BEETALOO BASIN GROUNDWATER MONITORING BORE INSTALLATION PROGRAM- KYALLA 117

Environmental Management Plan

EP117

Review record

Rev	Date	Reason for issue	Author	Reviewer	Approver
A	07/09/2018	Draft EMP released for comment	A.Court	M.Kernke	M.Hanson
0	09//11/2018	Revised to reduce sites	A.Court	M.Kernke	M.Hanson
1	22/11//2018	Revised to include AAPA Certificates	A.Court	M.Kernke	M.Hanson

Environmental Management Plan

NT-2050-15-MP-0017

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Executive Summary

The Beetaloo Basin Groundwater Monitoring Bore Installation Environmental Management Plan (EMP) forms the basis of Origin Energy's (Origin) application to the Northern Territory (NT) Department of Primary Industry and Resources (DPIR) for the installation of environmental monitoring bores located adjacent to the proposed future exploration sites to collect baseline groundwater level and quality data prior to further exploration.

The proposed network of groundwater monitoring bores will be used to obtain baseline groundwater quality and quantity data adjacent to the proposed future drilling and stimulation lease sites to meet Recommendation 7.11 of the Inquiry and relevant guidelines published by NT Department of Environment and Natural Resources (DENR) on Well Pad Groundwater Monitoring Bores (currently draft).

This EMP has been prepared with reference to the *NT Petroleum (Environment) Regulations 2016* and the Exploration Agreement between Origin, local Aboriginal groups and the Northern Land Council (NLC). The overall objective of the EMP is to ensure minimal environmental impact and minimise risk of any inadvertent adverse outcomes from Origin's activities. It is noted that this EMP does not seek approval for future exploration activities or potential hydraulic fracture stimulation activities. Should Origin seek to undertake further exploration, the company will prepare a separate submission and obtain approvals before conducting such activities.

The EMP covers a series of low impact activities proposed to expand Origin's existing, four-year, baseline groundwater monitoring program in preparation for its' 2019 exploration program. The groundwater monitoring program will involve the installation of monitoring bores sufficient to meet guidelines currently in development at the proposed Kyalla 117 N2 lease sites within the Origin Beetaloo Exploration Area (refer Figure 1).

The activities subject to this EMP are:

- Establishment of a 50mx50m groundwater monitoring lease areas containing up to four clustered monitoring bores at each location.
- Clearing and construction of up 500m of a new access track approximately 14 m wide.
- Establishment of up to three 50mx50m gravel pits to provide material for improving stability of water crossings along the access tracks.
- Groundwater monitoring bore drilling, completing and equipping of up to four groundwater water monitoring bores.
- Installation of fencing, gates and grids.

For the preparation of this EMP, a land condition assessment was completed in August 2018 to review the physical, natural and cultural heritage environment of the proposed lease areas for groundwater bore drilling and the associated access tracks.

The proposed groundwater monitoring bore sites is located within *Corymbia* low woodland with a tussock grass understorey. The proposed site 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 surrounding areas 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.

There was no evidence of weeds observed during the survey. This suggests the primary controls for this program will therefore be focused on preventing the introduction of weeds and managing weeds promoted through site disturbance.

The archaeology assessment did not identify culturally sensitive landforms or artefacts within the proposed groundwater monitoring bore sites. In addition, sacred site clearance survey by Aboriginal Area Protection Authority (AAPA) anthropologist and traditional owners have been completed. The clearance certificates did not identify any restricted work areas (RWA's) within Origin's proposed disturbance area.

The environmental, heritage and social risks associated with the proposed groundwater monitoring bore drilling activities have been assessed utilising the Origin risk assessment framework. The detailed risk assessment presents the range of potentially impact-causing activities, corresponding mitigation measures and residual risk ratings based on their assessed worst-case consequence and likelihood of occurrence.

Key environmental impacts and risks identified for the program include:

- impacts on flora, fauna and habitat from clearing native vegetation

- impacts on pastoral land and habitat from bushfire

- impacts on to land and surface water from erosion, in particular where access tracks cross small drainage channels

- impacts to cultural heritage sites.

It was considered that with the appropriate controls implemented to mitigate the impacts, there were no residual risks above a medium, with 16 out of the 18 risks identified as being considered low. The medium risks identified were consistent with standard civil construction activities completed across the NT, being the potential spread of weeds and the ignition of bushfires from the proposed activities.

At completion of activities and once a determination has been made in relation to decommissioning, a site-specific rehabilitation plan will be developed for each site. Where the site is not able to be handed over to the pastoralists for beneficial use, the site will be rehabilitated back to a safe, stable landform consistent with surrounding land use.

Due to the nature of the activity, community engagement for the 2018 groundwater monitoring bore installation project has been with host Traditional Owners via the northern Land Council (NLC) and host Pastoralists directly affected by the proposed activity. Detailed community and stakeholder engagement is underway covering future exploration activities which are beyond the scope of this EMP.

Origin recognises the growing community interest in ensuring onshore natural gas development takes place in a safe and environmentally sound way. Origin are committed to delivering operational excellence (which encapsulates our health, safety and environmental performance).

