)	2	2	L	Yes	Rehabilitation success will be determined through the timing of rehabilitation, with rehab activities undertaken before the wet season to maximise success. Ongoing monitoring and maintenance of rehabilitated areas will be critical to identify and repair areas where rehabilitated success is poor, Consequences are likely to be moderate, with impacts likely to have moderate, locally restricted and medium to long term (1-5 years). The likelihood is influenced by the requirement for security provisions, rehabilitation plan requirements and COP conditions. The likelihood is anticipated to be highly unlikely, with a probability below 10%.	Yes	Low
55			Disruption of agricultural operations due to ongoing access, traffic, helicopter movements etc.	A.4.1 Site selection and planning A.4.2 Noise	1	3	L	•All activities require engagement with pastoralists (Administration) •Lease site has been located to avoid disruption to agriculture operations and infrastructure. (Elimination) •Engagement will be undertaken in accordance with NT Petroleum (Environment) Regulations (Administration) •Traffic levels are anticipated to be small- as per Traffic Impact Assessment.(Elimination) •Helicopter movements to be restricted to wet season when landholder activities are minimal (Elimination) •Helicopter movements to be undertaken in consultation with leaseholder to avoid impacts to livestock, cattle yards, watering points, homesteads and other sensitive areas as advised by leaseholder. (Elimination)	•Ongoing pastoralist engagement to monitor performance and identify potential impacts from activity on local amenity. (Administration)	•Complaints regarding Origin's activities will be dealt through Origins complaint resolution process. Where complaints are received, Origin will investigate if additional controls are needed and implement to address the complaint (such as shrouds, Changes to flare configuration etc.) (administration/engineering)	1	3	L	Yes	Origin has extensive experience in co-existing its activities with agricultural users. Consultation with pastoralists is undertaken to ensure impacts on their activities are mitigated. These impacts are addressed in the compensation agreements and access guidelines. It is noted that there is an impact on stakeholder in regards to working with proponents to plan E&A activities. this is unavoidable and required to ensure the activities can be designed to accommodate the activities of both parties. Consequences are anticipated to be minor for E&A activities, with the likelihood unlikely. The likelihood is reduced through compensation agreements which consider the pastoralist time when negotiating agreements.	Yes	Low

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56		Safety hazard to pastoralists, community and tourists from increased traffic levels	Increased risk of vehicle accident	A.4.1 Site selection and Planning	3	1	L	•Traffic impact assessment completed, with traffic levels are anticipated to be small (Elimination) •Fatigue management policy implemented for transport companies, with breaks required every two hours (Administration) •Alcohol and drug policy implemented with zero tolerance (0.00% BAC and no illicit substances) (Elimination) •Workers are flown in and out of Daly waters from Darwin. Busses are used to limit vehicle transport movements between the Daly Waters airport and remote camps- there is limited Drive In/Drive Out workers into the Beetaloo- except where local or regional contractors are utilised. (Elimination) •The camp is located away from major roads with most movements internal between camp lease and drill site (Elimination) •Stuart highway intersection design approved by DIPL with appreciate line of site provided for vehicles to identify turning vehicles. (Engineering) •Origin has completed 100,000's of transport movements each in QLD with transports incidents extremely rare. (Elimination)	•Ongoing community engagement to monitor performance and identify potential impacts from activity on local amenity. (Administration)	•Complaints regarding Origin's activities will be dealt through Origins complaint resolution process. Where valid complaints are received, additional controls will be implemented to address community complaint (Administration)	3	1	L	Yes	E&A activities will increase traffic levels up to 44 vehicles per day during the peak. This traffic volume is well below the Level of Service for the highway, which is estimated to be above 1100 vehicles per hour. Accidents from truck turning into access tracks or from general vehicle accidents are anticipated to have a serious consequence, with an injury to community members/ tourist requiring hospitalisation. Given Origin completed 100,000's of heavy vehicle movements each year with serious incidents extremely rare, smaller volume of traffic required for Beetaloo, the lack of road users, traffic management plan for the access track turn in, Zero tolerance for alcohol and drugs and use of trained drivers, the likelihood is considered Remote, with a probability less than 1%	Yes	Low
57		Labour competition with local businesses and agricultural procedures.	Exploration activities compete with agricultural industry for resources.		1	1	L	•Proposed activity is temporary with no major labour requirements- stakeholders engaged to ensure they know the temporal nature of work (Administration) •Local and regional contractors will be utilised where available (Elimination) •All work to be short-term with predominantly skilled workforce sourced regionally/interstate. •Contracts will be structured to reduce 'boom and bust' cycle (clear understanding of limited scope of work).	•Ongoing community engagement to monitor performance and identify potential impacts from activity on local amenity. (Administration)	•Complaints regarding Origin's activities will be dealt through Origins complaint resolution process. Where valid complaints are received, additional controls will be implemented to address community complaint (Administration)	1	1	L	Yes	Labour competition is a consequence that may occur in a full scale shale development and is not anticipated to have a major impact during exploration. Exploration activities are generally short term campaigns and are completed similar to most small infrastructure projects (such as road upgrades). Local contractors are to be used where available, with a priority on using Tn businesses. The consequence of labour competition during E&A is minor, with a likelihood of remote (<1% probability)	Yes	Low
58	**Air Quality**	Reduction in air quality associated with exploration emissions (Civil, Drilling, Stimulating and Well Testing).	Emissions from the combustion of diesel.	A.4.1 Site selection and planning D.5.1 Baseline assessment	1	2	L	•Low emission equipment to be utilised (Engineering) •All equipment to be maintained in accordance with the manufacturer's recommendations (Engineering) • Flares onsite to combust hydrocarbons and condensate at Velkerri 76 S2 (Engineering) •No sensitive receptors within 20km (Elimination)	•Equipment condition and maintenance to be built into contract (Administration) •Routine site inspections and assurance undertaken to ensure equipment is maintained and operated as per manufacturers requirements. (Engineering)	•All equipment defects identified by site inspection and assurances to be rectified promptly.(Engineering)	1	1	L	Yes	Impacts to sensitive receptors are not anticipated, with the closest receptor over 20km away. Flares will be utilised to minimise the release of VOC's. The potential consequence from E&A activities is predicted to be minor. The likelihood is a function of source (lack of) and separation distance between receptors. the likelihood of a sensitive receptor being exposed to emissions from E&A activities above the NEPM guidelines are remote (<1%).	Yes	Low
59			Air emissions from gas and condensate flaring.	A.4.1 Site selection and planning D.5.1 Baseline assessment B.4.13 Hydraulic Stimulation and flowback operations D.5.8 Venting and flaring	1	2	L	•Flares have been designed and will be operated in compliance with the US EPA 40 CFR § 63.18 to achieve a 98% combustion efficiency (Engineering) •Emissions of NOx, CO and TVOC are small and not anticipated to reduce ambient air quality as there are no regional sources (Elimination) •Vertical flare stack used for gas- maximising dispersion. Horizontal flare at Velkerri 76 S2 to enable flaring of condensate (Engineering) •Flares to be designed and operated to minimise smoking (Engineering) •Site located away from receptors (Elimination) •No sensitive receptors within 20km (Elimination)	•Flares will be inspected as a part of weekly routine site inspection to rectify any excessive smoke production from flares (noting condensate flaring may produce small quantities of ongoing smoke due to the higher molecular weight of the hydrocarbons). (Administration)	•Where excessive smoking of flares is identified, the flare operating status will be reviewed and optimise to reduce particulate generation (Engineering)	1	2	L	Yes	Risks associated with emissions from flares are well known within literature, and Australia and International policy/standards exist (such as NGERS and various US EPA technical guidance notes). The location of the activity is likely to limit the potential exposure to receptors, with consequences likely to be minor, localised and short term (days base on wind direction and atmospheric boundary conditions). The likelihood is predominantly reduced through the separation distance between the activity and receptors, with a likelihood of remote (<1% predicted)	Yes	Low
60			Air emissions from chemical releases during drilling and stimulation activities.	A.4.1 Site selection and planning B.4.16 Well site layout and housekeeping b.4.13 Hydraulic Stimulation and flowback operations	1	1	L	•National Occupational Health and Safety Codes: Code of Practice for the Control of Workplace Hazardous Substances. (Administration) •Chemical Risk Assessment completed on all chemicals used for stimulation (Elimination/Administration) •Chemical handling and mixing practices to reduce particulate emissions. (Engineering) •No sensitive receptors within 20km. (Elimination)	•Routine site inspections and assurance undertaken to ensure ongoing chemical handling and mixing practices do not result in an offsite release of substances (Administration)	•Corrective actions implemented to address poor chemical handling and mixing practices. (Engineering)	1	1	L	Yes	Risks associated with air emissions from petroleum activities are well known, with various risk assessment and emissions estimation technical guidance notes available within Australia and internationally (such as the National Pollutant Inventory and the US EPA). Due to overriding occupational health safety requirements to limit worker exposure and lack of local receptors, the consequence is anticipated to be minor. The likelihood is reduced to remote, given the large separation distances between the activity and closest receptors.	Yes	Low
61		Increased nuisance from dust and particulate emissions associated with exploration activities caused impacts to regional ecosystems and fauna	Civil activities, drilling operations, well testing.	A.4.1 Site selection and planning	1	5	M	•Water trucks will be used to decrease dust emissions. (Engineering) •Roads maintained to prevent bull dust generation (Engineering) •No sensitive receptors within 20km (Elimination)	•Routine site inspections and assurance undertaken to identify and rectify high dust emissions (Administration)	•Dust control to be implemented where unacceptable dust from transport activities occur (Engineering)	1	5	M	Yes	Dust will be generated through transport movements along access tracks and around lease pads. The consequence of dust is anticipated to be moderate, with localised, short term impacts to areas immediately adjacent to access tracks. The likelihood of the risk is reduced through the isolated location (lack of sensitive receptors), regionally extensive vegetation communities (good outside refuge away from access tracks and use of dust suppression . As dust generation has been observed, and is commonly associated with dirt tracks, the likelihood of an impact is considered likely.	Yes	Low
62			Bushfire from accidental ignition by site activities (civil works, drilling, flaring, grinding) or personnel.	A 4.6 Fire management	3	2	M	•Bushfire management plan implemented to prevent and respond to bushfires- including establishment of communication and fire response protocols with pastoralists (Administration) •Bushfire awareness included in site inductions. (Administration) •Designated smoking areas on-site (Elimination) •Firefighting equipment to be available to deal with fires (Engineering). •Fire breaks have been constructed around the existing lease and camp pads and willl be constructed around the expanded Amungee NW lease pad (Engineering) •Minimum of 45m separation distances between flares and surrounding vegetation (Engineering) •Ignition sources placed outside of the hazardous area. (Elimination) •Intrinsically safe equipment used in hazardous area. (Elimination) •Hazardous area drawing will provide classification of hazardous zones while drilling. (Elimination) •No flaring during periods of total fire ban (Elimination) •Activities will comply with landholder and regional bushfire management plans. (Elimination) •Area in the vicinity of Amungee NW lease has had recent (within 2-3 years) fire activity, reducing the fuel load (Elimination). Last fire at Velkerri 76 S2 was 2018	•Annual fire preparedness assurance activities completed where activities are proposed during high fire risk periods (administration) •Daily monitoring of bushfires in the region during periods of high fire danger (administration) •Annual fire frequency mapping using the Northern Australia Fire Information fire history database (administration)	•Fire hazard reduction strategies (such as back burning) to be implemented to reduce the risk of fire ignition/ impact as required (Elimination) •Where a bushfire is started and cannot be controlled, Origin to engage with pastoralist to coordinate response activities (Administration/ engineering)	3	2	M	Yes	Fire is a common occurrence within the Barkly Region. A fire is likely to have a serious impact, with moderate term reversible impacts (years). With the appropriate controls, such as separation distances, firebreaks, and adherence to total fire bans, the likelihood of causing a fire from drilling, stimulation and well testing is anticipated to be highly unlikely, with a predicted occurrence of <10%	Yes	Low
63	**Greenhouse Gas Emissions**	Unsustainable Greenhouse Gas emissions from the activity.	Combustion of diesel for exploration activities.	A.4.1 Site selection and planning	2	1	L	•Australian emission standards for equipment ensures minimum operating efficiency (Engineering) •All equipment to be maintained in accordance with the manufacturer's recommendations (Engineering) •No sensitive receptors within 20km (Elimination)	•Equipment condition and maintenance to be built into contract (Administration) •Routine site inspections and assurance undertaken to ensure equipment is maintained and operated as per manufacturers requirements. (Engineering)	•All equipment defects identified by site inspection and assurances to be rectified promptly.(Engineering)	2	1	L	Yes	The risks associated with Greenhouse Gas generation through diesel combustion are well documented in literature and domestic/international greenhouse policy (such as NGERS and IPCC). The consequences of GHG generation from exploration activities is moderate, with less than 1% of the NT emissions generated. The likelihood of the level of GHG production being unsustainable is considered remote, with a probability less than 1%	Yes	Low

Ref	Environmental Factor	Risk scenario description	Risk Source	Code of Practice	unmitigated (CoP implemented) Risk Rating			Risk mitigation Measures			Residual Risk Rating			ALARP criteria achieved?	Residual risk ALARP and Acceptable Statement	Acceptablecriteria achieved?	Scientific Uncertainty Ranking
					Consequen	Likelihood	Risk Rating	Prevent	Detect	Recover	Consequen	Likelihood	Risk Rating				
64			Flaring of gas and condensate during well testing.	B.4.13 Hydraulic Stimulation and flowback operations D.5.8 Venting and flaring	2	2	L	•Venting to be minimised with all venting reported under NGERS. •Flares have been designed and will be operated in compliance with the US EPA 40 CFR § 63.18 to achieve a 98% combustion efficiency. •Emissions from source rock during drilling are negligible. •Condensate will be flare and/ortransported offsite for sale if permissible. •Total worst case emissions from activity are not significant- being less than 0.38% of NT's Total GHG emissions and 0.011% of Australia's GHG emissions	•Flares will be inspected as a part of weekly routine site inspection to rectify any excessive smoke production from flares (noting condensate flaring may produce small quantities of ongoing smoke due to the higher molecular weight of the hydrocarbons). (Administration)	•Where excessive smoking of flares is identified, the flare operating status will be reviewed and optimise to reduce particulate generation (Engineering)	2	2	L	Yes	The risks associated with Greenhouse Gas generation through diesel combustion are well documented in literature and domestic/international greenhouse policy (such as NGERS and IPCC). The consequences of GHG generation from exploration activities is moderate, with less than 1% of the NT emissions generated. The likelihood of the level of GHG production being unsustainable is considered remote, with a probability less than 1%. The well testing will also allow for natural gas to be used as a transition fuel	Yes	Low
65			Uncontrolled release of gas encountered during drilling, stimulation, barrier failure, operator error or vehicle collision under a multi-well scenario	B.4.1 Well integrity management B.4.3 Well design and barriers B.4.13 Hydraulic Stimulation and flow back operations D.5.8 Venting and flaring	2	2	L	•Drilling overbalanced to reduce the inflows of hydrocarbons (Engineering) •Blow out prevention in place to manage well failure and uncontrolled gas influxes (Engineering) •Blow out preventor pressure rating and testing •All equipment will be API compliant to handle expected conditions (Engineering) •Site manned during operation (Administration) •Well suspended with multiple cement and casing barriers in place- with 4 casing section utilised (conductor, surface, intermediate and production).(Engineering) •Barricading to be used to protect each exploration well from vehicle collision during multi-well drilling activities. (Engineering)	•Process monitoring to detect events that could potentially result in a uncontrolled release of gas (such as fluid balances, well head pressure etc.) (Engineering) •Routine (monthly) well inspections (Administration	•An emergency as diverter and flare to be used during drilling to manage gas ingress (Engineering) •Contracts in place with emergency well intervention specialists (such as Boots and Cootes) (administration) •Emergency response plan implemented (administration)	2	2	L	Yes	The COP and standard drilling, stimulation and well testing safety controls are designed to prevent the uncontrolled release of hydrocarbons. Flares are used during drilling and well testing to manage any encountered hydrocarbons The consequence are anticipated to be moderate, with impacts likely to be moderate, restricted in duration (minutes to hours). The likelihood is considered highly unlikely with a occurrence probability less than 10%, based on the well designed, construction and operations requirements mandated by the COP.	Yes	Low
66			Uncontrolled release of gas from well due to sabotage.	D.5.8 Venting and flaring	2	2	L	•Multiple barriers used during well suspension/operation- including downhole suspension plugs, suspension fluid and surface valves (Engineering) •Sites manned during operation (Administration) •Security cameras located on sites (Engineering) •Sites locked (Engineering) •Valves locked (Engineering)	•Routine (monthly) well inspections (Engineering)	•Contracts in place with emergency well intervention specialists (such as Boots and Cootes) Administration) •Emergency response plan implemented (Administration)	2	2	L	Yes	The risks associated with Greenhouse Gas generation through well sabotage is anticipated to be moderate, with impacts likely to b restricted in duration (hours to days). The likelihood is considered remote (probability <1%), with the site remoted and multiple valves locked on the well to prevent tampering	Yes	Low
67			Leak of gas from wells.	B.4.1 Well integrity management B.4.3 Well design and barriers D.5.4 Emission detection and management D.5.5 Leak remediation and notification	1	2	L	•Well design considers multiple (4) specifically-engineered cement and steel casing barriers in place between hydrocarbon-bearing zone and surface. This includes conductor casing, surface casing, intermediate casing and production casing intervals (Engineering) • Well design and Well Barrier Integrity Validation reports submitted to DITT as part of Well Operations Management Plan (WOMP). (Administration/ engineering) •Wells constructed and suspended with barriers in place and verified as per governing code (engineering) •Limited gas production time only to extended production test. (Elimination)	•Routine 6 monthly well leak detection (Engineering) •Routine (monthly) well inspections (Administration)	•Any leaking wells to be reported and remediated at a frequency consistent with the COP depending on severity (Engineering)	1	2	L	Yes	The consequence of a well leak are anticipated to be minor with impacts likely to be small (<1000L/hour) and restricted in duration (days to weeks). The likelihood is considered highly unlikely with a occurrence probability less than 10%, based on the well designed, construction and operations requirements mandated by the COP. Leak detection and reporting requirements are also controls to ensure any leaks are promptly identified and fixed.	Yes	Low
68	**Cumulative Risk**	Cumulative impacts on groundwater quantify.	Groundwater take from surrounding land users exceeds the natural recharge rate of the Basin.	Water extraction licences under the NT Water Act	2	1	L	•Groundwater extraction volumes to be monitored and kept below WEL (Elimination) •Groundwater extraction assessments include an estimate of current extraction levels at a regional scale. •No intensive users of groundwater within the region, with stock and domestic being the major usage. (elimination) •Cumulative impacts considered in the water extraction licence under the NT Water Act. (Elimination) •Strategic Regional Environmental Baseline Assessment (SREBA) completed to collected baseline environmental data, with Environmental Impact Assessments completed to address cumulative impacts from industry (Administration/ Engineering/ elimination)	•Groundwater monitoring of control and impact monitoring bores will detect localised groundwater depressurisation before regional impacts occur (Engineering)	•Where sustained groundwater depletion is observed in regional aquifers, alternative water supplies may be required, such as deeper aquifers with limited extraction (Elimination) •Water Act make good provisions to ensure any impacts on users from exploration activities are "made good"	2	1	L	Yes	The regional understanding of the CLA is sufficient to understand the risks associated with groundwater extraction. The absence of users and small exploration take reduces the uncertainty of the activity. This risk has been assessed as a part of the WEL application and approval. Due to the lack of receptors, the consequence is considered moderate (i.e. 1 user within 16km) and likelihood remote (probability less than 1%	Yes	Low
69		Cumulative impacts on terrestrial ecology.	Impacts from exploration activities and existing agricultural activities results in impacts to vegetation communities, fragmentation and poses a threat to protected flora and fauna.	A.4.1 Site selection and planning A.4.1.1 Well pad specific site selection A.4.4 Biodiversity Protection	2	1	L	• Velkerri 76 S2 is an existing site with no new clearing proposed . Amungee NW is an existing site with a small additional area (12.74ha) to be cleared to expand the existing lease pad and camp lease and install helipad, laydown yard and fence line / firebreak (Engineering) •Area has limited development with no widespread land clearing or other pressures from agriculture or other users. (Elimination) •Petroleum activity is limited in scale and will not material decrease availability of habitat across the region (Elimination) •Strategic Regional Environmental Baseline Assessment (SREBA) completed to collected baseline environmental data, with Environmental Impact Assessments completed to address cumulative impacts from industry (Administration/ Engineering/ Elimination)	•N/A- No increased risk to cumulative regional impacts.	N/A.	2	1	L	Yes	The region has low land clearing pressure with no applications for large scale land clearing present. The level of disturbance proposed is small, with field ecological scouting confirming ecological communities present.	Yes	Low
70		Cumulative impacts on amenity.	Exploration activities further reduces amenity (visual, noise, traffic and lighting) through additional landscape modification, dust, noise, light and traffic.	A.4.1 Site selection and planning A.4.1.1 Well pad specific site selection	1	2	L	• Wellsites are located in a remote/rural landscape, away from sensitive receptors (Elimination) •Rig equipment located onsite/ within the adjacent property (Elimination) •Flaring may create a visible hue on the horizon consistent with that of a small town. •Traffic volumes are anticipated to be small and well below existing industries. (Elimination) •A Traffic Management Plan covering the intersection upgrade work has been submitted to DPIL for approval . (Elimination) •Low level of development activity within the region, with activity unlikely to cause declines in amenity. (Elimination)	•Community complaints regarding nuisance (including dust, traffic etc.) to be used to detect cumulative impacts (Administration)	•Complaints are to be investigated and additional controls implemented where appropriate. (Administration/ engineering)	1	2	L	Yes	The region is underdeveloped with the activity located away from major transportation routes, homesteads and communities. The activity is of a small size and unlikely to result in any loss of amenity. Any loss of amenity is therefore likely to be minor, with a likelihood of highly unlikely.	Yes	Low
71		Cumulative impacts on surface water quality.	Exploration activities in addition to existing surrounding land use (agriculture) reduces surface water quality.	A.4.1 Site selection and planning A.4.1.1 Well pad specific site selection A.4.3 Erosion and sediment control and hydrology	1	1	L	•Area has limited development with no widespread land clearing pressures from agriculture or other users likely to reduce water quality. (Elimination) •Activity will largely occur on existing disturbed areas with limited additional clearing on Amungee NW (12.74ha). (Elimination) •No surface water take or wastewater releases permitted. (Elimination) •Strategic Regional Environmental Baseline Assessment (SREBA) completed to collected baseline environmental data, with Environmental Impact Assessments completed to address cumulative impacts from industry (Administration/ Engineering/ Elimination)	N/A- no increased impact o surface waters anticipated	N/A- no increased impact o surface waters anticipated	1	1	L	Yes	The region is underdeveloped with the activity located away from major flow pathways with limited topographic variation.. The activity is of a small size and unlikely to result in any material increase in sediment loads to surface waters.	Yes	Low