It should be noted that the water bore monitoring installation network is a recommendation of the NT Inquiry and as such the broader NT community is expecting the work program to be executed swiftly.

1. Introduction

1.1 Background

Origin Energy (Origin), holds three petroleum exploration permits in the Barkly region under the Beetaloo Joint Venture with Falcon Oil and Gas. These permits consist of EP76, EP98 and EP117 which cover 18,512 square kilometres (km^2) of pastoral lease on the Sturt Plain, part of the Barkly Tableland, Northern Territory (Figure 1) and were originally granted by the NT Minister for Mines and Energy under the *Petroleum Act 2014*.

Origin drilled three vertical wells (Kalala S-1, Amungee NW-1, Beetaloo W-1) and one horizontal well (Amungee NW-1H) during 2015 and 2016. A successful hydraulic fracture stimulation and production test was undertaken on the Amungee NW-1H well in 2016, highlighting the potential of the Beetaloo Basin as a future unconventional shale development. Upon completion of the 2016 work program, Kalala S-1 and Beetaloo W-1 were suspended and a pressure monitoring commenced at Amungee NW-1H.

On 16 April 2018, the Northern Territory (NT) Government announced the lifting of the moratorium on hydraulic fracturing of onshore unconventional gas reservoirs within the NT. The lifting of the moratorium was made with the endorsement of the 135 recommendations handed down by the independent Scientific Inquiry into Hydraulic Fracturing of Onshore Unconventional Reservoirs in the Northern Territory (referred to herein as the Inquiry). One of the inquiry recommendations was for the collection of baseline groundwater level and quality data before the commencement of any future hydraulic fracturing activities.

A letter dated 31 August 2018, from the Minster of the Department of Primary Industries and Resources to Origin, confirmed that the installation of water bores has been deemed as a "low impact" enabling activity and therefore will be considered under an EMP prior to the implementation of the inquiry recommendations.

This Environmental Management Plan (EMP) forms the basis of Origin's application to the Northern Territory Department of Primary Industry and Resources (DPIR) for the installation of environmental monitoring bores located adjacent to the proposed future exploration sites to collect baseline groundwater level and quality data prior. This EMP progresses the Origin current 5-year work program, which is currently with the department for consideration of a proposed extension and revision.

1.2 Project Proponent

The proponent for the project is Origin as the operator. The key Operator contacts for this plan are provided below:

Name	Title	Contact number
Tracey Boyes	Asset Manger	+61 475 949 668
Matthew Hanson	Project and Operations Manager	+61 477 748 843
Stephanie Stonier	Corporate Affairs Manager	+61 475 940 931
Matt Kernke	Environment Specialist	+61 467 700 565

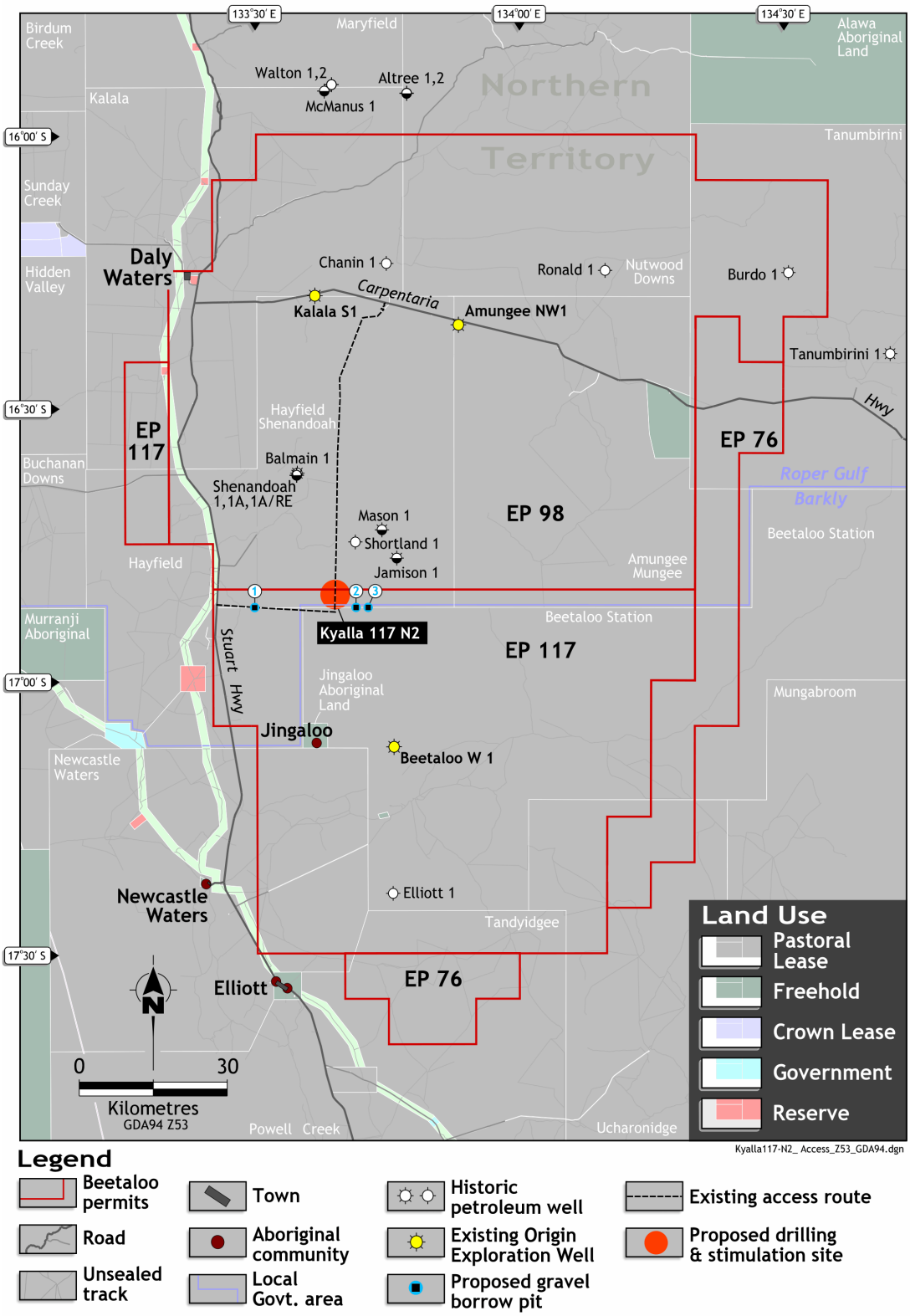

Figure 1 Location of Origin Permit Area

1.3 Project Boundary

Origin are proposing to undertake a series of low impact activities required to expand its existing, four-year, baseline groundwater monitoring program in preparation for its' 2019 exploration program. The groundwater monitoring program will involve the installation of monitoring bores sufficient to meet guidelines currently in development at the proposed Kyalla 117 N2 lease sites within the Origin Beetaloo Exploration Area (refer Table 1 and Figure 1).

For the purpose of this EMP, the project boundaries are defined as the area which may be affected by the groundwater monitoring bore installation project. This is restricted to:

- The two 50 x 50 m groundwater monitoring bore lease sites, including provision for fire breaks.
- Establishment of up to three 50mx50m gravel pits to provide material for improving stability of water crossings along the access tracks.
- The installation of approximately 500m of new access tracks (approximately 14 m wide) to connect the groundwater monitoring lease to the existing access tracks.
- Minor repair and maintenance of 28 km of existing tracks, fencelines and firebreaks to access the groundwater monitoring bore lease sites.

Table 1 Proposed Lease Area for Water Monitoring Bores and Disturbance Areas

Exploration Permit	Well Name	Station	Zone*	Approx Easting	Approx Northing	Disturbance Area (ha)
EP117	Kyalla 117 N2-1	Hayfield/Shenandoah	53	356175	8137500	0.25
500m Access Track						0.7
Total Disturbance Area for 2018 (Ha)						**0.95 ha**

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

^ Existing Origin Lease, previously known as Amungee NW-1h and Beetaloo W-1.

In addition, three proposed gravel pits locations have been identified and summarised in **Table 2**.

Table 2 Proposed Lease Area for Water Monitoring Bores and Disturbance Areas

Exploration Permit	Gravel Pit	Station	Zone*	Approx Easting	Approx Northing	Disturbance Area (ha)
EP117	Gravel Pit 1	Shenandoah	53	339880	8134770	0.25
EP117	Gravel Pit 2	Shenandoah East	53	360420	8134916	0.25
EP117	Gravel Pit 3	Shenandoah East	53	362876	8134932	0.25
Total Gravel Pit Disturbance Area for 2018 (Ha)						**0.75 ha**

1.4 Purpose

Origin is required to provide a site-based Environmental Plan Management (EMP) for its proposed groundwater monitoring bore installation program to the Department of Primary Industry and Resources (DPIR). This EMP has been prepared with reference to the *NT Petroleum (Environment) Regulations 2016* and the Exploration Agreement between Origin, local Aboriginal groups and the Northern Land Council (NLC).

The overall objective of the EMP is to ensure minimal environmental impact and minimise risk of any inadvertent adverse outcomes from Origin's activities.

More specifically, this EMP aims to:

- be a practical and usable document, with environmental management principles that are easily implemented and effective
- address regulatory requirements
- provide a description of site-specific aspects of the existing environment (physical, biological, social and cultural)

- provide site-specific impact management strategies to assist Origin in maintaining a positive position in the local community throughout its program
- provide site-specific plans for review, monitoring and rehabilitation
- align with the principles of Ecological Sustainable Development (ESD) through the adoption of responsible development practices that are designed to maximize social benefit, whilst minimising the level of impact on the surrounding ecosystems.

The 'site' is defined as all the work areas including the groundwater monitoring bore pads and access tracks.