Ref	Environmental Factor	Risk scenario description	Risk Source	Code of Practice	unmitigated (CoP implemented) Risk Rating			Risk mitigation Measures			Residual Risk Rating			ALARP criteria achieved?	Residual risk ALARP and Acceptable Statement	Acceptablecriteria achieved?	Scientific Uncertainty Ranking
					Consequen	Likelihood	Risk Rating	Prevent	Detect	Recover	Consequen	Likelihood	Risk Rating				
72		Cumulative impacts-greenhouse gas emissions	Exploration activities materially increase Northern Territory's and Australia Greenhouse Gas emissions	B.4.1 Well integrity management B.4.3 Well design and barriers B.4.13 Hydraulic Stimulation and flow back operations D.5.8 Venting and flaring	2	1	L	•Activities required to prove up natural gas resources, with all available technology utilised to reduced emission intensity of exploration activities •Flaring required to mitigate emissions from the activity (Engineering) •Full development (if technically and commercially viable) likely to provide a viable transition fuel with up to 50% emissions of coal (Engineering) •Total greenhouse gas emissions for the Beetaloo Sub-basin are low compared to total NT and Broader Australia Greenhouse gas emissions. The worst case percentage of total NT and Australian GHG emissions is estimated at 2.6% and 0.078% respectively. •Strategic Regional Environmental Baseline Assessment (SREBA) completed to collected baseline environmental data, with Environmental Impact Assessments completed to address cumulative impacts from industry (Administration/ Engineering/ elimination)	N/A- Greenhouse gas emissions are approved prior to commencement of activity	N/A- Greenhouse gas emissions are approved prior to commencement of activity	2	1	L	Yes	The role natural gas plays as a low carbon intensity transition fuel to support renewable energy use is well known. Broad adoption of natural gas within the US has replaced coal in energy production and has been responsible for a continued decline in carbon emissions. The use of natural gas is one of the low carbon intensity fuels required to reduce carbon emissions.	Yes	Low

APPENDIX N

Stakeholder Engagement Log

Part A- Stakeholder Engagement Log Summary

Please note that confidential communications by NLC is summarised in the below table and provided to the Minister separately.

Date	Originator of communication	Company of contact	Person of contact	Contact type	Summary of contact	Does it trigger merit review?	A statement of the interest holder's response to stakeholder	Change to EMP required?	Details of changes the interest holder has made as a resulting from stakeholder engagement
				9 (1) f	**9(1)c**	**9 (1)d**	**9 (1) e**		**9 (1)g**
10/07/2018	Origin Energy	NLC	[redacted]	Written	Origin request to obtain site clearances for its proposed 2018/19/20 exploration program. This request included a description of the proposed activities (including up to 10 wells at each location, estimated duration and summary of key environmental considerations and risk controls.	No	NA	NA	Pre-2019 Regulations and data capture requirements.
17/07/2018	Origin Energy	NLC	[redacted]	Written	Origin provided additional information regarding maps and proposed site locations.	No	NA	NA	Pre-2019 Regulations and data capture requirements.
16/11/2018	NLC	Origin Energy	[redacted]	Written	NLC Conditions of Work Report to Operator _Origin_181115 received. Report summarised clearance activities, identified restricted work areas and conditions of work.	No	Yes	Yes	Identified restricted work areas and conditions of work add to the EMP where relevant. Pre-2019 Regulations and data capture requirements.
03/04/2019-10/04/2019	Origin Energy	NLC/TO	NLC/TO	Meetings	x6 on country meetings in Elliott with Native Title family groups regarding NLC Cleared Areas CA3 (Amungee NW1H (existing well site location), CA5 (Kyalla 117) and CA10 (Velkerri 76). 8 May 2019: One meeting in Darwin with Native Title family for NLC Cleared Areas from Sacred Site Clearance and Avoidance Survey in response to Origin's WPS. All meetings included an overview of the proposed work program and the environmental controls to address environmental risks. Origin used story boards to present and discuss key aspects regarding the environment and its protection.	No	NA	NA	NA

Date	Originator of communication	Company of contact	Person of contact	Contact type	Summary of contact	Does it trigger merit review?	A statement of the interest holder's response to stakeholder	Change to EMP required?	Details of changes the interest holder has made as a resulting from stakeholder engagement
3/09/2019	Origin Energy	NLC	[redacted]	Meeting	Meeting to discuss future site clearances and scope amendment by Origin. Additional information on lease pad layout and revised site list include.	No	NA	NA	NA
29/06/2020	Origin Energy	NLC	NLC	Face to Face	Meeting to provide an update of the Beetaloo exploration project and discuss sacred sites clearances.	No	Ongoing consultation/engagement with NLC regarding Origins current and future activities.	No	N/A
23/07/2020	Origin Energy	NLC	NLC	Workshop	Overview of future project phases and approvals processes.	No	Origin and NLC discussed the various phases of the project from exploration to development and the various activities associated.	No	N/A
27/10/2020	Origin Energy	NLC	NLC	Face to Face	Ongoing meeting to discuss sacred site clearances and exploration activities.	No	Origin discussed a range of future exploration activities and provided a summary of the relevant site and environmental constraints	No	N/A
28/03/2021	Origin Energy	NLC	NLC	Face to Face	Origin conducted Annual on Country meetings with NTHs from across the Beetaloo Basin. NLC facilitated these consultations and were present at all meetings. One meeting in Katherine (Minyeri and Mataranka groups); one meeting in Elliott (Marlinja and Borroloola group) and one meeting in Darwin for Darwin-based Native Title Holder families.	No	Story (visual) boards used by Origin to explain and communicate what exploration occurred in 2020 and what the planned 2021 exploration program involved regarding activities at Amungee, Kyalla and Velkerri.	No	N/A
17/08/2021	Origin Energy	NLC	NLC	Email	Origin informed the NLC that Origin had made an explanatory document available publicly on its website, outlining Origin's engagement with Native Title Holders.	No	N/A	No	No
22/09/2021	Origin Energy	NLC	NLC	Email	Origin submitted a work clearance request to the NLC (sacred site avoidance survey request).	No	N/A	No	No

Date	Originator of communication	Company of contact	Person of contact	Contact type	Summary of contact	Does it trigger merit review?	A statement of the interest holder's response to stakeholder	Change to EMP required?	Details of changes the interest holder has made as a resulting from stakeholder engagement
25/10/2021	Origin Energy	NLC	NLC	Face to Face	Meeting to discuss Origin's forward program, including activities around the Amungee NW site and broader Beetaloo.	No	Origin discussed a range of topics including the forward exploration project	No	N/A
29/10/2021	Origin Energy	NLC	NLC	Email	Annual work program update providing them information on Origin's forward exploration program.	No	N/A	No	N/A
03/11/2021	Origin [redacted])	Pastoralist	[redacted]	Email	Origin provided a copy of the stakeholder engagement pack summarising the required information under Section 7 of the Petroleum (environment) Regulations. This included the location of the activity, a description of the activity, potential risks and impacts of the activity, environmental outcomes and potential risks/ impacts to stakeholder's rights.	No		Yes	
09/11/2021	[redacted]	Origin	[redacted]	Email	Pastoralists raised several queries and questions associated with the stakeholder engagement pack: 1. Clarification of the term "Code of Practice" and cross-reference to relevant clauses. 2. Clarification around expansion of the site footprint. 3. Use of existing access tracks and traffic impacts – e.g. dust. 4. Clarification of water use 175 ML. 5. Low level flying over paddocks and impacts to cattle / calves. 6. An explanation of residual chemical toxicity and how it is measured. 7. Outline of the controls in place to transfer wastewater to enclosed tanks within 8 hours. 8. Outline of sump mitigations to protect stock / wildlife. 9. Fire risk mitigations during seismic. 10. Gate hazards.	No Stakeholder responded to Origin as documented in the table.	Origin responded in writing to all stakeholder queries. Refer document *"Amungee Mungee Stakeholder Engagement Response to Comment"*, dated 18/11/2021 and appended to Origin email 8/12/2021 below.	Yes	Included additional items in the risk assessment, specifically pertaining to mitigating gates being left open.

Date	Originator of communication	Company of contact	Person of contact	Contact type	Summary of contact	Does it trigger merit review?	A statement of the interest holder's response to stakeholder	Change to EMP required?	Details of changes the interest holder has made as a resulting from stakeholder engagement
19/11/2021 – 20/11/2021	NLC	Origin Energy	Origin Energy	Email	NLC informs Origin that a survey report was provided to AAPA.	No	201121: Origin acknowledged advice from NLC.	No	N/A
30/11/2021	NLC	Origin Energy	Origin Energy	Email	NLC submit Conditions of Work Report to Origin (post sacred site avoidance survey activities).	No	N/A	No	N/A
29/11/2021 – 03/12/2021	NLC	Origin Energy	Origin Energy	Email	NLC seeking shapefiles and to go with the work program to progress GIS and anthropology research.	No	03/12/2021: Shapefiles and mapping information provided to NLC in relation to CY22 work program.	No	N/A
8/12/2021	Origin [redacted]	Pastoralist	[redacted]	Email including attachment	Finalisation of stakeholder engagement in accordance with Regulation 7. The email included an attachment outlining Origin's responses to stakeholder queries raised on 9/11/2021.	No	As above, Origin responded in writing, refer document *"Amungee Mungee Stakeholder Engagement Response to Comment"*, dated 18/11/2021. No further queries were raised by the stakeholder.	Yes	EMP changes were addressed during previous engagement on 3/11/2021 and 9/11/2021 (see above).
08/12/2021	Origin [redacted]	DIPL	[redacted]	Telcon	Origin advised DIPL of Amungee multi-well EMP activities and sought request to use DIPL gravel pit and upgrade Amungee / Carpentaria Highway intersection.	No	Origin to provide a works summary to DIPL for approval.	No	Awaiting approval/advice from DIPL.
21/01/2022	Origin Energy	NLC	NLC	Telcon	Origin contact NLC to discuss logistics options for Annual on Country meetings.	No	NLC to internally consider options for coordinating annual on country meetings.	No	N/A
28/01/2022	Origin Energy	NLC	NLC	Email	Origin provided status update to NLC regarding Origin's EMP (Amungee Multi-well) submission, including links to EMP under assessment.	No	No	No	N/A
31/01/2022	Origin Energy	NLC	NLC	Email	Origin provide NLC with an Annual Work Report.	No	No	No	N/A
18/01/2022 – 31/01/2022	Origin Energy	NLC	NLC	Email	NLC request for a copy of Origin's visual story boards.	No	31/01/2022: Origin provided NLC with a copy of the visual 'Story Boards' previously used in Annual on Country engagements.	No	N/A
31/01/2022 – 04/02/2022	Origin Energy	NLC	NLC	Email	Origin notification of ETA for addendum work program.	No	04/02/2022: Origin provided Addendum work program (CY22) to NLC.	No	N/A

Date	Originator of communication	Company of contact	Person of contact	Contact type	Summary of contact	Does it trigger merit review?	A statement of the interest holder's response to stakeholder	Change to EMP required?	Details of changes the interest holder has made as a resulting from stakeholder engagement
04/02/2022	NLC	Origin Energy	NLC	Email	NLC communicates Media Releases to Origin regarding biosecurity zones (03/02/2022), NLC meetings and offices update (18/01/2022) and NLC Direction – No Meetings – COVID 14/01/2022)	No	No	No	N/A
11/02/2022	Origin Energy	NLC	NLC	Telecon	Origin provides NLC with a verbal operational update and discusses logistics and arrangements for Annual on Country engagements	No	No	No	N/A
12/02/2022	Origin Energy	NLC	NLC	Email	Origin informs NLC of an intended site visit and engagement with Native Title Holders by Origin's CEO and Chairman.	No	No	No	N/A
17/02/2022	NLC	Origin Energy	Origin Energy	Email	NLC provides Origin with a notice advising of extended biosecurity zones across the NLC area.	No	No	No	N/A
18/02/2022	Origin Energy	NLC	NLC	Telecon	Origin provides NLC with a verbal operational update and discusses logistics and arrangements for Annual on Country engagements.	No	No	No	N/A
18/02/2022	Origin ([redacted])	DIPL	[redacted]	Telcon / email	Origin's request for approval for activities to support ongoing exploration on Amungee NW, exploration permit (EP) 98: 1. Use of DIPL gravel pit. 2. Upgrade to Amungee /Carpentaria Highway intersection. 3. Future seismic within Carpentaria Highway corridor not included in Amungee multi-well EMP.	No	Origin work program summary submitted to DIPL for approval.	No	Awaiting approval/advice from DIPL.
25/02/2022	Origin Energy	NLC	NLC	Telecon	Origin provides NLC with a verbal operational update and discusses logistics and arrangements for Annual on Country engagements.	No	No	No	N/A
01/03/2022	[redacted]	DIPL	Origin ([redacted])	Email	DIPL provided the following advice: 1. Requested more information regarding seismic program 2. Requested that intersection drawings to meet DIPL requirements. 3. Did not approve use of DIPL gravel pit.	No	Nil, DIPL advice being reviewed internally.	Yes	Amungee Multi-well EMP (NT-2050-15-MP-041) amended to exclude use of DIPL gravel pit. Gravel will be sourced from existing pits or proposed pits under a future EMP. Seismic program on hold and part of a future EMP.

Date	Originator of communication	Company of contact	Person of contact	Contact type	Summary of contact	Does it trigger merit review?	A statement of the interest holder's response to stakeholder	Change to EMP required?	Details of changes the interest holder has made as a resulting from stakeholder engagement
									Origin will continue to liaise with DIPL regarding future activities.
09/03/2022	Origin ([redacted])	DIPL	[redacted]	Telcon / email	Origin seeking clarification on: 1. DIPL proposed design specifications. 2. Timing of NTG upgrades to Carpentaria Highway.	No	Nil, DIPL options being reviewed internally.	No	Origin will continue to liaise with DIPL regarding future activities and intersection upgrade.
11/03/2022	[redacted]	DIPL	Origin ([redacted])	Email	DIPL addressed Origin queries of 09/03/2022. DIPL upgrades to Highway scheduled for later in the year.	No	Nil, DIPL options being reviewed internally.	No	Origin will continue to liaise with DIPL regarding future activities intersection upgrade.