1.5 Structure of EMP

This EMP is structured to meet the requirements of an environmental management plan, as per Schedule 1 of the NT Petroleum (Environment) Regulations 2016. This EMP is divided into the following sections:

- Section 1 – provides background information to Origin's exploration program and the purpose of the EMP for water bore drilling program
- Section 2 – provides a detailed description of the proposed water bore installation activities
- Section 3 – provides a summary of the relevant environmental legislation and other requirements
- Section 4 - describes the existing environment in detail, including the site location, site history and the physical, natural and social environment of the permit area and specifically lease sites
- Section 5 – provides detail on stakeholder consultation
- Section 6 – provides the environmental management procedures for the civil construction activities. This section describes the potential impacts and risks associated with the program of works, how these can be managed or mitigated, responsibilities for management, monitoring and performance measurement, resources required and the relevant legislation and guidelines for each aspect identified
- Section 7 – provides the implementation strategy
- References – an alphabetical list of all reference material referred to in this EMP
- Appendices – ancillary information in support of the EMP.

2. Project Description

2.1 Location and Proposed Operations

The exploration permits cover 18,512 square kilometres (km ^{2}) of pastoral lease on the Sturt Plain, part of the Barkly Tableland, approximately 500 km south-east of Darwin (refer Figure 1). Origin, as the Operator of exploration permit areas EP76, EP98 and EP117, propose to install up to four groundwater monitoring bores in a cluster on Origin's proposed lease site within the Origin Beetaloo Exploration Area.

The network of groundwater monitoring bores sufficient to satisfy the relevant guidelines (currently in development) will be used to obtain baseline groundwater quality and quantity data adjacent to the proposed future drilling and stimulation lease sites to meet Recommendation 7.11 of the Inquiry and relevant guidelines published by NT DENR on Groundwater Monitoring Bores for Exploration Petroleum Wells in the Beetaloo Sub-Basin. As the guidelines are still in draft, the exact location of the monitoring bores at each of the proposed sites will be undertaken in consultation with the DENR Water Division to ensure any potential changes are incorporated in the program design.

The proposed number and aquifer monitoring zone has been selected based on the information presented in Table 3. These formations have been chosen based on their quality and importance as a local water source and are anticipated to include the following units:

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

The screening interval of each groundwater monitoring bore will be determined by a suitably qualified hydrogeologist.

A schematic of the multi-level monitoring bores is provided in Figure 2.

It is noted that this EMP does not seek approval for future exploration activities or potential hydraulic fracture stimulation activities. Should Origin seek to undertake further exploration, the company will prepare a separate submission and obtain approvals before conducting such activities.

Table 3 Aquifer properties and monitoring rationale

Formation		Aquifer Status	Av. EC (uS/cm)	Yield (L/sec)	Thickness (m)	Proposed Monitoring
Shallow / Perched alluvium aquifer		Local aquifer - temporary storage after wet season	100 - 200	<0.1	<20	Yes - If present and containing water of sufficient quality and quantity to be of value for environmental or consumptive use
Undifferentiated Cretaceous		Local aquifer - unsaturated across much of the Beetaloo Basin	1,800	0.3 - 4	0 - 130	Yes - If present and of sufficient storage
Cambrian Limestone Aquifer	Anthony Lagoon Beds	Regional Aquifer	1,600	Up to 10	0 - 200	Yes – likely deepest subunit
	Gum Ridge Formation	Regional Aquifer	1,400	Up to 20	0 - 300	Yes – likely deepest subunit

Formation	Aquifer Status	Av. EC (uS/cm)	Yield (L/sec)	Thickness (m)	Proposed Monitoring
Antrim Plateau Volcanics	Regional Aquitard - *Local aquifer in the north-west of the Beetaloo Basin where it is fractured shallow*	900	0.3 - 5	0 – 440	No- Not used locally – Use North of Daly Water and West of the Stuart Hwy
Bukalara Sandstone	Local Aquifer - used only along the northeast margin of the Beetaloo Basin	1,000	0.3 - 5	0 – 75	No- Not used locally – Use Northern Nutwood Downs
Jamison Sandstone	Local Aquifer - outside the Beetaloo Basin only	138,000	NA	0 – 150	No
Moroak Sandstone	Local Aquifer - outside the Beetaloo Basin only	131,000	0.5 - 5	0 – 500	No
Bessie Creek Sandstone	Local Aquifer - outside the Beetaloo Basin only	NA	0.5 - 5	450	No

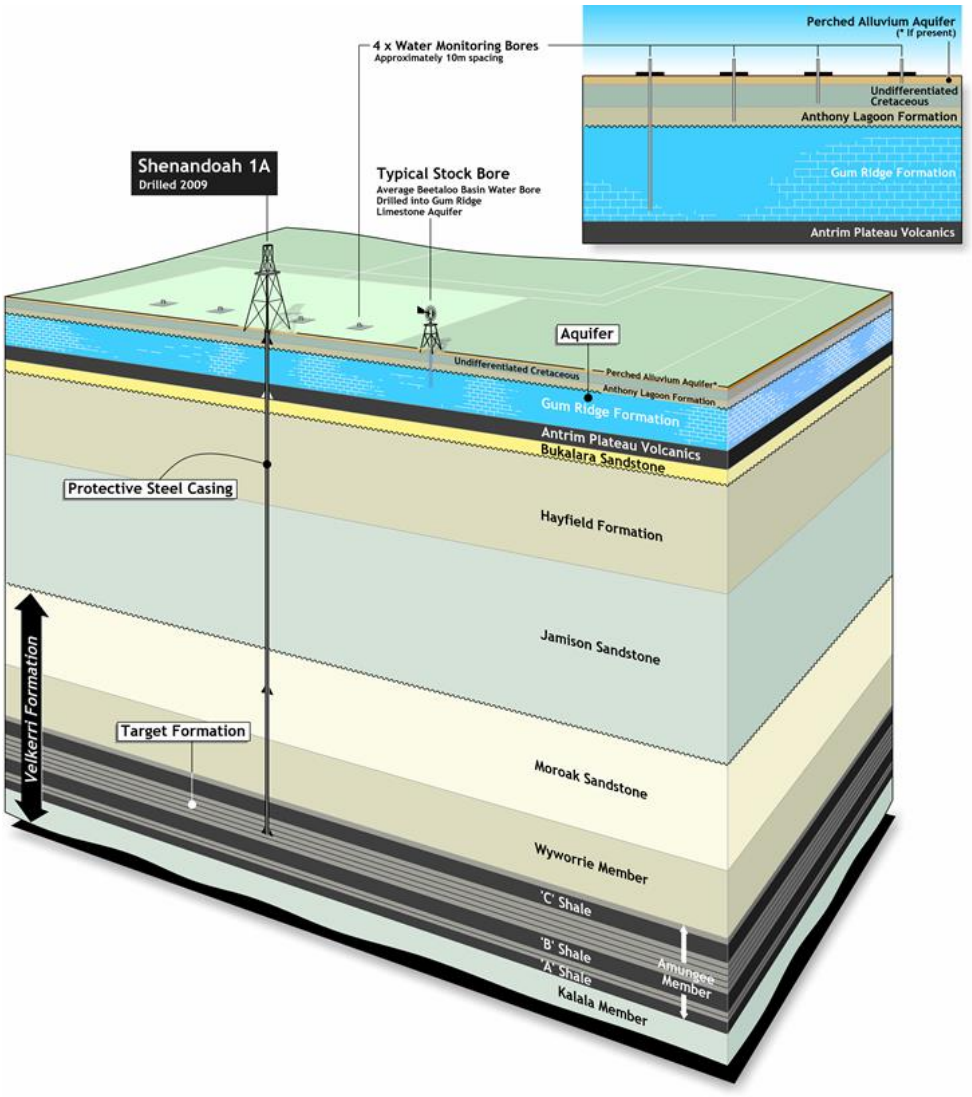

Figure 2 Geological schematic for the proposed multi-level groundwater monitoring bores

2.2 Civil Activities

The civil activities subject to this EMP are:

- Establishment of a 50mx50m groundwater monitoring lease area containing up to four clustered monitoring bores at each location.
- Clearing and construction of up to 500m of new access roads approximately 14 m wide.
- Minor repair and maintenance of 28 km of existing tracks, fencelines and firebreaks to access the groundwater monitoring bore lease sites.
- Establishment of up to three 50mx50m gravel pits to provide material the access tracks (if required).
- Water Bore drilling, completing and equipping of up to four groundwater water monitoring bores per lease area.
- Installation of fencing, gates and grids (as required and in accordance with access agreements with the land holders).

Land clearance will be minimised to avoid disturbance of soils, vegetation and wildlife habitats and avoid interference or blockage of natural drainage patterns. Erosion control measures such as check banks will be used to minimise the effect of overland flow. The material for erosion control measures would be sourced locally from the proposed gravel pits identified. Long-term visual impact will be minimised by avoiding steep cuts and fills which may cause erosion and slump problems.

The proposed monitoring bore lease pad and associated access road (requiring clearing and construction) are located outside the major flow paths of the small intermediate streams and creeks.

The groundwater monitoring bore lease pads will be constructed to accommodate the cluster of groundwater monitoring bores. These lease pads will be 50mx50m and located to avoid major civil work requirements. These sites will require vegetation clearing to provide space for the water bore drilling rig and associated equipment.

The access track will be designed to minimise their environmental footprint. The existing access tracks connecting the proposed lease site to the Stuart highway is in good condition and will require minimal (if any) maintenance. A new 500m access track connecting the existing access tracks to the proposed lease sites will be required.

The track will be typically less than 14 m wide; with provisions for a six (6) metre formed surface and eight (8) metre shoulder as per the NTG Standard Drawings (CS3003) for Typical Cross Section for Rural Environment – Pastoral Access Road 2 (refer Appendix A). Where vegetation clearing is required, mature trees and trees with hollows will be avoided where possible.

Where gravel is required to allow safe access, existing gravel borrow pits will be used where possible or, alternatively, new borrow pits may need to be created. This is included in the scope of discussions with landholders and NLC.