PART B Detailed Stakeholder Summary of Information provided and relevant PER sections

Section 7(2)(a)	Stakeholder	Document & content	Date provided
(i) "the regulated activity the interest holder proposes to carry out"	Pastoralist	Stakeholder engagement pack: • Section 5 a detailed description of the proposed activities covered under this EMP.	3/11/21
	NLC/traditional owners	• Annual on country meetings • Story boards • Annual work program communications • Face to face meetings • Work clearance requests • Condition of work reporting	Refer table, Part A
(ii) "the location (or locations) where it isproposed to carry out the activity"	Pastoralist	Stakeholder engagement pack: • Section 4 provides details of the location of the proposed activities covered under this EMP.	3/11/21
	NLC/traditional owners	• Annual on country meetings • Story boards • Annual work program communications • Face to face meetings • Work clearance requests • Condition of work reporting	Refer table, Part A
(iii) "the anticipated environmental impacts and environmental risks of the activity"	Pastoralist	Stakeholder engagement pack: • Section 6 provides details of the environmental outcomes, impacts and risks associated with the activities covered by this EMP.	3/11/21
	NLC/traditional owners	• Annual on country meetings • Annual work program communications • Face to face meetings • Sacred site clearances and discussions • Work clearance requests • Condition of work reporting	Refer table, Part A
(v) "the possible	Pastoralist	Stakeholder engagement pack:	3/11/21

Section 7(2)(a)	Stakeholder	Document & content	Date provided
consequences of carrying out the activity to the stakeholder's rights or activities"		• Section 7 provides details of possible consequences of carrying out the activity to the stakeholder's rights or activities associated with the activities covered by this EMP.	
	NLC/traditional owners	• Annual on country meetings • Annual work reports • Annual work program communications • Face to face meetings • Sacred site clearances and discussions • Work clearance requests • Condition of work reporting	Refer table, Part A

APPENDIX O

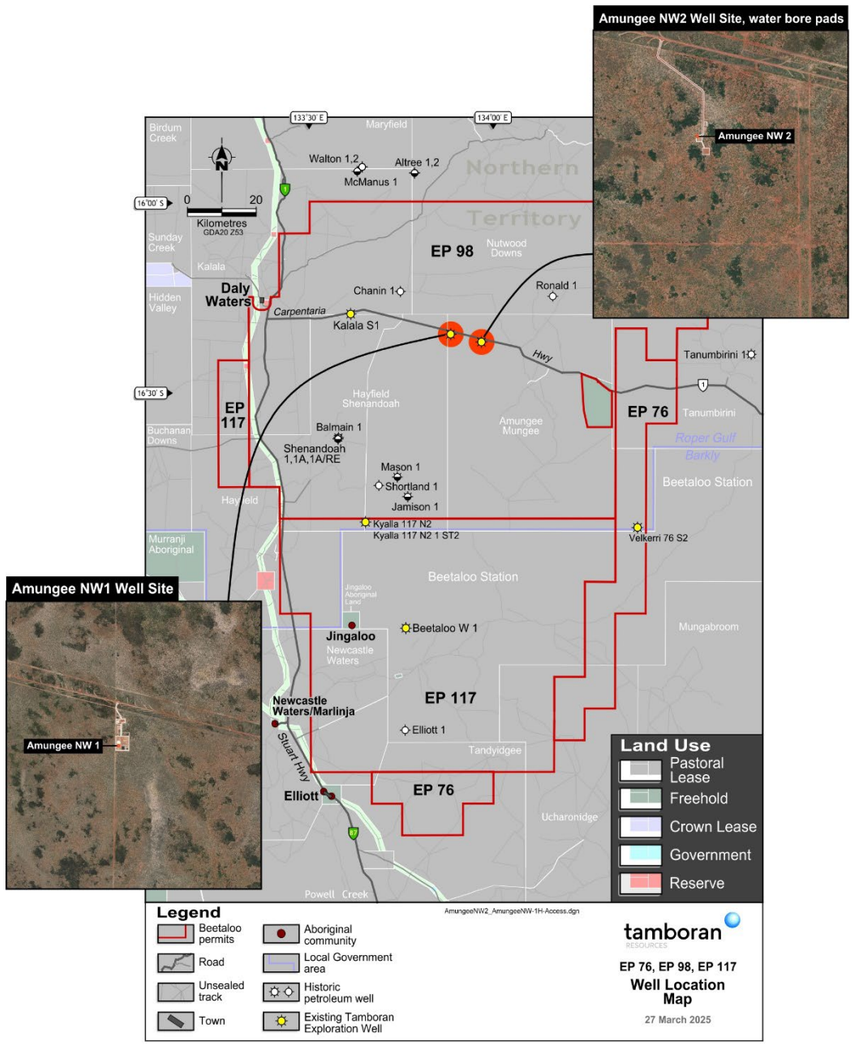
Rehabilitation Management Plans

Exploration Permit 98
Rehabilitation Management Plan 2022 onwards
Amungee NW and Amungee NW2

Rev 3, Mar-2025

Name	Contact details
Robert Wear Beetaloo Field Manager	Mobile: [redacted] Satellite Phone: [redacted] Email: [redacted]

Location of Amungee NW	
Property and land uses	Gas exploration, cattle grazing, and native title rights and interests recognised by the native title determinations over the land and waters.
Climate	The permit area is described as arid to semi-arid. Climate is influenced by the monsoon and there is a distinct wet and dry season. Most rainfall (90%) occurs during the summer months, between October and March. Annual rainfall varies across the permit area is around 680 mm, with rainfall totals show moderate variability and drought conditions are known to occur every 10 years.
Pre-disturbance land condition summary	Amungee NW (Zone 53, 380858.44 mE; 8192297.82 mS) is in the EP98 tenement. The natural vegetation community that exists at Amungee NW is Corymbia spp. dominated woodland with a diverse understorey and dense grass cover. Small patches of *Acacia shirleyi* (Lancewood) are also in close proximity. The dominant upper strata species is *Corymbia drysdalensis* and C. *ferruginea*. The mid strata consisted of *Terminalia canescens* and *Grevillea striata*. The understorey consisted of mostly grasses including *Themeda triandra*, *Heteropogon contortus*, *Chrysopogon fallax*, *Triodia bitextura*. Hyptis (Class B/C weed) also occurs near the site. The Landform at Amungee NW is characterised by plains and rises associated with deeply weathered lateritic profiles. Soils at this site are silty/ loamy soils containing around 35% fines and 70% gravel and has a high risk of losing structural integrity under moist conditions. Habitat surrounding the site is in good condition. The habitat contains good refuge opportunities in the form of dense leaf litter, dense grass cover, large woody debris and smaller tree hollows.



Rehabilitation zones			
Infrastructure	**Size (ha)**	**Soil type / slope**	**Vegetation community / dominant species**
Well pad	10.0	Lateritic silty sands <1% slope.	Open *Corymbia* spp. Woodland with *Chrysopogon* spp. Open tussock grassland. Patches of *Acacia shirleyi* (Lancewood) nearby.
Camp pad	1.2		
Helipad	1.0		
Laydown	1.0		
Access track	1.1		
Fenceline/firebreak	4.0		
Amungee NW2 water bore pads and access track	3.5		
Disturbance total	**21.8***	**Note current clearing Amungee NW is 11.98 ha and Amungee NW2 is 3.5 ha as at March 2025*	

Rehabilitation aims and objectives	
Site management aim	The aim is to rehabilitate any part of the land affected by the regulated activity to a safe condition consistent with industry standards, the Code and in consultation with the landholder.
Rehabilitation objectives	The rehabilitation objective is to provide a stable landform, which supports a) the rights and interests of the Native Title Holders in the land and water, and b) a resilient self-sustaining vegetation community that can withstand impacts including fire and cattle grazing and is safe to humans and wildlife.

Pre-disturbance photos of vegetation community

Rehabilitation risk	
Key Risks	**Controls**
Drought - impacting the establishment of rehabilitated vegetation	• Time rehabilitation actions to coincide with the beginning of the wet season, to ensure access to the site and maximise the establishment period of vegetation over the wet season. • Re-spread topsoil across the site to utilise the local seed bank. • Ongoing monitoring to identify if further seed inputs are required. • Collection of seed from the local area to ensure seed stock is suited to the climatic conditions of the site.
Fire - impacting revegetation	• Establish a mix of perennial and annual grass species. • Establish a mix of resprouting (e.g., *Eucalyptus* spp. and *Corymbia* spp.) and reseeding species (e.g., *Acacia* spp.). • Ongoing monitoring to determine fire impacts on revegetation. • Ongoing monitoring to determine if further seed inputs are required.
Grazing - impacting revegetation	• Establish a mix of perennial and annual grass species. • Re-spread timber with topsoil. • Ongoing monitoring to determine grazing impacts on revegetation. • Ongoing monitoring to determine if further seed inputs are required. • Ongoing monitoring to determine if fencing is required.
Exposed ground - leading to an increase in weed establishment and/or erosion	• Remove windrows and topsoils. • Respread of topsoil and vegetated matter across the site. • Annual weed surveys of rehabilitated area once rehabilitation is established. • Control of any weed incursions.

Rehabilitation strategy		
Parameter	**Methods**	**Objective**
Vegetation	• Rehabilitation to seismic lines will be completed progressively after seismic has been acquired on each line to reduce exposed soils and minimise runoff in first flush events. • Disturbed areas to be allowed to naturally regenerate or revegetate on completion of the regulated activity. • All compacted areas to be ripped and scarified to promote regeneration of vegetation, this may require assistance through spread of native seed stock. Where possible, native seed stock would be supplied by local indigenous suppliers.	• Establish vegetation trending toward the target vegetation community for the area disturbed (i.e. species richness, %cover and structure) and in accordance with the Code (Clause A.3.9(d)). • Reinstate disturbance area to its pre-disturbed condition. • The type of ground cover applied to completed earthworks is to be compatible with the anticipated long-term land use, environmental risk, and site rehabilitation measures.
Ground cover	• Previously removed vegetation and topsoil will be uniformly respread over disturbed area. This will assist with the rehabilitation process by increasing infiltration and returning seed-bearing topsoil, as well as reducing erosion. • Shot holes disturbances will be reinstated via respreading soils and vegetated matter. • After first 12 months, additional input of native seed mix may be required from the area to assist rehabilitation process.	
Landform stability	• All windrows are to be removed as soon as practicable after seismic survey completion.	

Final success criteria (5 years)	
Area to be rehabilitated	• Total area of approved surface disturbance is 18.3 ha. • Total area required for rehabilitation 11.98 ha (as at March-2025).
Vegetation composition returned to an agreed and as close to pre-disturbance level that requires little or no ongoing management	• Vegetation composition (i.e. type, density) equivalent to 60% of the analogue site, showing a trajectory to becoming ecologically integrated into the surrounding area and self-sustaining. • Perennial species cover, including woody species such as trees and shrubs (i.e. Acacia, Eucalypt and Bullwaddy) and perennial grass/forb species equivalent to 60% of the analogue site. • Ground foliage cover equivalent to 60% of the target vegetation community. • The dominant flora species in the mid and ground strata equivalent to 80% of the analogue site. • Organic litter and course woody debris equivalent to 50% of the analogue site. • Evidence native fauna is using habitat (i.e. tracks, scats, burrows).
Watercourse crossings	• All stream crossings, where intersected, to be reinstated to the original topography. • No evidence of erosion as result of activity present within first 12 months.
Erosion	• Site stabilisation to occur and all erosion and sediment control infrastructure removed. • Less than 5 % erosion should be evident after the first 12 months and no subsidence or erosion should be evident for at least 5 years after completion.
Weeds	• No weed infestations in rehabilitated area that are declared under the NT Weeds Management Act.
Hazardous materials and waste	• All hazardous material and waste removed from site upon completion of works to licensed landfill facilities or recycling facilities. • No residual soil contamination that poses a threat of environmental harm.
Safety for humans and wildlife	• Rehabilitation of disturbance areas should be similar in landform to the surrounding area. No steep slopes or barriers to remain on site that endanger wildlife, livestock or humans. • Windrows removed. • Water bores and exploration wells to be sealed and isolated (as required). • 100% removal of all surface facilities including fencing (star pickets / fencing wire).

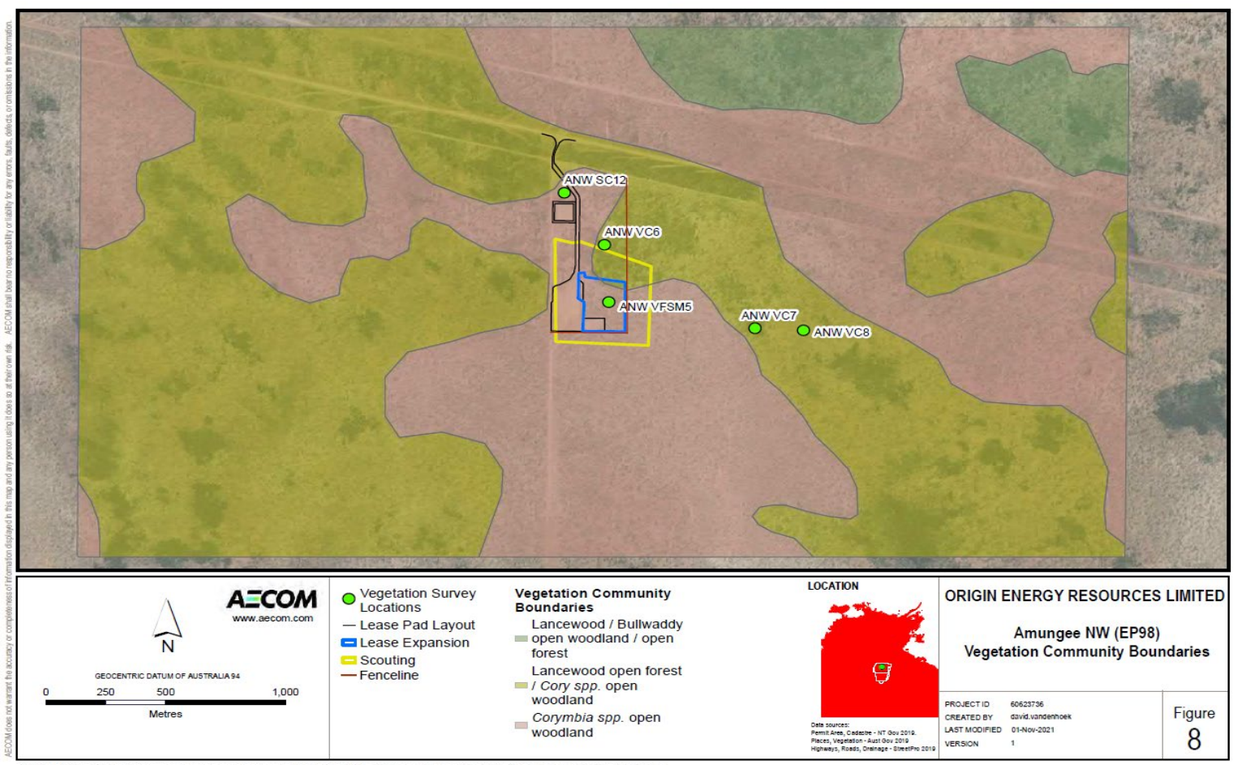
This rehabilitation plan is to be read in conjunction with the overarching Environment Management Plan and Emergency Response Plan for Tamboran's operations in the Beetaloo Sub-basin.

Prepared by Tamboran's Senior Approvals Manager. Figures produced by AECOM Australia from 2019 field surveys.

Monitoring program and schedule				
Stage	**Timing**	**Method**	**Measurable attributes**	**Corrective actions**
Progressive rehabilitation	Within 6-12 weeks of completion of activities	• Ripping of compacted areas. • Topsoil, windrows and cleared vegetation stockpiled are to be respread following the works. • Refer to detail in Tamboran's Erosion and Sediment Control Plan	• All disturbed areas must be considered suitably stabilised as per IECA Table in the Tamboran Erosion and Sediment Control Plan.	• Weed management. • Establish buffers as per EMP requirements

Preliminary assessment	Post rehabilitation, end of wet season survey (ideally between February and July) within 12 months of rehabilitation completion	• Analogue sites will be established for the two vegetation communities identified in the baseline Land Condition Assessment (AECOM 2019) at adjacent undisturbed sites.
		• Permanent 100 m x 4 m transects (one per vegetation community), will be established at disturbed and analogue sites including photo monitoring point(s).
		• Collect 1 x 1 m ground cover quadrats every 10 m along each 100 m transect.
		• Transects to be positioned <20 m from pastoral and gas infrastructure assets (i.e. access tracks, fence lines, well pads, water troughs) to reduce edge effects.
			• Weed presence/absence (species and density).
			• Disturbance (fire frequency and intensity, evidence of feral animal/ cattle).
			• Evidence of erosion (type of erosion, approximate area of erosion).
			• Vegetation condition (comparison to analogue sites):
			  • Seedling/sapling density of dominant species respective to each vegetation community.
			  • % ground cover.
			  • % annual cover vs % perennial cover.
			  • number of species at canopy, mid and ground strata.
				Corrective action as required based on third-party report and/landholder feedback:
				• Erosion remediated
				• Weed management
				• Additional seeding
				• Soil amelioration

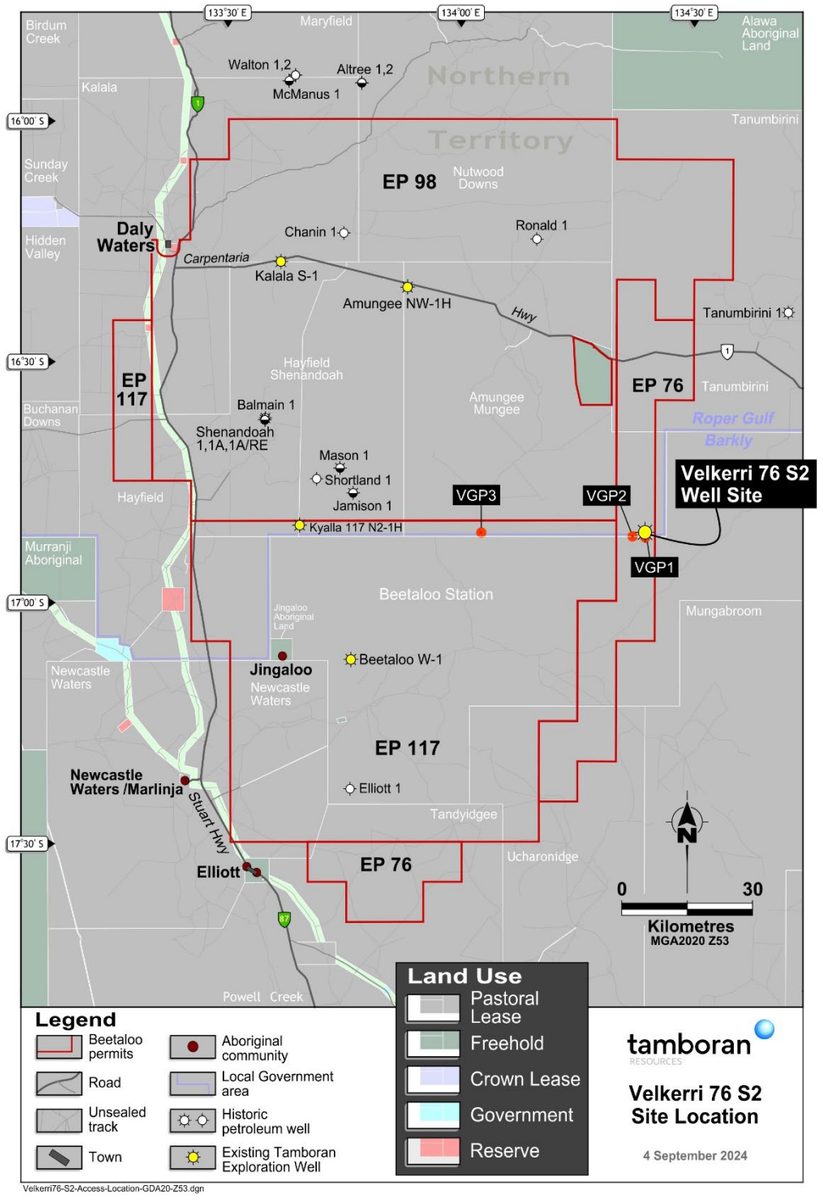
Early rehabilitation	Years 1, 2 and 3 post rehabilitation, end of wet season survey (February to July).	• Monitoring to be undertaken using permanent transects at analogue and disturbed sites. • Collect data as per preliminary methods. • Compare results from monitoring sites with analogue sites and previous year's assessment to determine if require additional management inputs (i.e. seeding, stabilisation). • Annually review success criteria.	• Early assessment of rehabilitation will determine attributes of woody plants in each 100 m x 4 m transect. • Assessment of species richness, DBH (>1.5 cm) and height (>2 m), in addition to measurable attributes described within the preliminary assessment.	
Long-term rehabilitation	Annually until final success criteria has been met, end of wet season survey (February to July).		• Long-term assessment to determine establishment, recruitment, and growth rate attributes of plant species, in addition to parameters described during early rehabilitation stage.	
Completion of rehabilitation	5 years post rehabilitation or when achieve final success criteria.	• Final inspection and report prepared by a suitably qualified person as per rehabilitation monitoring program. • Signoff by landowner and regulator.	• As per final success criteria (5 years).	• N/A