The total area proposed to be cleared for the water bore program is approximately 1.7 ha for the lease pads and new access tracks.

2.3 Groundwater Monitoring Bore Drilling Activities

An indicative schematic of the water bore rig layout and final lease configuration is provided in Figure 3 and Figure 4.

All bores will be drilled and constructed by a licensed water bore driller and in accordance with the current version of the *Minimum Construction Requirements for Water bores in Australia*.

Location of the lease areas has considered the minimum offset distance of at least 1 km between site activities and pastoral water supply bores. Each aquifer intersected will be isolated from overlying aquifers with a cemented casing string. Drilling will be undertaken with air or mud rotary techniques. If mud rotary techniques are employed, the circulation fluid will be water based and will utilise standard water bore drilling polymer or bentonite-based density and viscosity modifying additives.

A qualified hydrogeologist will supervise drilling activities and will determine the appropriate screening depth of each the monitoring bores.

A survey of each monitoring bore would be established at each well pad monitoring bore in Australian Height Datum (AHD), accurate to ±10 cm, to accurately determine depth to water table during each sampling event.

Within 28 days of bore completion, it is the driller's responsibility to provide a statement of bore (Form 21), with registered number, to the Water Resource branch of the Department of Environment and Natural Resources (DENR).

All cuttings and drilling mud will be disposed of on site in accordance with the *Minimum Construction Requirements for Waters bores in Australia* for water bore drilling practices.

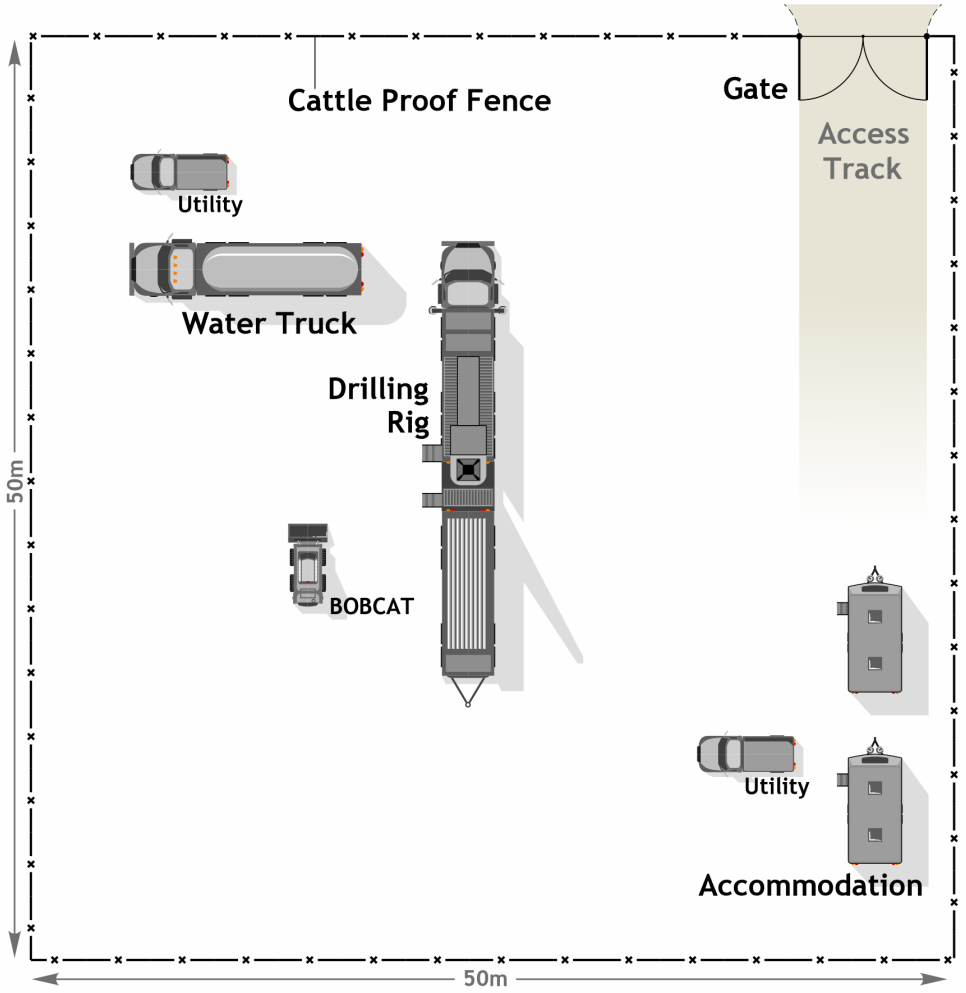

Figure 3 Proposed Water Bore Lease Area Layout (figures not to scale)

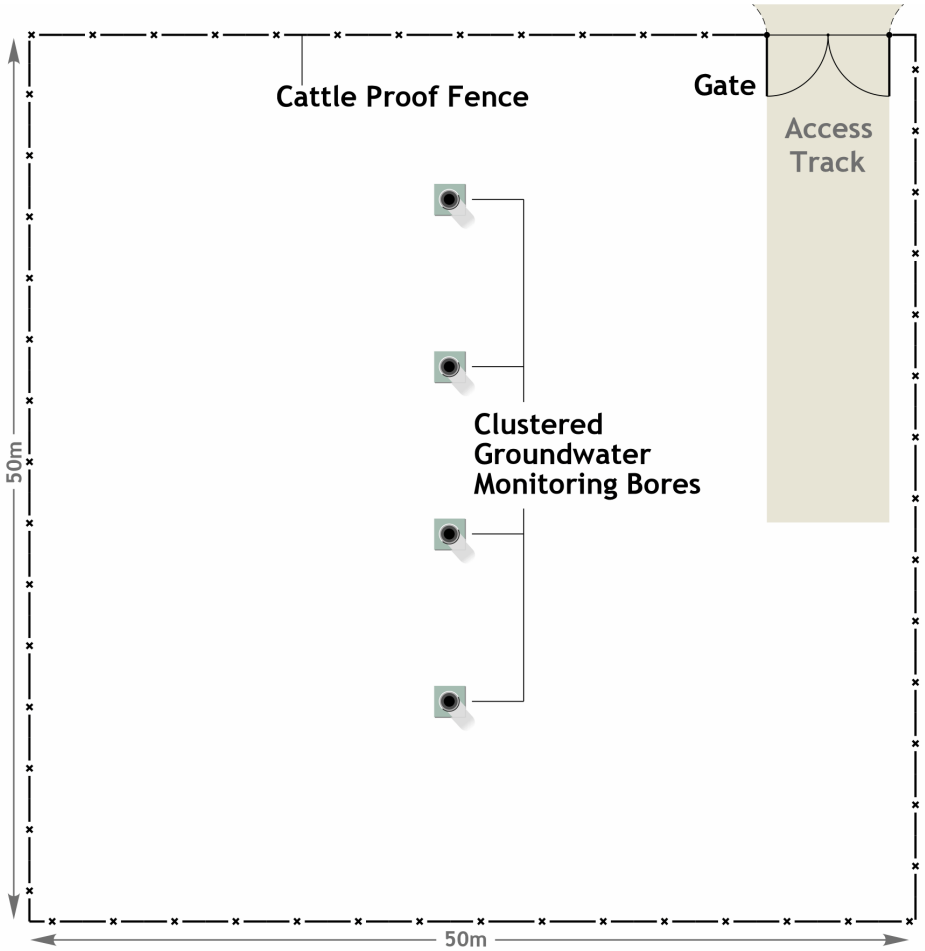

Figure 4 Indicative multi-level monitoring bore lease layout post drilling

2.4 Groundwater Monitoring Bore Sampling Activities

Following the installation of the groundwater monitoring bore sampling will be undertaken in consideration of standard industry practice including:

- the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000* (ANZECC Guidelines).
- AS/NZ5667.1: 1998. *Water Quality Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*
- AS/NZ5667.11: 1998. *Water Quality Sampling Part 11: Guidance on Sampling of Groundwaters*.

Prior to the collection of water quality samples the following methods would be implemented:

1. The standing water level (SWL) will be measured and the bore volume calculated as described in the relevant standards.
2. Three bore volumes of water shall be removed from the bore to ensure a representative sample.
3. Measurements of groundwater pH, reduction potential (redox), temperature and electrical conductivity (EC) will be conducted during purging using a calibrated multi-parameter probe to assess whether physiochemical conditions have stabilised prior to sample collection.

The water samples will be collected in appropriate laboratory supplied sampling containers and placed in chilled eskies and transported under standard chain of custody (COC) procedures to a laboratory National Association of Testing Authorities (NATA) accredited for the analysis requested to ensure sample integrity is maintained.

Each sample collected would have a unique identification number that would be cross referenced to the monitoring location and time of sampling.

Groundwater samples will be dispatched to the laboratory for analysis of the parameters provided in Table 4. These parameters have been selected based on the draft Preliminary Guideline: Groundwater Monitoring Bores for Petroleum Wells in the Beetaloo Basin.

Groundwater monitoring will be undertaken at a frequency dictated within the NTG "Guideline: Groundwater Monitoring Bores for Petroleum Wells in the Beetaloo Basin" as revised from time to time. Monitoring may be undertaken at a frequency of up to monthly; contingent on weather and access.

Table 4 Groundwater Parameters for Laboratory Analysis

Parameter	Analyte
General Parameters	Electrical Conductivity, pH, Total Dissolved Solids, Total Suspended Solids, Alkalinity
Dissolved metals (filtered)	Arsenic, barium, boron, cadmium, chromium, copper, lead, lithium, iron, manganese, mercury, silver, selenium, silica, strontium, and zinc.
Major Ions	Sodium, calcium, magnesium, potassium, sulphate and alkalinity
Anions	Chloride, fluoride, sulphate, nitrate and nitrite
Petroleum	Total Petroleum Hydrocarbons, Benzene, toluene, ethylbene, xylene (BTEX), TRH*, polyaromatic hydrocarbons (PAHs), dissolved methane, ethane and propane.
Radioactive	Gross Alpha, Gross Beta

During the initial implementation of the sampling program, a review of the suite of analytes will be required once a stable baseline has been established for the monitoring bores.