Exploration Permit 76
Rehabilitation Management Plan 2024 onwards
Velkerri 76 S2 (including gravel pits)

Rev 3.0, Mar-2025

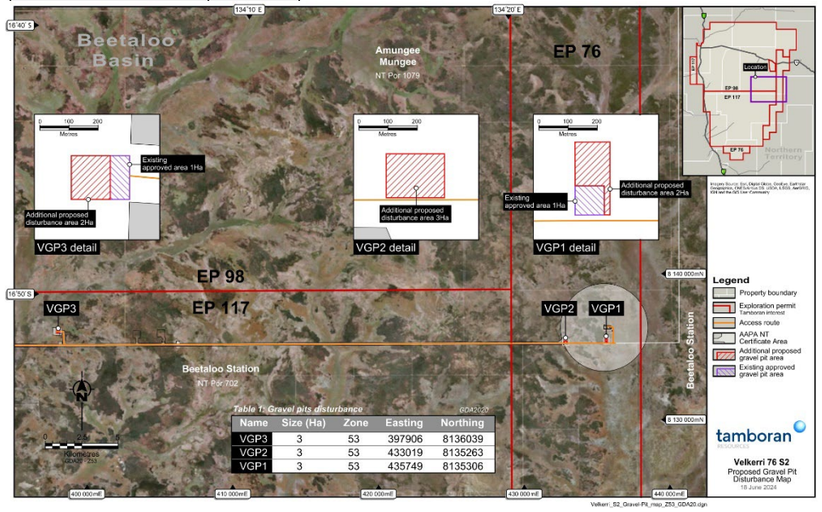
Location of Velkerri 76 S2 and gravel pits (VGP1, VGP2 and VGP3)	
Property and land uses	Gas exploration, cattle grazing, and native title rights and interests recognised by the native title determinations over the land and waters.
Climate	The permit area is described as arid to semi-arid. Climate is influenced by the monsoon and there is a distinct wet and dry season. Most rainfall (90%) occurs during the summer months, between October and March. Annual rainfall varies across the permit area is around 680 mm, with rainfall totals show moderate variability and drought conditions are known to occur every 10 years.
Pre-disturbance land condition summary	The Velkerri 76 S2 well site (Zone 53; 435557 E, 8137497 N) is located within Beetaloo Land System, which is classified as lateritic plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products, sandy and earth soils. Baseline survey conducted for the Velkerri 76 S2 well site did not encounter weeds or other major disturbance. Bushfire has not occurred in area in over 4-8 years. Habitat in the area of Velkerri 76 S2 in good condition with minor disturbance from grazing impacts. The habitat contained good habitat values for wildlife including large hollow bearing trees common and refuge opportunities for small birds and reptiles in the form of good coverage of leaf litter, grass cover and large woody debris.



Velkerri76-S2-Access-Location-GDA20-Z53.dgn

Name	Contact details
Robert Wear Beetaloo Field Manager	Mobile: [redacted] Satellite Phone: [redacted] Email: [redacted]

Rehabilitation zones			
Infrastructure	**Size (ha)**	**Soil type / slope**	**Vegetation community / dominant species**
Well pad and laydown	5.5	Lateritic red earths, sands and podzols <1% slope.	Eucalyptus low woodland/Eucalyptus (mixed) low open woodland/Iseilema (mixed) tussock grassland and Acacia open forest/Acacia tall open shrubland/Chrysopogon (mixed) low open tussock grassland
Camp pad	1.2		
Helipad	0.5		
Stockpile Storage Area	0.2		
Gravel pit VGP1	3.0		
Gravel pit VGP2	3.0		
Gravel pit VGP3	3.0		
80 km existing pastoral track	8.0		Acacia low woodland/Eragrostis (mixed) low open tussock
2 km Access track constructed	2.9		As per well pad
Disturbance	**27.3***	**Note: current clearing is 19.3 ha, including 1.0 ha VGP1, as at March 2025.*	



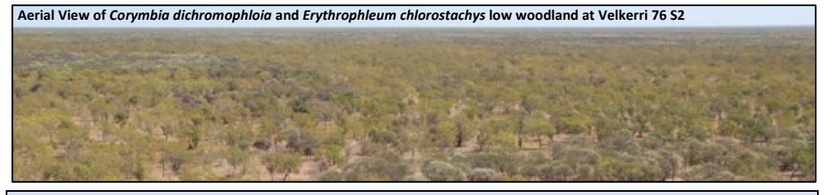
Velkerri_S2_Gravel-Pit_map_Z53_GDA20.dgn

Rehabilitation risk	
Key Risks	**Controls**
Drought - impacting the establishment of rehabilitated vegetation	• Time rehabilitation actions to coincide with the beginning of the wet season, to ensure access to the site and maximise the establishment period of vegetation over the wet season. • Re-spread topsoil across the site to utilise the local seed bank. • Ongoing monitoring to identify if further seed inputs are required. • Collection of seed from the local area to ensure seed stock is suited to the climatic conditions of the site.
Fire - impacting revegetation	• Establish a mix of perennial and annual grass species. • Establish a mix of resprouting (e.g., *Eucalyptus* spp. and *Corymbia* spp.) and reseeding species (e.g., *Acacia* spp.). • Ongoing monitoring to determine fire impacts on revegetation. • Ongoing monitoring to determine if further seed inputs are required.
Grazing - impacting revegetation	• Establish a mix of perennial and annual grass species. • Re-spread timber with topsoil. • Ongoing monitoring to determine grazing impacts on revegetation. • Ongoing monitoring to determine if further seed inputs are required. • Ongoing monitoring to determine if fencing is required.
Exposed ground - leading to an increase in weed establishment and/or erosion	• Remove windrows and topsoils. • Respread of topsoil and vegetated matter across the site. • Annual weed surveys of rehabilitated area once rehabilitation is established. • Control of any weed incursions.

Rehabilitation aims and objectives	
Site management aim	The aim is to rehabilitate any part of the land affected by the regulated activity to a safe condition consistent with industry standards, the Code and in consultation with the landholder.
Rehabilitation objectives	The rehabilitation objective is to provide a stable landform, which supports a) the rights and interests of the Native Title Holders in the land and water, and b) a resilient self-sustaining vegetation community that can withstand impacts including fire and cattle grazing and is safe to humans and wildlife.

Pre-disturbance photos of vegetation community

Aerial View of *Corymbia dichromophloia* and *Erythrophleum chlorostachys* low woodland at Velkerri 76 S2



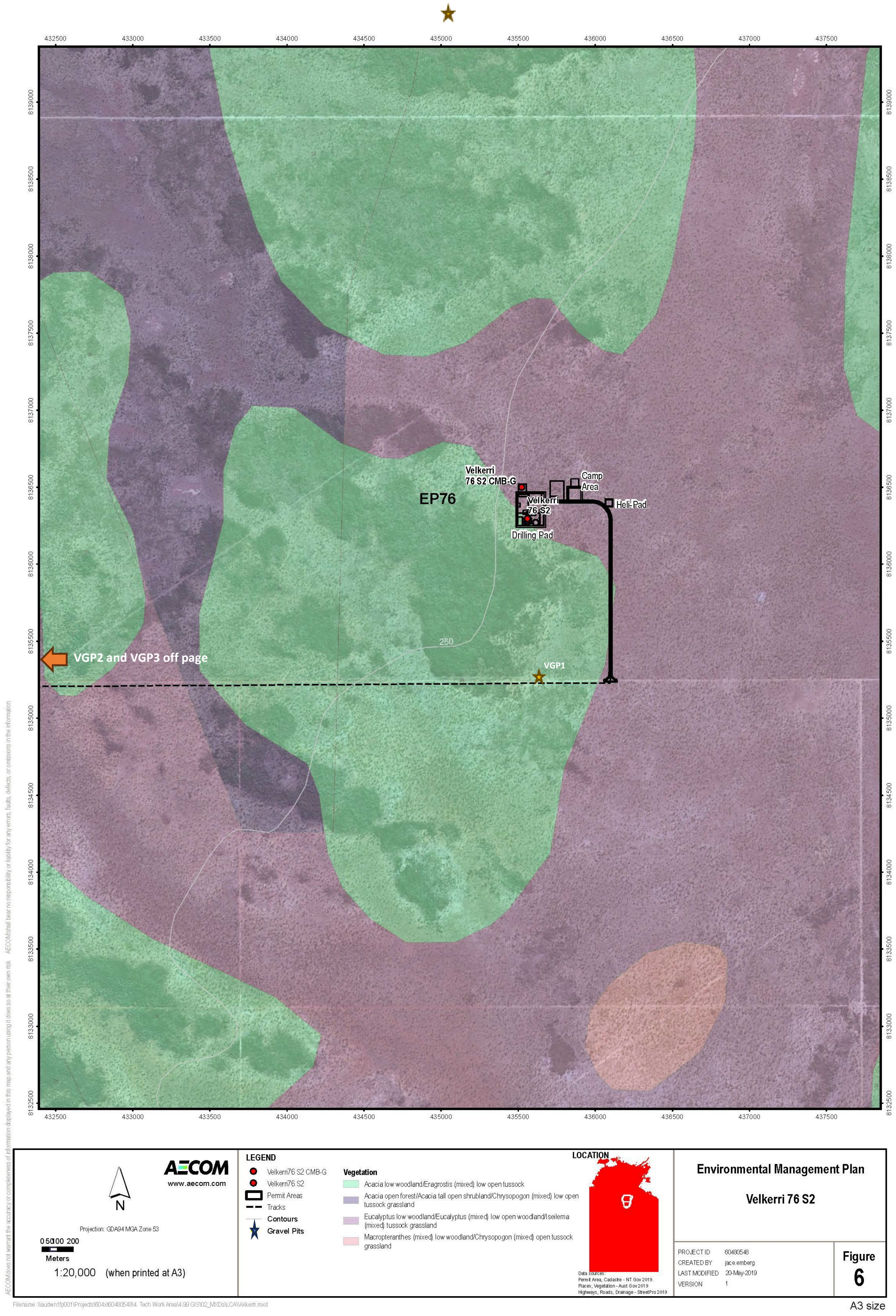
Rehabilitation strategy		
Parameter	**Methods**	**Objective**
Vegetation	• Rehabilitation will be implemented for disturbance areas following completion of the individual activity within 12 months. • Disturbed areas to be allowed to naturally regenerate or revegetate on completion of the regulated activity. • All compacted areas to be ripped and scarified to promote regeneration of vegetation, this may require assistance through spread of native seed stock. Where possible, native seed stock would be supplied by local indigenous suppliers.	• Establish vegetation trending toward the target vegetation community for the area disturbed (i.e. species richness, %cover and structure) and in accordance with the Code (Clause A.3.9(d)). • Reinstate disturbance area to its pre-disturbed condition. • The type of ground cover applied to completed earthworks is to be compatible with the anticipated long-term land use, environmental risk, and site rehabilitation measures.
Ground cover	• Previously removed vegetation and topsoil will be uniformly respread over disturbed area. This will assist with the rehabilitation process by increasing infiltration and returning seed-bearing topsoil, as well as reducing erosion. • After first 12 months, additional input of native seed mix may be required from the area to assist rehabilitation process.	
Landform stability	• All windrows are to be removed post construction and at completion of the activities.	

Monitoring program and schedule			
Stage	**Timing**	**Method**	**Measurable attributes**
Progressive rehabilitation	Within 6-12 weeks of completion of activities	• Topsoil, windrows and cleared vegetation stockpiled are to be respread following the works. • Refer to detail in Tamboran's Erosion and Sediment Control Plan	• All disturbed areas must be considered suitably stabilised as per IECA Table in the Tamboran Erosion and Sediment Control Plan.
Preliminary assessment	Post rehabilitation, end of wet season survey (February to June) within 12 months.	• Analogue sites will be established for the two vegetation communities identified in the baseline Land Condition Assessment (AECOM 2019) at adjacent undisturbed sites. • Permanent 100 m x 4 m transects (one per vegetation community), will be established at disturbed and analogue sites including photo monitoring point(s). • Collect 1 x 1 m ground cover quadrats every 10 m along each 100 m transect. • Transects to be positioned <20 m from pastoral and gas infrastructure assets (i.e. access tracks, fence lines, well pads, water troughs) to reduce edge effects.	Following measurable attributes will be compared with analogue sites: • Seedling/sapling density of dominant species respective to each vegetation community. • Percentage of ground cover respective to bare land and vegetation. • Number of species at canopy, mid and ground strata. • Evidence of erosion (type of erosion, approximate area of erosion). • Weed presence/absence (species and density). • Disturbance (fire frequency and intensity, evidence of feral animal/ cattle) • Incidental observations.

Early rehabilitation	Years 1, 2 and 3 post rehabilitation, end of wet season survey (February to June).	• Monitoring to be undertaken using permanent transects at analogue and disturbed sites.
		• Collect data as per preliminary methods.
		• Compare results from monitoring sites with analogue sites and previous year's assessment to determine if require additional management inputs (i.e. seeding, stabilisation).
		  • Implement reseeding if species richness does not show a trajectory to achieving pre-disturbance conditions 5 years post disturbance.
		  • Species which fail to naturally recover from soil seed bank will be selected for reseeding.
		• Annually review success criteria.
			• Early assessment of rehabilitation will determine attributes of woody plants in each 100 m x 4 m transect.
			• Including assessment of species, DBH (>1.5 cm) and height (>2 m), in addition to parameters described within the preliminary assessment.

Long-term rehabilitation	Annually until final success criteria has been met, end of wet season survey (February to June).		• Long-term assessment to determine establishment, recruitment, and growth rate attributes of plant species, in addition to parameters described during early rehabilitation stage.

Final success criteria (5 years)	
Area to be rehabilitated	• Total area of approved surface disturbance is 27.3 ha. • Total area required for rehabilitation 27.3 ha.
Vegetation composition returned to an agreed and as close to pre-disturbance level that requires little or no ongoing management	• Vegetation composition (i.e. type, density) equivalent to 60% of the analogue site, showing a trajectory to becoming ecologically integrated into the surrounding area and self-sustaining. • Perennial species cover, including woody species such as trees and shrubs (i.e. Acacia, Eucalypt and Bullwaddy) and perennial grass/forb species equivalent to 60% of the analogue site. • Ground foliage cover equivalent to 60% of the target vegetation community. • The dominant flora species in the mid and ground strata equivalent to 80% of the analogue site. • Organic litter and course woody debris equivalent to 50% of the analogue site. • Evidence native fauna is using habitat (i.e. tracks, scats, burrows).
Watercourse crossings	• All stream crossings, where intersected, to be reinstated to the original topography. • No evidence of erosion as result of activity present within first 12 months.
Erosion	• Site stabilisation to occur and all erosion and sediment control infrastructure removed. • Less than 5 % erosion should be evident after the first 12 months and no subsidence or erosion should be evident for at least 5 years after completion.
Weeds	• No weed infestations in rehabilitated area that are declared under the NT Weeds Management Act.
Hazardous materials and waste	• All hazardous material and waste removed from site upon completion of works to licensed landfill facilities or recycling facilities. • No residual soil contamination that poses a threat of environmental harm.
Safety for humans and wildlife	• Rehabilitation of disturbance areas should be similar in landform to the surrounding area. No steep slopes or barriers to remain on site that endanger wildlife, livestock or humans. • Windrows removed. • Water bores and exploration wells to be sealed and isolated (as required). • 100% removal of all surface facilities including fencing (star pickets / fencing wire).



APPENDIX P

EMP Commitment Register

Appendix F EMP Commitment Register

Obligation details	Accountability	When
The layout of the site and exact placement of infrastructure will be informed by the environmental sensitivities and mitigation measures identified in this EMP.	Project Manager	Site establishment
Land clearance will not be undertaken as a part of this activity, unless authorised to do so.	Civil construction superintendent	Continuous
The monitoring and maintenance under the erosion and sediment control plan shall be implemented.	Civil construction superintendent	Pre and post wet season
The spill management plan will be implemented including spill prevention, detection, response and reporting measures.	Drilling and Completions Lead	Throughout the activity
The wastewater management plan will be implemented including the use of covered tanks, wastewater characterisation, storage monitoring and appropriate disposal.	Drilling and Completions Lead	Throughout the activity
The bushfire management plan will be implemented to reduce the risk of bushfires. This includes the use of appropriate separation distances between flares and the surrounding vegetation	Civil construction superintendent Drilling and Completions Lead	Throughout the activity
The Methane emission management plan shall be implemented, including strategies to prevent, detect, remediate and report potential leaks.	Drilling and Completions Lead	Throughout the activity
Secondary containment will be implemented for all chemical storage and handling areas.	Civil construction superintendent Drilling and Completions Lead	Throughout the activity
Tamboran and its subcontractors will prioritise the use of local labour where such skill sets are available.	Project Manager Contracts Administrator	Activity planning
The weed management plan shall be implemented, including assuring all equipment and vehicles on-site have a valid weed hygiene certificate and routine monitoring is completed. All identified weeds associated with Tamboran's activities to be treated and managed in consultation with the DLPE Onshore Petroleum Weed Management Officer.	Beetaloo Field Manager/ Civil Construction Superintendent / Drilling and Completions Lead	Throughout the activity and post rehabilitation
Records of weed distribution will be maintained within Tamboran's GIS and provided to the DLPE Onshore Petroleum Weed Management Officer.	Environment and Approvals Manager	Throughout the activity
Site shall be fenced to prevent fauna and livestock access the wastewater storage	Civil construction superintendent / Drilling and Completions Lead	Site establishment and post drilling
Where monitoring confirms bird or bat mortality associated with on-site wastewater storages, Tamboran will implement additional controls to prevent such impacts from occurring. This may include netting or bird deterrents as appropriate.	Drilling and Completions Lead	During wastewater storage
The Well Operations Management Plan approved by DME will be implemented to ensure the protection of aquifers and the environment. This includes protecting aquifers through the use of multiple cement and casing barriers and performing the specified well integrity verification testing.	Drilling and Completions Lead	All E&A drilling, stimulation, well testing and decommissioning activities
All groundwater will be extracted, monitored and recorded in accordance with the water extraction licence.	Environment and Approvals Manager	Throughout the activity
All wastes will be transported and disposed of at licensed facilities in accordance with the *NT Waste Management and Pollution Control Act 1998*.	Project Manager/ Civil Construction Superintendent / Drilling and Completions Lead	Throughout the activity

Obligation details	Accountability	When
Drilling muds and cuttings will be tested in accordance with the Code of Practice for Onshore Petroleum Activities in the Northern Territory. Where an independent experts considers on-site disposal of muds and cuttings as being environmentally sound, a report will be submitted to DLPE for approval a to the proposed disposal approach and potential risks.	Health Safety and Environment Representative (HSE Representative)	Prior to the disposal of muds
Where Tamboran's activities cause a material impact on the quality and quantity of a stock or domestic bore, Tamboran will make good such impacts in accordance with section 7.5.2.2 of the Inquiry Report. This may include adjusting pump heights, compensation or where appropriate, re-drilling/modifying the bore into an alternative water source.	Project Manager	Upon confirmation an activity has resulted in impairment to a water supply point
Each aquifer intersected will be isolated from overlying aquifers with a cemented casing string as per the WOMP.	Drilling and Completions Lead	During drilling of an E&A well
No material change to the quality and quantity of aquifers will result from Tamboran's activities	Project Manager	Throughout the activity
Surface water will not be used for any activities proposed in this EMP or future operations.	Project Manager	Throughout the activity
Stormwater flooding across the cleared site will be managed to minimise impacts from erosion and sedimentation.	Project Manager	Throughout the activity
Tamboran have committed to comply with conditions as prescribed by AAPA for the duration of the program.	Project Manager	Throughout the activity
Tamboran has committed resources and time to allow competent and experienced personnel to participate in educational and community information sessions from Darwin in the north, to Alice Springs in the south and across to Borroloola in the east.	Project Manager	Planning and implementation of activities
Appropriate housekeeping standards will be maintained, and the site will be maintained free of rubbish.	Beetaloo Field Manager / Camp Coordinator / Civil Construction Superintendent / Drilling and Completions Lead	Throughout the activity
Camps will be used to mitigate the impact on available accommodation and townships.	Project Manager	Throughout the activity
Wastewater, sewage and sullage generated by the domestic camp activities will be managed by a Department of Health approved sewage treatment system or captured and removed from site.	Project Manager	During wastewater (sewage) management
Monitor road and access track conditions to ensure deterioration with possible increase in dust creation, does not occur and undertake rehabilitation as required.	Beetaloo Field Manager Project Manager	Daily during the activity
Tamboran will progressively implement a rehabilitation plan to rehabilitate all disturbed areas.	Health Safety and Environment Representative	With 12 months of determining an asset is no longer required
Work instructions summarising the requirements of this EMP will be prepared and submitted to contractors performing work under this EMP. Field Map Workbook to be developed identifying all Buffer areas around sensitive areas identified in the EMP and no clearing areas.	HSE Representative	Prior to commencement of an activity.

APPENDIX Q

Emergency Response Plan

Beetaloo Basin

Emergency Response Plan

TAMBORAN RESOURCES LIMITED INTEGRATED MANAGEMENT SYSTEM		
DOCUMENT TITLE:	Emergency Response Plan	
DOCUMENT NO:	TBN-HSE-MP-05	REVISION NO: 4
DOCUMENT CUSTODIAN:	HSE Manager	REVISION DATE: 22/10/2024

Revision

Rev. No	Revised By	Justification	Date
2	G Bertini	Minor wording changes, update to contact details and site locations	16/11/2023
3	G Bertini	Minor wording changes, update to contact details emergency response mapping and inclusion of wastewater loss of containment response actions	15/03/2024
4	G Bertini	Minor update for 3D seismic program	22/10/2024

Document Approval

Responsibility	Approver
Owner of the Emergency Management Plan	Ed Wong VP Drilling and Completions

Abbreviations

Abbreviations and acronyms used within this document:

Abbreviation	Definition
AAR	After Action Review
BMP	Bushfire management plan
CMT	Crisis Management Team
DEPWS	Department of Environment, Parks and Water Security
DITT	Department of Industry, Tourism and Trade
DMO	Duty Medical Officer
EAP	Employee Assistance Program
EMT	Emergency Management Team
EMT-L	Emergency Management Team Leader
ERN	Emergency Response Notification
ERT	Emergency Response Team
EPT	Extended production testing
ERP	Emergency Response Plan (this document)
ERIP	Emergency Response Interface Plan
ERT	Emergency Response Team
GPS	Global Positioning System
HSEMS	Health and safety management system
HLSO	Helicopter Landing Site Officer
OSC	On-Scene Commander
MAE	Major Accident Event
PPRR	Prevent Prepare Respond Recover
SEMT-L	Site Emergency Management Team Leader
SIMOPS	Simultaneaous Operations
SIF	Serious injury or fatality
SITREP	Situation Report
SMP	Spill Management Plan
TPC	Third party contractor
VP	Vice President

Table of Contents

1 Introduction

1.1 Purpose

This ERP is designed to guide the On-Scene Commander (OSC) and Site Emergency Team to respond effectively to a site level emergency and then return the site to normal operations.

The plan will:

- Briefly describe the Tamboran emergency response structure
- Explain the notification and escalation pathway
- Identify key personnel and their role in an emergency scenario
- Describe information about the site including:
    - Site location/s and geographic area
    - Emergency equipment and medical resources available
    - Exclusion zones (if applicable)
- Identify the tools for use during an emergency.

Support for the Emergency Management Team is provided through the Tamboran Crisis Management Plan (TRL-HSE-PL-03).

1.2 Scope

This emergency response plan encompasses all Tamboran's activities within the Beetaloo Basin. The plan applies to all employees, contractors, and visitors and includes (but is not limited to) the following activities:

- All regulated activities approved under the environment management plans (EMPs) and legislated under Regulation 5 of the Petroleum (Environment) Regulations 2016
- Transport to and from work areas (excluding chartered flights to and from Daly Waters)
- Field scouting (environmental, cultural heritage, constructability etc)
- Groundwater bore construction, monitoring and sampling
- Site inspections and well-head maintenance

Where site operations are under the HSEMS of a Lead Contractor then bridging arrangements and interfaces will be agreed to and documented.

Out of scope:

- Charter flights and commercial flights to and from Daly Waters and Darwin
- Logistics and freight haulage from depots to Daly Waters laydown
- Accommodation in commercial establishments (hotels etc)

1.3 Compliance with Legislation

This plan meets the requirements as identified by legislation for emergency response plans including:

- Work Health and Safety (National Uniform Legislation) Act 2011
- Work Health and Safety (National Uniform Legislation) Regulations 2011
- Petroleum Act 1984
- Petroleum Regulations 2020
- Petroleum (Environment) Regulations 2016
- Code of Practice for Petroleum Activities in the Northern Territory 2019
- Bushfire Management Act 2016
- Bushfire Management (General) Regulations 2018
- Dangerous Goods Act 1998
- Dangerous Goods Regulations 1985

- Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Act and Regulations
- Waste Management and Pollution Control Act 2016
- Northern Territory Contaminated Land Guideline (June 2017)

1.4 Operator Details

Tamboran Resources Ltd (Tamboran)
100 Barangaroo Avenue
Barangaroo NSW 2000

1.5 Beetaloo Basin Location

The Beetaloo Basin is located approximately 700 km south of Darwin with operational activity being undertaken in 4 permit areas (EP76, 98, 117 and 136) as per Figure 1 below.

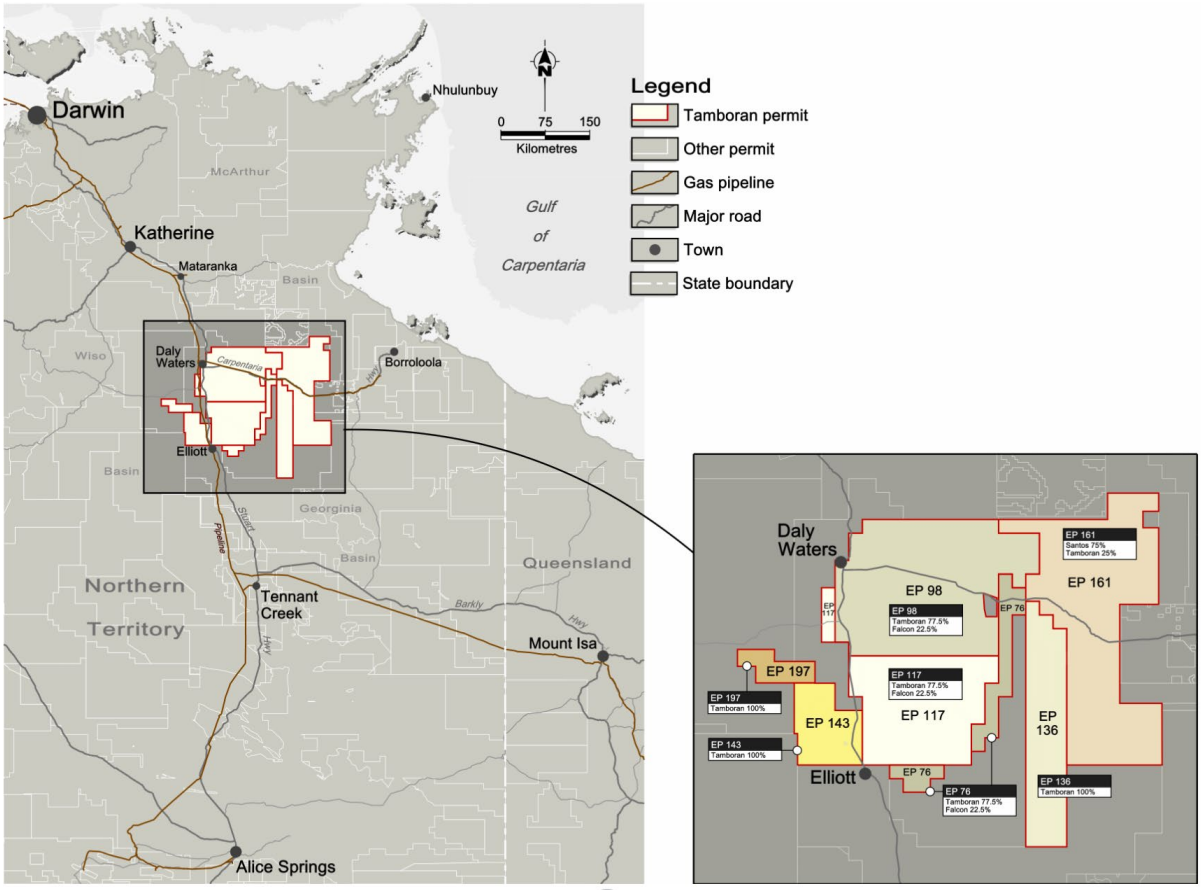


Figure 1. Beetaloo Basin permit areas

2 Emergency Management Structure

The overall Emergency Management structure is three-tiered as shown in Figure 2 with:

- An Emergency Response Team (ERT) on site. This will be led by a Tamboran Representative and supported by specialist contractors and local emergency services.
- An office-based Emergency Management Team (EMT) lead by Tamboran VP Drilling and Completions.
- The Tamboran Crisis Management Team (CMT) is led by the Tamboran COO.

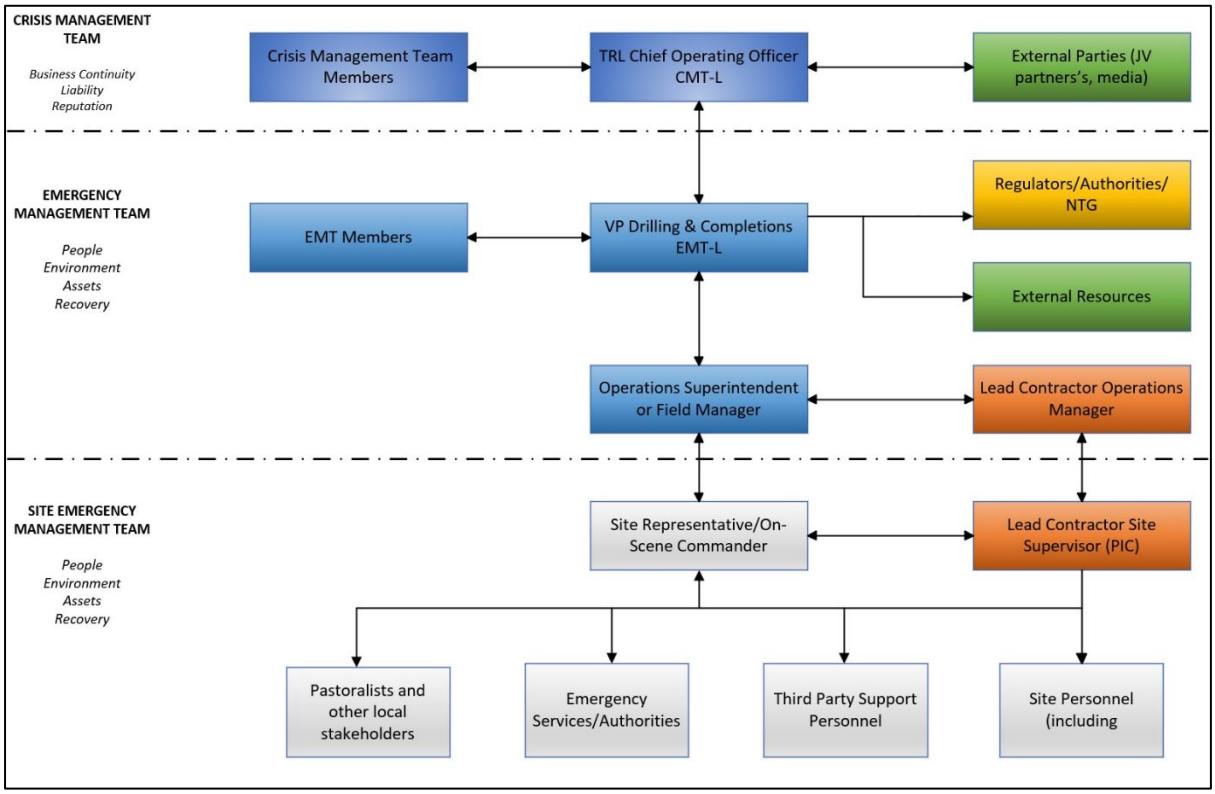


Figure 2. Emergency Management Structure

2.1 Emergency Response Philosophy

The site emergency response team will have the ability to provide a basic response to incipient fires, spills and medical emergencies to preserve life and reduce the impact to people, community, environment, and assets.

Where increased response capability to mitigate the consequences of incident types such as loss of well control or bushfire, specialist contractors (including emergency services) will be engaged to undertake the response.

3 Emergency Management

3.1 Definition of a Site Emergency

An emergency is defined as an unplanned event which requires a response to normalize an activity that has resulted in:

- Injury to an individual or group of people
- A near miss with SIF potential
- Loss of control of any health, safety environment or community related incident
- Uncontrolled release of a substance to air, land, or water
- Loss of reputation or business continuity
- Loss or damage to equipment or assets
- The potential for any of the above

3.2 Emergency Response Plan Activation

This Site Emergency Response Plan (SERP) should be activated for emergencies that cause or have the potential to cause SERIOUS or greater consequences. Consequence classification is based on Tamboran's Risk Matrix.

The Site Emergency Management Team Lead (SEMT-L) or On Scene Commander (OSC) has the authority to activate this SERP. Escalation to the Emergency Management Team Lead (EMT-L) must occur so that activation of the EMT can be considered and stood up if required.

Figure 3 below describes activation pathway for the SERT.

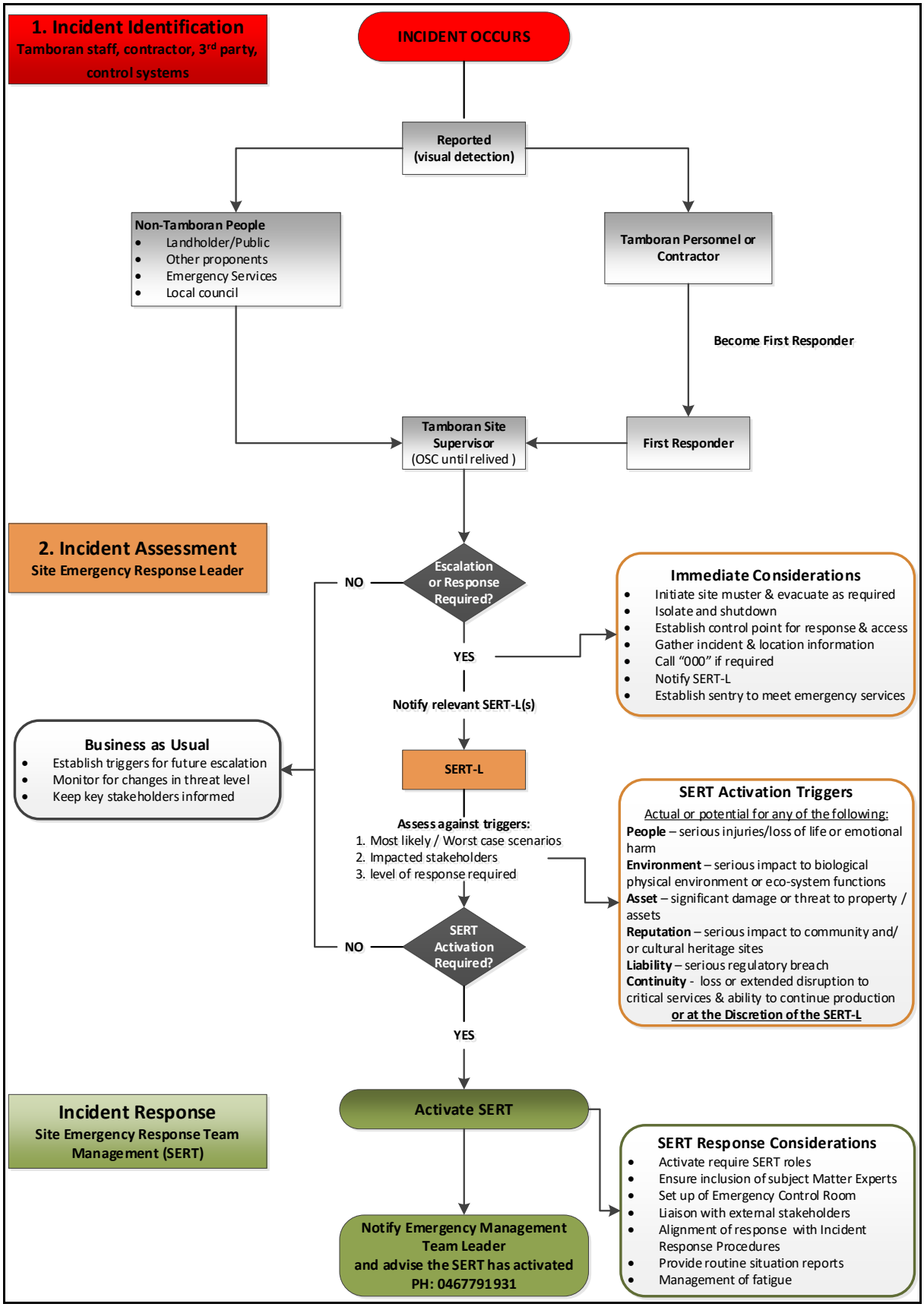


Figure 3. Identification and Escalation

Triggers for Activation			
People	Serious injury/illness or worse to any person		☐
Environment	Moderate effects on biological physical environment and serious short-term effect to eco-system functions		☐
Asset	Serious damage or loss to production, property and/or infrastructure		☐
Reputation	Serious impact to community or cultural heritage		☐
Liability	Serious breach of law or regulation		☐
1 – Isolate and Evacuate			
Muster	Account for all personnel (upwind) whilst assessing the situation		☐
Isolate	Either through Emergency Shutdown Devices (ESD's) or remotely		☐
Evacuate	If required evacuate to designated evacuation points either upwind or at a safe distance as determined by event type or respective response guideline		☐
Control	Establish control points to coordinate response and restrict access		☐
Meeting Points	Nominate pre-determined emergency services meeting points near known landmarks or road intersections and establish personnel to meet emergency services upon their arrival		☐
2 – Communicate and Escalate			
Confirm	Confirm details of the emergency (type of emergency, injuries, contained oruncontained etc.) and response required.		☐
Activate	Activate SERT, EMT and CMT, contact Emergency Services and communicate with other Stakeholders		☐
Escalate	Consider likely impacts		☐
Impacts (actual & potential)	Most likely	What is realistically likely to happen and who / what is impacted?	
	Worst case	How bad could it really get and then who / what is impacted?	☐
3 – Respond			
• Continually reassess situation		• Appoint OSC	☐
• Designate communication channels		• Establish exclusion zones	☐
• Activate appropriate resources		• Develop SMEACS briefing	☐
• Apply Incident Response Guidelines		• Provide regular updates	☐
4 – Response Management			
Personnel	Appropriate personnel in the ERT, CMT and from outside resources		☐
Resources	Appropriate resources available to manage the incident		☐
Tools	Appropriate tools available for the ERT, CMT, OSC and other responders		☐

Table 1. ERP activation and actions

3.3 Emergency Scenario Guides

The Emergency Scenario Guides provide an easy to understand, detailed response to the below identified emergency situations. The guides define the key roles and responsibilities to ensure essential response actions are undertaken and should be used in conjunction with this plan.

Category	Response Procedures
FIRE	▪ Bushfire
PERSONAL SAFETY	▪ Medical Emergency ▪ Vehicle Accident ▪ Missing Overdue worker ▪ Lone Worker ▪ Snakebite
ENVIRONMENT	▪ Environment Related Incident (earthquake/cyclone) ▪ Environment – Weather Related Incident – ▪ Loss of containment or spill ▪ Flood
HAZMAT	▪ Hazardous chemicals ▪ Loss of well control (level 1 or 2)
SECURITY	▪ Protest / Trespass ▪ Bomb Threat ▪ Armed Intruder ▪ Lockdown

3.3.1 Spill Response and Loss of Containment

The Beetaloo Spill Management Plan (TB2-HSE-MP-09) provides specific information on how to manage and handle spill response within the Beetaloo Asset (including spills located off tenure). This document should be referenced for all emergency spill response scenarios.

Refer to Appendix E for additional guidance steps and considerations in the event of a loss of containment from wastewater storage.

3.3.2 Chemical Response

The Chemical Response guidelines (CDN 4411922) provide specific information for specific chemicals that are used on Tamboran sites. The guidelines provide information on:

- PPE requirements
- Chemical details and description
- First aid requirements
- Evacuation considerations
- Fire and spill management

Additionally, a Chemical Risk Assessment was completed for activities. The fluid systems reviewed were:

- Hydraulic fracture stimulation fluids;
- Hydraulic fracture chemical tracers; and
- Drilling fluids

As part of the Chemical Risk Assessment a hazard assessment was undertaken with the evaluation of the environmental hazard of the chemical additives in the hydraulic fracturing fluid systems, based on their environmental persistence, bioaccumulation, and aquatic toxicity properties. Also included was an evaluation of human health effects (i.e. genotoxicity, carcinogenicity, reproductive toxicity, oral toxicity, inhalation toxicity, dermal toxicity, chronic repeated dose toxicity).

A hard copy emergency manifest, identifying notifiable quantities of hazardous substances, must be in the emergency box located at the muster point of all field locations.

3.3.3 Bushfire

Specific wellsite and activity specific Bushfire Managements Plans (BMPs) have been prepared. A copy of the relevant bushfire management plan is found on site and is easily accessible for all personnel.

The below tools should be utilized by site personnel for additional support and guidance during bushfire season (Northern Territory runs from April – November) can provide technical advice in developing bushfire management processes and emergency planning during the fire season.

- https://www.pfes.nt.gov.au/incidentmap
- NAFI (firenorth.org.au)

3.3.4 Security

In addition to the ER response guide, the Tamboran Beetaloo Basin Security Plan (TBN-OPS-MP-01) should be enacted and supports a response to security scenarios.

3.3.5 Aviation

Daly Waters Airstrip

Daly Waters Airstrip is used for undertaking medical retrievals by Care Flight and The Royal Flying Doctors. Tamboran has supplied a set of emergency landing lights which must be deployed for night landings. These lights are for use by Tamboran and the Daly Waters community and are stored within the Tamboran storage shed at Daly Waters. Contact the Tamboran Field Manager for deployment or access to the lighting. See Appendix J for Daly Waters Emergency Landing Lights Layout.

Helicopter Landing Site Officer (HLSO)

If a helicopter is required for an emergency a designated trained Helicopter Landing Site Officer (HLSO) should be sourced (where available) to support ground activities. It is the responsibility of the HLSO to ensure that they are familiar with the landing locations.

Purpose built helicopter landing pads are located at Amungee NW, Velkerri 76 and Kyalla 117. Landing site coordinates are identified in Appendix D and in the Emergency Response Notification (ERN) document that is prefilled by the Tamboran Operating Company Representative when moving to a new well location or if conducting a campaign then nominated in the campaign specific bridging document.

3.3.6 Medical Emergency

First Responders must notify the OSC and in turn the SEMT-L if they call Emergency Services. Once notified, the OSC is responsible for all communications back to the SEMT.

In the event of a medical emergency, the medical clinician, and first aiders (if requested to assist) will commence immediate treatment.

Due to the remoteness of the Beetaloo Basin, there may be a delay to external medical resources responding should they be required therefore life-threatening injury/illness should be escalated without delay.

To initiate external medevac support for priority 1 and 2 patients:

- The onsite medical clinician is to contact emergency services by calling the St John on call Duty Medical Officer on 08 8999 8666 or using 000
- External medical resources will be arranged by the DMO and deployed. Providers include Care Flight, St Johns Ambulance (from Katherine) and Royal Flying Doctor Service.
- At the first available opportunity, the Aspen Duty Medical Officer will also be contacted by the medical clinician and informed of the incident, the patient's condition, and current treatment / medivac plan.

Depending on the situation, the Aspen Duty Medical Officer will assist with telehealth advice in consultation with the Care Flight and Top End Health Services Duty Medical Officers.

Priority 1 – Life threatening / time critical

Priority 2 – Urgent (early surgical intervention required)

Priority 3 - Serious but not time critical (e.g, severe abdominal pain without compromise)

For Priority 3 patients alternate medivac options may be available to the medical clinician and these need to be considered on a case-by-case basis in consultation with the NT Duty Medical Officers and Tamboran site leadership team.

Priority 4 (illness/injury that can be treated onsite with capability and resources available) the medical clinician will commence treatment and will contact the Aspen Duty Medical Officer as required to discuss treatment strategies.

3.4 Contractor Scenarios

If an incident occurs, the Tamboran Representative will become the On-Scene-Commander (OSC) and liaise with the associated contractor. If an emergency event exceeds the contractor's capability, ie loss of well control, then Tamboran will assume control of the incident and delegate management as required.

When working under their own HSEMS, it will be the responsibility of the Contractor to provide an initial emergency response and co-ordinate the emergency event. If a Tamboran employee is involved in an emergency event at a site under the control of a contractor, it is expected that the Tamboran employee will conform to the contractor's response requirements and support the contractor if willing and competent to do so.

3.5 Major Accident Event

A Major Accident Event is an uncontrolled incident, including fire, explosion, or release of dangerous substance with the potential to lead to multiple fatalities or major environmental damage (potential for critical or catastrophic consequence as per Tamboran Risk Matrix).

A loss of well control is considered a Major Accident Event (MAE) which, while rare, requires additional controls and engineering assessments to mitigate potential consequences.

See Appendix E for details on well control incidents and classification.

4 Roles and Responsibilities

The following roles and responsibilities are essential to ensure effective communication when responding to emergency events.

- First Responder (FR), located at the incident scene and may be a Contractor
- On Scene Commander (OSC) located at the incident scene
- Site Emergency Management Team Leader (SEMT-L)

Individuals may undertake multiple roles depending on the nature of the emergency, its duration and complexity. The functional roles that will assist the EMT-L are listed below and known as the Emergency Management Team (EMT).

- Operations
- Planning
- Logistics
- Log Keeper

Additional roles such as technical engineering, travel and accommodation services may support the CMT depending on the type of incident.

If the EMT-L is unable to undertake their responsibilities a competent alternate or delegate must be appointed to ensure the EMT continues to function.

SERT Roles	Responsibilities
Work parties (including contractors) /First Responder	▪ Respond to the situation as per the contractor's emergency response plan. ▪ Actively participate in the risk management process to assist in the development of emergency action plans; ▪ Check notice boards for any recent updates to information; ▪ Maintain a high level of awareness of actions to be taken in the event of an emergency. ▪ Follow instructions from Emergency Controller, Emergency Services personnel, First Aiders, and other designated emergency personnel as appropriate; and ▪ Prior to commencing any work or entering a work area, sign onto JSEA for associated activity
First Aiders	▪ Ensure first aid competencies (minimum Apply First Aid and CPR) are maintained ▪ Provide first aid treatment or assessment as needed whilst working within their skill level ▪ Determine need for medical assistance and provide information to medical personnel or emergency services as required ▪ Ensure that first aid kits are maintained, complete and items are in-date; and ▪ Ensure that all treatments provided, regardless of the type or complexities are recorded
Paramedic/Remote Area Nurse	▪ Be familiar with current work groups and work locations within Beetaloo Basin ▪ Provide emergency health care on site (12hr workday and on call 24/7) ▪ Ensure that medical response emergency equipment (including medications and ambulance) is fit for purpose, in date and in good working order. ▪ Liaise with external medical emergency services (Care Flight, St Johns etc)
Tamboran On Scene Commander	▪ Manage first response at site level. During first response, ensure safety of other personnel and ensure that the emergency is communicated effectively to the required people. ▪ Act as Site Emergency Management Team Leader (SEMT-L) ▪ Nominate personnel to act in support roles (log keeper, logistics) ▪ Escalate to Emergency Services, if required. ▪ Ensure that emergency action plans are discussed regularly at pre-start meetings, so that all persons under their control are aware of emergency procedures. ▪ Ensure that emergency equipment is maintained in good working order (complete, clean and available for immediate use)
Site personnel	▪ Be familiar with individual work sites including muster points and evacuation routes ▪ Be familiar with this plan and the steps required to implement the plan ▪ Keep themselves and others safe from danger during an emergency
EMT Roles	**Responsibilities**
Emergency Management Team (lead by VP Drilling and Completions)	▪ Ensure adequate personnel and resources are available to manage and support an emergency ▪ Nominate personnel to act in support roles (log keeper, logistics etc) ▪ Provide technical support and advice. ▪ Co-ordinate with other Operators for use of Well Control package ▪ Support field team with emergency service direction/calls as requested ▪ Escalate and communicate with Crisis Management Team if required. See Crisis Management Plan for defined roles and responsibilities.

Table 2. Roles and Responsibilities

4.1 Toolkit and Supporting Resources

The below forms and checklists provide a detailed overview of the additional administrative tools to be utilized by emergency team.

Operations Checklist	TBN-HSE-FRM-02
Planning Checklist	TBN-HSE-FRM-03
Logistics Checklist	TBN-HSE-FRM-04
Administration/Log Keeper Checklist	TBN-HSE-FRM-05
Situation Report Form (SITREP)	TBN-HSE-FRM-06

4.1.1 Emergency Response Equipment

The below emergency response equipment is always available on operational sites.

Equipment	Location
Remote Area Nurse/Paramedic and Ambulance	On active drilling, completions, stim, EPT and active construction sites.
Medical clinic	Based within the camp accommodation and supports the above activities. Used to provide basic primary health care and emergency medical care
Front end loader	Operational D&C sites
Trash pumps (including hoses)	Operational D&C sites Daly Waters (contingency and for transport/use at unmanned sites as required)
Fire extinguisher/s	Tamboran vehicles Site offices and camp (when established)
Spill kits (oil/fuel and general purpose)	Spill kits are strategically located at active drilling, completions, stim, EPT and active construction sites. Size of kits is dependent on type and duration of activity and are provided by the contractor
Water cart	Available on-site during high-risk fire danger and utilized for dust suppression in first instance
First aid kits	Tamboran vehicle Site office (where established)

5 Emergency Management and Control

After an emergency is detected, the following management stages will be used to control and contain the incident and return to business as usual.

- Raise the alarm
- Isolate and secure
- Communicate and escalate
- Respond and recover

5.1 Raise the alarm

One or more of the following methods can be used to raise the alarm:

- in person
- radio (UHF, VHF etc)

- phone (mobile, satellite or landline)
- emergency alarm/siren
- Leak detection alerts at unmanned locations

5.2 Isolate and evacuate

Stop all work and make sure the worksite is safe:

- secure the well, or impacted area
- stop vehicle and mobile plant operations

If you need to abandon vehicles and mobile plant:

- pull over and park in a safe area
- ensure access and egress to the site is not impeded
- switch off and leave the keys in the ignition

Plan a safe route to the muster point and avoid movement through unsafe areas:

- account for all people
- standby at the muster point until instructed to evacuate

5.3 Communicate and escalate

- Gather information – where is the emergency, what has happened, who is affected, is anyone missing, where are the safe areas etc
- Advise and update the Tamboran Supervisor
- Call Emergency Services (Police, Ambulance, Fire) if required
- Identify meeting points for responders (Medical Providers, ERT etc) and Emergency Services
- EMT and/or CMT to be activated if required

5.4 Respond and recover

- Apply first aid to injured people (if safe to do so)
- Consider Simultaneous Operations (SIMOPS), advise nearby work groups
- Assist Emergency Services
- Follow response procedures. Take into consideration emergency scenarios (ie loss of containment) that have occurred at an unmanned location.
- Secure the scene if Regulator involvement is required. This should include physical barricading (flagging, rope etc) to ensure equipment is not interfered with.
- Initiate incident investigation
- Conduct after action review of the emergency response effort and assign corrective actions

6 Other Considerations

6.1 Meeting Emergency Services

Where Emergency Services such as Ambulance, Police and Fire are dispatched by road or air, a Tamboran employee or contractor representative will meet the Emergency Service at a designated location and guide them to the incident site.

Designated location - Hi-Way Inn (cnr Stuart and Carpentaria Highways, Daly Waters)

Additional meeting points may be required and will be identified and communicated on call out. These will be dependent on the type of emergency, access availability and exclusion zones.

To enable an effective response, a detailed annual work program is provided to NT Police, Fire & Emergency Services. At the beginning of each campaign of work, a copy of the worksite ERN (emergency response notification) shall be provided to Emergency Services in Mataranka and Katherine. This ERN provides site specific details, GPS co-ordinates, directions to site and contact phone numbers. This will enable emergency services to be familiar with the work location prior.

6.2 Hazard Awareness

All personnel arriving at the incident site must be made aware of:

- Hazards present because of the incident (fire, heat radiation, flooding/water, chemical exposure etc)
- Hazardous areas and exclusion zones
- Safe locations and muster points
- Additional PPE (if required)

6.3 Shift Changeover

Shift changeovers are required for continuity of emergency management. The EMT-L is responsible for changeover of personnel involved in the emergency. Effective changeover will be achieved by:

- Staggering changeover times
- Avoiding changeovers during critical periods
- Having changeovers in daylight, where possible
- Briefing incoming personnel

7 Termination of Emergency

The emergency can be considered over when:

- Emergency services have declared the emergency over and have returned control of the site back to Tamboran.
- The emergency team has returned the site to a safe condition
- All personnel are accounted for
- Injured/ill personnel have been stabilized and/or evacuated
- Environmental controls are in place

8 Recovery and Post Emergency Actions

8.1 After Action Review

After Action Review (AAR) is to be held after each emergency. This process is designed to discuss strengths and weaknesses and necessary improvements for this plan and related procedures. All actions arising from the review shall be entered into Tamboran's Risk and Compliance Management System and tracked through to completion and closure.

8.2 Incident Investigation

Incident investigations should be undertaken in accordance with Tamboran's Incident Investigation processes with the following steps being considered:

- Securing the incident site and restricting access until investigators (both internal and external) have completed their work and handed back control of the site.
- Gathering of evidence that may assist the investigation (list of personnel involved, response logs, situation boards, photographs etc)

8.3 Recovery Actions

Prior to resuming work, develop a recovery plan that considers the following:

- Check plant and equipment for structural, physical, and electrical/instrumentation integrity
- Ensure all active detection and protection systems are restored
- Replenish emergency response equipment as required
- Replace or return third-party emergency equipment

In addition, consider the following points:

- People who were involved may require counselling, depending on the nature of the incident
- People should be debriefed with all relevant information captured for a "lessons learnt"
- Conduct a toolbox talk on specific start up activities before restarting work
- Consider the potential for loss of confidence or potential IR issues following the incident or the response to that incident
- Emergency response plans and training may need to be revised before resuming the work activity

8.4 Clean Up

Post incident clean up should be done using the following guidelines:

- Conduct initial site inspection to identify extent of equipment and/or plant damage
- Assess potential decontamination requirements (removal of chemicals/foam/oil/contaminated soil)
- Store all contaminated material in proper containers pending offsite disposal by licensed hazardous waste contractors
- Assess damage or potential damage to surrounding environment. This may include conducting soil testing of contaminated area/s to inform site remediation requirements.
- Repair and/or replace damaged equipment/plant
- Inspect and test affected equipment

9 Training and Capability

All personnel must be given specific training on how to respond to an emergency, fulfill their role in the site ERT and use of emergency equipment available.

Training may be in the form of:

- External or internal competency-based training
- Emergency response drills (both practical and desktop exercises)

9.1 Exercises

Emergency response exercises will be conducted monthly as per the schedule below. This schedule should be dynamic and align with the current operations, type and level of risk that exists on site.

Exercises must involve escalation and activation of the Emergency Management Team (EMT) and Crisis Management Team (CMT) as indicated on schedule below.

	JAN	FEB	MAR	APR	MAY	JUN
Primary	HAZMAT	Structural failure	Environment	Personnel safety – medical emergency	Fire	Personnel safety
Secondary	Flood	Personnel safety	HAZMAT	Personnel safety	Personal safety	Personnel safety

	JUL	AUG	SEP	OCT	NOV	DEC
Primary	Personnel safety	Fire	Environment – oil/chemical spill	Personal safety – medical emergency	Flood	Structural failure
Secondary	Security - protest	Personal safety	HAZMAT	Security	Personal safety	Environment - loss containment

Table 3. Emergency response exercise schedule. Note white shading indicates inclusion of EMT and CMT in the exercise

It is recommended that a Level 3 loss of containment event be simulated yearly as a minimum to test the Emergency Management structure (EMT, CMT) in line with the requirements set out in this ERP. Scenarios should progress from level 1 to level 3 (blowout stage) to ensure that all Emergency Management leaders are provided with an opportunity to participate.

In addition, the drills should include the primary well control contractor and support contractors to test their state of readiness. The aim of the exercise is to simulate the loss containment event, test personnel's response to the event, test the mobilisation and function of the Emergency Management structures, and test the mobilisation of the contractors required to respond to the well control event.

Any lessons learned from the exercise should be incorporated when appropriate to continually improve Tamboran's response to such an event.

10 Stakeholder Management

10.1 Pastoralists

Contact with Pastoralists can be initiated by the SEMT-L in urgent circumstances (i.e. bushfire threat) however, the Landholder Relations Advisor should be used in the first instance. See Appendix C for contact details.

10.2 Next of Kin

In the event of a death, serious injury or other emergency, involving Tamboran personnel, advice to relatives about the condition of a person or about the incident will be coordinated by Human Resources through the Crisis Management Team.

During or after an emergency, the SEMT-L will refer any queries or concerns from relatives to Human Resources. HR may also activate Employee Assistance Program (EAP) providers to support site personnel or relatives affected by an incident.

Principal Contractors and Contractor companies are responsible for management of next of kin communication in consultation with Police services, and EAP management in accordance with their emergency response plans and relevant State obligations.

10.3 Dealing with Media Enquires

During an emergency event, media attention may occur at the affected site. If personnel receive an enquiry from a journalist or reporter, whether in person or by phone and are asked about Tamboran, they should say:

"I am not able to comment. If you give me your name and telephone number I will organize for the most appropriate person to call you."

Always ask for:

- the journalist / reporter's name.
- publication / media outlet.
- contact phone number and/or email.

It is important to remember that there is no such thing as "off the record". Even if you are speaking informally, you may be quoted at any time.

The EMT-L will advise the CMT-L of any media contact or enquiry.

11 Review and Update

The ERP will be reviewed and updated as necessary in response to one or more of the following:

- annually
- when major changes have occurred, which may affect the response coordination or capabilities.
- following routine testing of the plan
- after an actual emergency

During the review, the following aspects are to be considered:

- lessons learned from an emergency
- changes in legal requirements
- improvements to effectiveness in terms of response strategy, management, and communication
- developments in the latest techniques and technology in handling an emergency.
- changes to, or movement of people within the organization
- changes to contact numbers of internal and external organizations
- revisions to existing or availability of emergency management tools and equipment, resource suppliers or contractors

12 Associated Documents

Document	Document Reference
Beetaloo Basin Spill Management Plan	TB2-HSE-MP-09
Tamboran Resources Crisis Management Plan	TRL-HSE-PL-03
Emergency Scenario Guides	NA
After Action Review	TBN-HSE-FRM-07
Chemical Response Guidelines	CDN-4411944
Tamboran Risk Toolkit	NA
Bushfire Management Plan – Shenandoah S2 (Rev 1)	NA
Bushfire Management Plan – Kyalla 117 N2 (Rev 1)	NA
Bushfire Management Plan – Amungee NW (Rev 3)	NA
Bushfire Management Plan - Beetaloo W1 (Rev 1)	NA
Bushfire Management Plan – Maverick 1 (Rev 1)	NA
Bushfire Management Plan – Velkerri 76 S2 (Rev 1)	NA
Bushfire Management Plan – Kalala (Rev 1)	NA
Bushfire Management Plan – Shenandoah South 3D Seismic Survey (Rev 1)	NA

Appendix A. Contact List (Tamboran)

Tamboran Contacts		
Role	**Name**	**Primary contact details**
Field Manager	[redacted]	[redacted]
Drilling Superintendent	[redacted]	[redacted]
Tamboran Field HSE	[redacted]	[redacted]
VP Drilling & Completions	[redacted]	[redacted]
HSE Manager	[redacted]	[redacted]
Environment and Approvals Manager	[redacted]	[redacted]
Logistics Superintendent	[redacted]	[redacted]
Senior Counsel	[redacted]	[redacted]
Landholder Relations	[redacted]	[redacted]
Human Resources	[redacted]	[redacted]

Appendix B. Contact List (External Agencies)

External Agencies		
Role	**Name**	**Primary**
Emergency Services	Police, Fire, Ambulance	000 (or 112 from mobile)
St Johns Duty Medical Officer	N/A	(08) 8999 8666
Hospital	Katherine Hospital Kintore Clinic Katherine	(08) 8973 9211 (08) 8972 1677
McArthur River Mine Medical Resource	N/A	1800 211 573
Bushfires NT	Fire control officer	Katherine (08) 8973 8871 Darwin (08) 8922 0844
Volunteer Bushfire Brigade	N/A	(08) 8975 9936
Emergency helicopter operations	HM Air Services	(08) 8975 0777 OR 0413 002 407
Regional Shire Council	Roper Gulf Shire	(08) 8972 9000 OR (08) 8977 2300 (Mataranka Office)
Regional Shire Council	Barkley Shire	(08) 8962 0000 OR 0448 071 878 (after hours emergency)
Police (non-emergency)	Police Link	131 444 Elliott – (08) 8969 2010 Katherine – (08) 8973 8000
Poisons Information Centre	N/A	13 11 26
Bureau of Meteorology	Cyclone Warnings Forecasts & Warnings	1300 659 211 (08) 8920 3826
NT DITT Petroleum Operations	N/A	+61 1300 935 250
NT DEPWS	N/A	1800 064 567 (NT EPA Pollution Hotline – caller to state it's a petroleum matter) onshoregas.depws@nt.gov.au
NT EPA Pollution Hotline	N/A	1800 064 567 (as above)
NT WorkSafe	N/A	1800 019 115 ntworksafe@nt.gov.au
National Land Council (NLC)	N/A	(08) 8920 5100 (business hours only)
Well Control and Prevention	Wild Well Control Inc.	+1 281 784 4700

Appendix C. Contact List (Pastoralists)

Property Name	Contact Name	Phone
Amungee Mungee	[redacted]	[redacted]
Beetaloo Station	[redacted]	[redacted]
Sturt Plains Hayfield/Shenandoah	[redacted]	[redacted]
Hidden Valley	[redacted]	[redacted]
Kalala	[redacted]	[redacted]
Newcastle Waters	[redacted]	[redacted]
Nutwood Downs	[redacted]	[redacted]
Tanumbirini Station	[redacted]	[redacted]

Appendix D. Site Location Specifics

PERMIT AREA	EP98
Well Pad	**Kalala South**
Associated water bore	N/A
Well location	-16° 17' 37.7" S / 133° 36' 44.3" E -16.2941, 133.6124 (GDA94) E: 351740, N: 8198023 (MGA Zone 53)
Nearest town by vehicle	Daly Waters
Nearest major road	Carpentaria Highway
Nearest airstrip by vehicle	Daly Waters: 25 min/25 km OR Elliott: 2hrs / 165 km
Nearest hospital by vehicle	Katherine Hospital (299 km)
Well Pad	**Amungee NW-1H**
Associated water bore	VEL 98 N1 CMB-G (RN40894)
Well location	**Amungee NW-1H** -16°20'51.034"S / 133°53'4.403"E -16.34751, 133.8846 (GDA94) E: 380859, N: 8192292 (MGA Zone 53) **Amungee NW-2H** -16 22' 4.513"S / 133 58' 6.56"E 389833.037, 8190103.376
Helicopter landing pad	**-16.34298, 133.88520 (GDA94)**
Nearest town by vehicle	Daly Waters
Nearest major road	Carpentaria Highway
Nearest airstrip by vehicle	Daly Waters: 1hr /61 km OR Elliott 2.5hrs /202 km
Nearest hospital by vehicle	Katherine Hospital (329 km)
PERMIT AREA	**EP76**
Well Pad	**Velkerri 76 S2**
Associated water bore	VEL76-S2CMB-AL (RN41133) VEL76-S2CMB-G (RN41134) VEL98-N1 CMB (RN040894)
Well location	-16°51' 20.13"S; 134°23' 39.85"E -16.85571, 134.3939 (GDA94) E: 435432, N: 8136301 (MGA Zone 53)
Helicopter Landing Pad	16.856275S 134.395751 E Zone 53K
Nearest town by vehicle	Daly Waters
Nearest major road	Stuart Highway
Nearest airstrip by vehicle	Daly Waters: 2.5 hr /190 km OR Elliott: 3.0 hr /198 km
Nearest hospital by vehicle	Katherine Hospital (442 km)

Permit Area	EP117
Well Pad	**Kyalla 117 N2**
Associated water bore	KYA117-N2 CMB (RN40895) KYA117-N2 CMB (RN40896) KYA117-N2 CMB-G (RN41132) KYA117-N2 IMB-AL(R041137) KYA117-N2 IMB-G (RN041136)
Well location	**Kyalla 117** -16°50’ 29.01”S; 133°39’ 0.16”E -16.84141, 133.6501 (GDA94) E: 356183, N: 8137492 (MGA Zone 53) **Shenandoah South 1** E: 356183, N: 8137492 (MGA Zone 53) -16.84141, 133.6501 (GDA94)
Helicopter Landing Pad	16.836500 S 133.658333 E Zone 53 K
Nearest town by vehicle	Daly Waters
Nearest major road	Stuart Highway
Nearest airstrip by vehicle	Daly Waters: 1 hr /92 km OR Elliott: 1.5 hr /117 km
Nearest hospital by vehicle	Katherine Hospital (365 km)
Exploration well	**Shenandoah South 2**
Location	E: 355291; N: 8140676 (MGA Zone 53)
Nearest town by vehicle	Daly Waters
Nearest major road	Stuart Highway
Nearest airstrip by vehicle	Daly Waters: 1hr 10 mins (73 km)
Nearest hospital by vehicle	Katherine Hospital (367 km)
Exploration well pad	**Beetaloo West-1**
Well location	-17° 7’13.82”S / 133°45’43.63”E -17.12051, 133.7621 (GDA94) E: 368312, N: 8106689 (MGA Zone 53)
Nearest town by vehicle	Stuart Highway
Nearest major road	Elliot: 1hr 20mins (95kms)
Nearest airstrip by vehicle	Katherine (399kms)
Nearest hospital by vehicle	Elliot

Permit Area	EP136
Exploration well pad	**Maverick 1**
Well location	146° 30’ 53.93” E / 16° 31’ 5.47” S
Nearest town by vehicle	Daly Waters
Nearest major road	Carpentaria Highway
Nearest airstrip by vehicle	Daly Waters 1hr 30mins (130kms)
Nearest hospital by vehicle	Katherine (400kms)

Permit Area	EP117 – PROPOSED LOCATIONS
Exploration well pad	**Shenandoah North A**
Well location	E: 356687, N: 8163762 (MGA Zone 53)
Nearest town by vehicle	Daly Waters
Nearest major road	Daly Waters 1hr 20 mins (83 km)
Nearest airstrip/s by vehicle	Katherine Hospital (377 km)
Nearest hospital by vehicle	Stuart Highway
Exploration well pad	**Shenandoah South B (PROPOSED)**
Well location	E: 345035; N: 8135464 (MGA Zone 53)
Nearest town by vehicle	Daly Waters
Nearest major road	Stuart Highway
Nearest airstrip/s by vehicle	Daly Waters: 1.5 hr /81 km OR Elliott: 1.5 hr /117 km
Nearest hospital by vehicle	Katherine Hospital (354 km)
Exploration well pad	**Shenandoah South C (PROPOSED)**
Well location	E: 343471; N: 8133330 (MGA Zone 53)
Nearest town by vehicle	Daly Waters
Nearest major road	Stuart Highway
Nearest airstrip by vehicle	Daly Waters: 1.5 hr/86 km OR Elliott: 1.5 hr /117 km
Nearest hospital by vehicle	Katherine Hospital (359 km)

Appendix E. Loss of Containment (Wastewater)

In the event of a loss of containment from any wastewater storage, the following guide will be used to ensure the appropriate steps are implemented to minimise environmental harm. All actions are to be undertaken as a part of the steps outlined in section 5 of this plan and the Spill Management Plan

1. Loss of containment detected	
Type of infrastructure involved: ▪ Enclosed tank ▪ C-ring ▪ Flex-pond ▪ Drilling sump ▪ Gathering line	How has the loss of containment been detected? ▪ Routine inspection ▪ Remote telemetry/alarm
2. Review site location and determine response timeframe	
Where has the loss of containment occurred: ▪ Operational site ▪ Unmanned site	Operational site: ▪ Commence rapid spill assessment in accordance with SMP and actions below. ▪ Progress with site assessment and clean up in accordance with the SMP and actions below. Unmanned site: ▪ Tamboran Representative must review data immediately to determine level of response. A site inspection must be undertaken as soon as possible to investigate if a serious loss of containment is suspected. Weather (ie flooding) and access must be considered with alternative transport arrangements (helicopter) implemented to facilitate site assessment. ▪ Commence rapid spill assessment in accordance with SMP and actions below. ▪ Progress with site assessment and clean up in accordance with the SMP and actions below.

3. Actions

1. Confirm lease perimeter bund is intact and that wastewater hasn't left the site.
2. Inspect the storage infrastructure and identify exact location and cause of leak.
3. Determine whether further loss can be prevented. Consider:
    - Closing or replacing valves
    - Transfer of fluid to alternate storage (if available)
    - Emergency earthworks using equipment available on site
4. Determine extent of contamination
    - Estimate volume of the release
    - Undertake field test of water quality (pH and EC)
5. Recovery response actions. For ponding and spilled wastewater, actions need to be planned with weather conditions and site access in mind, especially during periods of high rainfall (wet season) and constraints such as road closures. Equipment needed to recover fluid:
    - Vacuum truck
    - Trash pumps and hoses
    - Front end loader
    - Mobilisation of earthmoving equipment may need to be considered.

Appendix F. Well Control (Incident Classification)

Three levels of well control event have been defined and are mirrored in the Well Control Standard (TBN-D&C-TS-01). If a well control Incident exceeds level 1 and 2, the Tamboran Operating Company Representative (OCR) will activate the Site ERT and notify the EMT-L.

The involvement of a contracted third-party specialist to handle the well control integrity event may also be required.
The specific response plan is detailed in the Tamboran Well Control Standard (TBN-D&C-TS-01)
The following information is guidance on different levels of well control. Additionally, Appendix G4 provides a basic overview of how Well Control events are managed.

Each level defines the level of escalation required including potential mobilisation of the Well Control contractor.

Level 1 (uncomplicated kick or lowrisk production / well integrity event)	**Level 2** (a kick with some complications or low – moderate risk well integrity event)	**Level 3** (complete loss of well control or moderate – high risk well integrity event)
These are events that commonly occur during drilling and workover operations, or. Low risk well integrity events during the production phase. Emergency interfacing is limited due to pressure and flow containment. Personnel and equipment are not threatened, and there are no injuries or fire involved. These events can be handled using resources and procedures available on-site (or readily mobilised in the case of a well integrity event). The situation is immediately managed by the Driller who will keep the rig manager informed of the situation. Caution: Level 1 incidents can escalate quickly to a more serious and threatening level if not handled properly.	A Level 2 event can be defined asan abnormal well control event during drilling and workover operations involving some sort of complication in which: ▪ Well control has NOT been lost at the surface ▪ Resources beyond the normal capabilities of therig crew or production operations staff may be required ▪ Outside well control consultation, materials, equipment, or personnel may be required Includes low – moderate risk production events (e.g. noticeable leak or significant annular pressure). There are no injuries or fires associated with this incident level since control has not been totally lost. The situation is typically managed by the Rig with the OSC liaising. The EMT is on standby but not activated. The incident is generally not sufficiently threatening to activate the CMT.	A Level 3 emergency denotes a complete loss of well control at surface during drilling and workover operations with no opportunity to restore it using all the resources available on-site. Includes moderate – high risk wellintegrity events during the production phase. Level 3 Incidents require the EMT to activate including notification to the CMT to effectively deal with the situation. External Well Control support (i.e. Boots & Coots, Wild Well Control, Cudd, etc.) must be activated upon confirming that the well is outof control at surface and measuresmust be immediately taken to protect people, the environment and material assets. These emergencies, although serious at the outset, have the potential to escalate further during control attempts. Such escalation may cause serious structural damage or total loss of the facility,rig, BOP stack and wellhead due to explosion, fire, loss of buoyancy or location subsidence.

Well Control Incident Level 1 – Uncomplicated Kick	
Situation managed by:	OCR in consultation with Drilling Superintendent, Drilling/Completion Engineer
Support:	Usually none required
Communication:	OCR or Drilling Superintendent to liaise with Brisbane based engineering team as required
Example situation:	Influx while drilling

Well Control Incident Level 2 – Kick with Complication	
Situation managed by:	OCR in consultation with Drilling Superintendent, Drilling/Completion Engineer SERT on standby
Support:	Technical team as required Well control specialist as required
Communication:	Drilling Superintendent to liaise with Technical Team
Example situation:	▪ Severe lost circulation combined with influx into wellbore ▪ Kick taken with pipe out of hole ▪ Leak or mechanical failure of well control equipment ▪ Gain and loss situations ▪ Plugged work string ▪ Influx taken while running casing or pumping cement ▪ Loss of casing shoe integrity ▪ Any complication experienced during live well operations

Well Control Incident Level 3 – Loss of Containment	
Situation managed by:	Onsite: SERT Office: Crisis Management Team
Support:	Technical Team to support SERT and CMT as required Well control specialist onsite and in office as required
Communication:	ERT-L to liaise with CMT-L Support functions to report to ERT-L or CEMT-L as required
Example situation:	▪ Severe lost circulation combined with influx into wellbore ▪ Kick taken with pipe out of hole ▪ Leak or mechanical failure of well control equipment ▪ Gain and loss situations ▪ Plugged work string ▪ Influx taken while running casing or pumping cement ▪ Loss of casing shoe integrity ▪ Any complication experienced during live well operations

Response to Level 3 Well Control Event

Personnel safety shall always be the highest priority in a well control event. Untrained personnel should never attempt to conduct well intervention activities due to the extreme risk for significant injury, fatality, or event escalation.

The primary focus immediately following a Level 3 well control event should consist of rig evacuation and care for injured parties. During drilling/completion operations the rig contractor's evacuation procedures shall be the prevailing document(s). The senior contractor representative (Rig Manager) shall serve as the On Scene Commander (OSC) during evacuation and search and rescue operations.

Upon completion and confirmation of a full muster, the Rig Manager shall be relieved of OSC duties by the Tamboran OCR.

Initial actions shall include, but are not limited to:

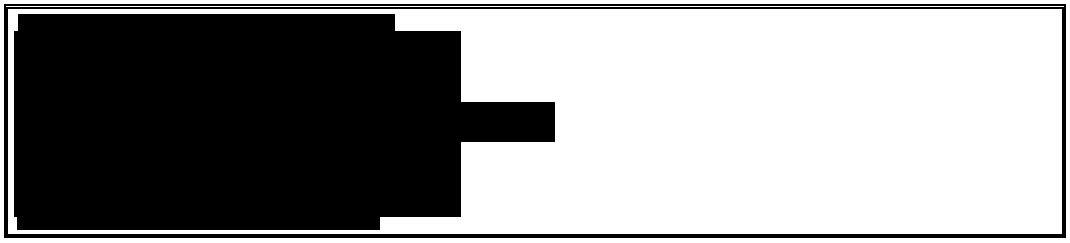
- Evacuate and make sure all personnel are safe and accounted for
- Isolate the area and restrict access
- Notify applicable groups (including well control specialists if required)
- Conduct initial assessments

In the event of a well control event, factually correct information is essential to aid in decision making. Once the site has been secured, personnel accounted for and appropriate notifications made, information should be gathered which aids the response to the incident. Appendix C8 & C9 include templates to aid in gathering the information necessary in such an event.

Once the site has been secured, some hazards and potential solutions are outlined in Appendix C10. Information in this Appendix should be used to identify the site-specific issues relevant to the event and mobilise services and materials that may be required to respond.

Contractor Mobilisation

The well control contractor is Wild Well Control. Tamboran VP, Drilling and Completions must authorise the mobilisation.



Appendix G. Well Control (Documentation and Information Gathering)

Initial information to be obtained following an incident:

Question	Answer
Are there any injuries and is immediate assistance required for evacuation of personnel?	
What assistance is currently underway for injured personnel?	
Has the rig been evacuated?	
What are the weather conditions?	
Has the location been secured?	
When were applicable contingency plans put into effect?	
Status of the emergency:	
Is there a fire? If not, should ignition be considered.	
Is there any pollution?	
Can source of pollution be stopped?	
Are toxic gases present?	
What is the condition of the drilling/workover rig?	
Should rig, or can rig, be moved off location?	
Are the BOP's operable?	
Status of the well	
Is the wellhead/tree intact?	
Pressure readings (annulus and drill pipe)?	
Previous casing size and depth?	
What is the well depth?	
Mud weight?	
Where is the drill pipe/tubing?	
Is an attempt to shut in the well feasible if not already done?	

Appendix H. Well Control (Call in Documentation)

Date and time of incident:		Location:	
Contact name:		Contact number:	
Rig:		WC Incident Level:	

Injured parties:			
	Name	Company	Type of Injury
1.			
2.			
3.			
4.			

Brief Summary (facts only):

What has been done so far to secure the site:

Who has been contacted so far:

Government/Regulatory Bodies Notified and Media Coverage:

Initial well conditions			
Shut In Drill pipe pressure (psi):		Shut In Casing pressure (psi):	
Pit gain volume (bbl):		Mud weight (ppg):	
Well depth (m MDRT): (m TVDRT if required)		Casing shoe depth (m MDRT): (m TVDRT if required)	
Last casing size (in):		Last FIT/LOT (ppg):	
Hole size (in):		Bit depth (m MDRT): (m TVDRT if required)	
Float in drill string: Ported?		If yes, drill pipe pressure to open float (psi):	
Operation in progress at time of kick:			
Actions since time of kick:			

Current conditions (if different from initial conditions reported above):			
Shut In Drill pipe pressure (psi):		Shut In Casing pressure (psi):	
BOPs closed (Y/N):			
Current operation and plans:			

Appendix I. Well Control (Hazards and Control Considerations)

Hazard	Services/Materials	Task
Security		
Visitors entering site	Self-powered site office with toilet and fridge.	Secure entry to site (ie lock gate) Contact security contractor to mobilise personnel/equipment as required
Lack of communication	Digital radios	Supply digital radios for working party
Visibility at night	Light plants	Contact primary contractor to mobilise equipment as required
Landowner not informed of situation	N/A	Contact made through Beetaloo Field Manager or Landholder Relationship Advisor
People		
Fatigue	Additional SERT personnel	Ensure sufficient personnel at site location to man SERT 24hrs
Lease Preparation		
Fire – overgrown with grass	Slasher	Contact primary contractor to mobilise equipment as required
Uneven ground	Grader	Contact primary contractor to mobilise equipment as required Seek approval and blade fire break if safe to do so
Removal ground soil	Excavator	Contact primary contractor to mobilise equipment as required
Ignition	N/A	Ensure any possibly ignition sources presentare removed/disabled if safe to do so
Movement around well	Bobcat & Backhoe	Contact primary contractor to mobilise equipment Tentatively confirm work to remove fence around well pending well controls specialistadvice upon arrival
Water used in well kill operations causing contamination	Bobcat and/or backhoe	Consider if application(s) of permits required to construct any in earth holding basin or water recovery trenches Contact primary contractor to mobiliseequipment as required
Housekeeping – equipment on well pad / lease	Crane/Forklift Truck	Contact primary contractor to mobilise equipment Clear lease to allow access to wellhead, if safe to do so, considering equipment which may be required to resolve the loss of containment.
Loss of containment effecting nearby wells	Operations coordination	If other wells are nearby (ie on production pad), check wells are secure and check annulion wells to ensure pressures have not significantly changed

Water		
Insufficient water to respond to event – fire control and well kill	Water	Confirm an adequate water source close by
Inability to deliver sufficient water to site	Water trucks	Determine volume of water required for event. See below for method to estimate water requirements Contact primary contractor to mobilise equipment as required
Inability to pump water required	Water pump(s) w/- suction & discharge hose	Contact primary contractor to mobilise equipment as required
Inability to store sufficient water at site	Onsite fluid storage tanks	Determine volume of water required for event.Contact primary contractor to mobilise equipment as required
Logistics		
Inability to move heavy equipment around well	100 t crane(s)	Contact primary contractor to mobilise equipment as required
Delay due to lack of road transport	Road transport	Contact primary contractor to mobilise equipment as required Sufficient road transport available to move required equipment (may need 24hr coverage)
Wellbore Fluids		
Gas	SCUF vent tank with generator to run same	Contact primary contractor to mobiliseequipment as required
Return fluids	Storage tank	Contact primary contractor to mobiliseequipment as required
Storage tank overflow	Vac trucks to remove fluid	Contact primary contractor to mobiliseequipment as required
Well Kill/Isolation		
Inability to kill well	Mud or cementing pump with sufficient hard lines	Contact primary contractor to mobilise equipment as required
Inability to kill well	Fluid Storage/Mud Tank(s) with sufficient hard lines	Contact primary contractor to mobilise equipment as required
Hydrocarbon zone isolation	Cement unit, cement, additives and associated equipment	Contact primary contractor to mobilise equipment as required
Wellhead Equipment		
Isolation of well before side outlet valve removal	VR plug lubricator	Contact primary contractor to mobilise equipment as required
Specialised Services		
Unable to fabricate equipment	Machine shop	Contact primary contractor to mobilise equipment as required
Removal of equipment/fabrication	Welding services	Contact primary contractor to mobilise equipment as required
HSE		
HSE – hydrocarbon spill, uncontrolled release of well fluids into the air	Evaluate if any specialistservices are required (ie air sampling, radiation, noise)	Contact primary contractor to mobiliseequipment as required

Appendix J. Well Control (Water Requirements)

Surface intervention of a blowout requires massive volumes of water. Well Control specialists will determine pumping, volume of water required onsite and ongoing water requirements.

If water cannot be stored in ground pits, or surface ponds, water shall be stored on location utilizing multiple manifolded 450-barrel portable frac tank containers. Combined storage capacity up to 2,000,000 million gallons may be required (subject to confirmation). Tamboran shall consider the requirements for application(s) of any permits required to construct any in earth holding basin or water recovery trenches. It is critical to the safety of the well control crews and ultimate success of the well control mitigation that water supply remain uninterrupted. Water from the storage tanks will be piped to the fire pump(s) and distributed to fire monitor stands and hand lines as deemed appropriate by the well control specialist.

Water volume requirements vary from one blowout to another. For example, only one pump would be required for a minor fire (with backup pump circulating water as a redundant system) for a minor fire, whereas two or more pumps would be required for a major rig fire, thus doubling the water volume required. Typically, a benchmark of 2,000,000 gallons per day (48,000 bbls per day) is used in the Well Control Contingency Plan (WCCP) calculations.

A well on fire requires a tremendous volume of water. For example, the following calculations show how a fast 1,000,000-gallon (24,000 bbls) pit would be emptied using various capacity fire pumps:

- 1,000,000 gallons/(4,000 gpm + 4,000 gpm) = 125 minutes

Beetaloo Basin wells are typically supported by up to 2 x water bores located on the lease pad, each capable of supplying up to 20 lts./sec., or 72m3 per hour.

Water Supply Calculations – Using Tankers Only

Before mobilising water storage tanks and water to site, liaise with Boots and Coots to determine likely water requirements. Below are sample calculations only based on a worst-case scenario.

The following calculations give the number of tanker loads needed to replenish the pit with water:

- 1m3= 6.29 bbls
- 24m3 tanker capacity x 6.29 bbls/m3=150 bbls
- 24,000 bbls/150 bbls per load = 160 tanker loads

The following calculation factors in a water recovery rate of 30%:

- 160 tanker loads x (1.0-.3) = 112 tanker loads.

Using the two minimum 4,000 gpm fire pumps, it would require 61 tanker loads per hour to maintain operations.

With a remote pit containing an additional 1,000,000-gallon capacity for a total of a 2,000,000 gallon capacity (48,000 bbls), operations could be maintained for four (4) hours using two 4,000 gpm pumps. The flowing calculations give tanker load totals for 10 hours of wintertime daylight operations:

- (10 hours operations) – (4 hours water supply on hand) = 6 hours additional water supply
- (6 hours) x (61 tanker loads per hour) = 366 tanker loads
- (366 tanker loads) / (10 hours) = 37 tanker loads per hour

37 tanker loads per hour, although cumbersome, is far more manageable than 61 tanker loads per hour. However, using the above calculation, at the end of 10 hours the pits will be dry. The following calculation gives the tanker loads per hour to overnight replenish the 2,000,000 gallons (48,000 bbls):

- 48,000 bbls / 150 per load = 320 tanker loads
- 24 hours – 10 hours daylight operations = 14 hours to refill pits
- 320 tanker loads / 14 hours = 23 tanker loads per hour overnight

Appendix K. Daly Waters Runway Lighting Plan

Daly Waters Aerodrome
Emergency Landing Lights Layout Procedure

Purpose

This procedure describes how to layout the Eflare night landing lights for the safe arrival and departure of emergency aeroplanes such as Careflight and RFDS in under 60 minutes from the time of activation.

Scope

The Daly Waters community and any other stakeholders who may be able to assist in the lay out emergency landing lights in the event of an emergency.

Minimum Resources

Vehicles - to have UHF, amber flashing light / hazard lights and headlights on.

Personnel - to have torch, hi vis and reflective personal protective equipment.

Communications - UHF channel 16 is being monitored by all personnel in the aerodrome.

Key contacts

NT Careflight Operations
1300 650 654 or 0417 826 336

RFDS Alice Springs

For 24-hour medical and emergency assistance call:

NT (Central Australia) - 1800 733 768

HF Radio (4010kHz, 6890kHz or 8165kHz)

Satellite Telephone: 08 8648 9555 or +61 1800 733 772

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Activation from Emergency Services → **CONFIRM** who is in charge (for Origin this is the On Scene Commander) → **CONFIRM** the arrival time of the a/c and CTAF freq (126.7) → **ACTIVATE** oher personnel to assist (refer to Daly Waters Aerodrome Plan for contact numbers) → **COLLECT** Eflare kit from the Origin Office at the Daly Waters Pub → **MEET** at Daley Waters Aerodrome apron gate

Set up and planning

1. Split into 2-3 teams each with 2 persons and 1 vehicle.
   Teams: Runway 14, Runway 32 and Taxiway / Apron
2. Prepare vehicle - conduct radio checks, check lights and clear our rear seat including footwells.
3. Secure the respective eflare kit in back right seat of the vehicle with the seatbelt.
   Each kit to include the following lights and rubber bases:

Runway 14	Runway 32	Taxiway / Apron
• 24 x White lights	• 23 x White lights	• 2 x Orange hold point lights
• 4 x Red threshold lights	• 4 x Green/Red threshold lights	• 22 x Blue lights
• 8 x Green displaced threshold lights		

4. The On Scene Commander to monitor the time of arrival and monitor the CTAF frequency and provide updates and warning to personnel via UHF radio deploying eflares as necessary.
5. CAUTION: Where the aerodrome is delayed in setting up the eflares and leaving the aerodrome in an unsafe state for a landing, the pilot is to be notified on the CTAF 126.7 frequency advising on when the aerodrome will be available.
6. In the event an approaching aircraft is spotted either notify the aircraft directly or if unsuccessful notify personnel deploying the eflares on the UHF "Vacate runway immediately, aircraft on final, vacate runway immediately".
7. Where time permits a final runway inspection is conducted to identify any foreign objects or debris as part of the Eflare deployment. The vehicle should head on a 32 approach so approaching aircraft can be seen.

Placing and retrieving eflares

WARNING: When both deploying and retrieving eflares, the passenger needs to get out of the vehicle to place each light. Don't reach down from the vehicle as this risk over extension resulting in a back injury.

The driver must:

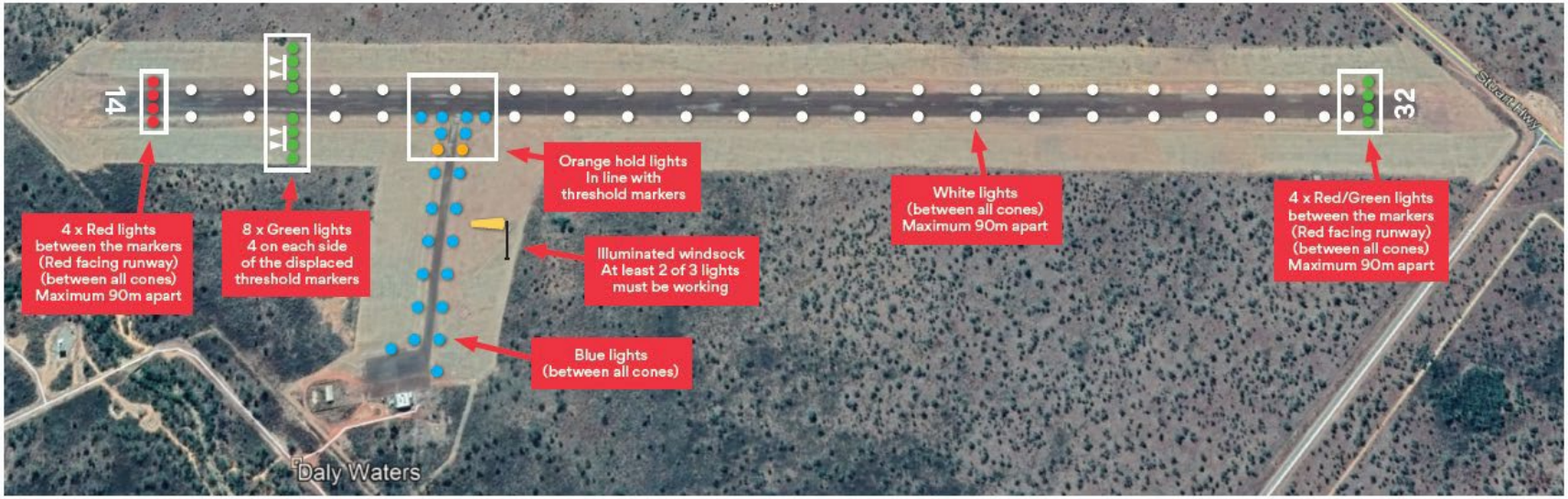
- Drive no faster than 25km/hr
- Drive on the right-hand side of the runway cones
- Stop in line with the rear left passenger door
- Wait for passenger to indicate they are ready before proceeding to the next light location

The person deploying the eflares must:

- Only remove the seatbelt on the runway when travelling less than 25km/hr
- Only set up 1 light at a time
- Avoid turning on the light in the vehicle
- Indicate to the driver when ready to go to next light location

Wait 10 minutes after aircraft has taken off before retrieving runway eflares.

Daly Waters Aerodrome Lighting Plan



Layout Procedures

Layout Runway 14

1. Start at the 14 end of runway (**turn left** from the taxiway).
2. 4 x Red lights - place evenly between the end cones. Locations are indicated with spray paint.
3. 4 x Green lights (each side) – placed each side on the white displaced threshold markers.
4. 8 x White runway lights – start on the East side or the **left side** if looking down the runway.
   Place a light between each cone so no more than 90m apart. Locations are indicated with spray paint markings.

Layout Runway 32

1. Start at the 32 end of runway (**turn right** from the taxiway).
2. 4 x Green/Red lights - place the Green side facing the away from the runway, evenly between the end cones. Locations are indicated with spray paint.
3. 23 x White runway lights – start on the East side or the **left side** if looking down the runway
   Place a light between each cone so no more than 90m apart. Locations are indicated with spray paint markings.

Layout apron / taxiway

1. Start on the runway and work back towards the apron.
2. 6 x Blue lights – 3 lights placed each side of the taxiway between the cones. Locations are indicated with spray paint.
3. 2 x Orange lights – place each side on the taxiway. Locations are indicated with spray paint.
4. 14 x Blue lights – placed between the cones along the taxiway. Remaining lights spaced approximately 60m apart.
5. 1 x Red light – placed near unserviceable marker in centre of apron.

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Appendix L. Example ERN (Emergency Response Number)

EMERGENCY RESPONSE CONTACT NUMBERS - RIG

Rig Name	: **SilverCity Rig 40**
Well Name	: **Amungee NW 2H**
Lease Number	: **EP 98**
GPS Coordinates	: **LAT 16° 20' 51.034" S LONG 133° 53' 4.403" E**

tamboran RESOURCES

Field Medical Support

Note - in the event of a medical emergency and the site paramedic can not be raised, contact CareFlight directly as per number listed below

CareFlight Emergency - 1300 650 654

Aspen Paramedic- 0447 879 992

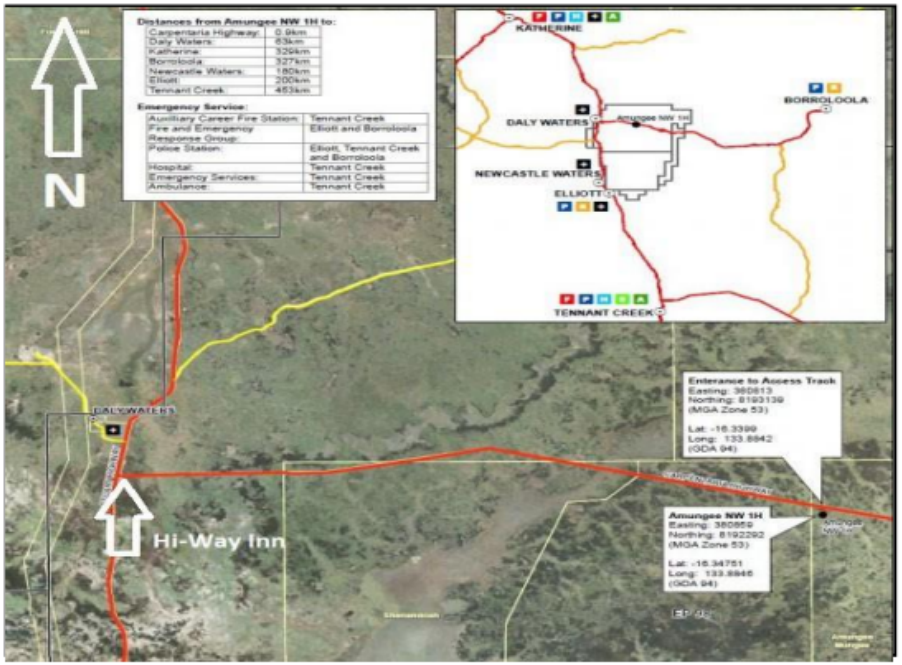
Site Contact - UHF Ch. 10

Emergency Services
000 from landline
112 from mobile phone

ADDITIONAL NUMBERS

Rig Manager:	**0458206987**
Well Site Representative:	**0474084934**
Camp Manager:	**0458777190**
Site Medic Sat Phone:	**0147140631**
UHF Channel:	**10**

DIRECTIONS FROM RIG TO HELICOPTER LANDING ZONE:
Helipad LAT 16° 20' 48" S LONG 133° 53' 3" E



SPECIAL INSTRUCTIONS:

All travel plans must be approved by the Well Site Rep prior to starting any trip
All equipment must have a weed hygiene certificate
Make arrangements with the Well Site Rep to have your equipment inspected before entering any access roads or well sites
Ensure all personnel sign in at the access gate with Weed Inspection details .

DIRECTIONS TO SITE: From intersection of Stuart Highway and Carpentaria (Hi-Way Inn Daly Waters)

1. Travel East on the Carpentaria highway for 56.8 km.
2. Turn right onto the access road and travel 200m to the gate. 40 Kph
3. Pass through the gate (remember to close after) follow road to the left. Travel 300m to camp pad
4. Continue past camp pad 500m to lease.

Appendix M. Emergency Response Planning Map