The procedures to be implemented for the monitoring program would be undertaken to ensure that there is no cross-contamination between monitoring bores during gauging and sampling. A documented Quality Assurance/ Quality Control (QA/QC) plan will be prepared and implemented in accordance with the relevant standards.

Recommendation 7.11 of the Inquiry requires that during fracture stimulation operations, electrical conductivity (E.C.) in the monitoring bores should be measured in real-time as an indicator providing 'early warning' of contamination, with the results telemetered from the site to the regulator and made available to the public. Discussions are underway with the relevant departments to resolve how best to implement these recommendations. Results of all monitoring would be made available to DENR and DPIR on a minimum quarterly frequency as part of the projects reporting commitments.

2.5 Camps

All civil contractors performing work will be housed in local hotel accommodation avoiding the need for camps.

Temporary caravans/mobile dongas will be used to house water bore drillers on each lease for the duration of water bore drilling activities. This infrastructure is temporary and will be powered by diesel generators.

Wastewater, sewage and sullage generated by the domestic camp activities will be managed in accordance with the Department of Health (DoH) "Health requirements for mining and construction camps".

It is anticipated that all sewage will be removed from site. If a sewage treatment system is to be used, approval will be sought from DoH and onsite irrigation will be undertaken in accordance with the Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent.

2.6 Waste Management

Waste management methods for the proposed water bore installation and access track development are summarised in Table 5. For the size of the proposed program, all waste produced will be backloaded with the crew for appropriate disposal and or recycling. Waste transfer certificated will be retained and provided to DPIR upon completion of the project.

Table 5 Waste and disposal methods

Domestic Waste	**Disposal Method**
Sewage and grey water	Treated in portable treatment systems prior to discharge to an evaporation sump approximately 50 m beyond the camp or removed from site. Grey water disposed of on-site in accordance with Department of Health requirements Sludge removed from site and disposed of at an appropriately licenced facility
Food waste, paper and plastic	Collected in dedicated waste bins for back-loading to an approved landfill
Glass and cans	Collected in separate waste bins for recycling
Industrial Waste	**Disposal Method**
Chemical bags and cardboard packaging materials	Compacted and collected at rig site for disposal to approved landfill
Scrap metals	Collected in designated skip for recycling or to approved landfill
Used chemical and fuel drums	Collected in designated skip for recycling
Chemical wastes	Collected in approved containers for disposal at approved landfill or returned to supplier
Timber pallets (skids)	Recycled or to approved landfill
Vehicle tyres	Shredded and disposed to approved landfill
Drilling Activity Waste	**Management / Disposal Method**
Oily rags, filters	Collected in suitable containers for disposal at approved landfill
Drilling cuttings (cuttings mixed with drilling fluids)	All cuttings and drilling mud will be disposed of on site in accordance with the *Minimum Construction Requirements for Waters bores in Australia* for water bore drilling practices.
Associated water (groundwater mixed with drilling fluids)	All cuttings and drilling mud will be disposed of on site in accordance with the *Minimum Construction Requirements for Waters bores in Australia* for water bore drilling practices.

2.7 Water Supply and Use

It is estimated that approximately 0.5ML of water will be required for lease pad construction and drilling related activities. Water will be sourced from existing pastoral bores in the vicinity of the construction activity, under an approved water take agreement with the relevant pastoralist.

As per the preliminary DENR Groundwater monitoring Guidelines, the proposed monitoring bores will be converted to a water supply bore for future drilling and stimulation activities. Approval prior to the commencement of Drilling and stimulation from the DENR Water Resources Department will be obtained.

Potable water will be sourced from Darwin and transported to the site.

Surface water will not be used for any activities proposed in this EMP.

2.8 Weed Management

To ensure the risk associated with the introduction and spread of declared weeds is mitigated, Origin will comply with the regulatory and leaseholder biosecurity requirements for all activities associated with this project. This will ensure all potential risks to the Northern Territory (NT) economy, community, industry and environment from the introduction of weeds are mitigated.

The controls Origin will implement to prevent the introduction and spread of weeds are summarised in the attached Weed Management Plan (Appendix B). These include:

- Activities will adhere to the guidelines within the NT Weed Management Handbook (2018).
- Weed desktop and field-based surveys to be undertaken to identify existing weed areas.
- Weed management and control measures to be implemented in alignment with existing leaseholder biosecurity procedures.
- All equipment will have certified equipment wash-down completed prior to entry to the exploration permit.
- New activities will be planned to address prevention of weed or non-indigenous plant spread.
- Machinery to be preferentially sourced locally, with machinery sourced from surrounding areas or Queensland being the 2nd and 3rd preferred option respectively.
- Pre and post wet (February to May) inspections and periodic audits will be conducted to identify and report weed outbreaks.
- Weeds will be actively controlled in cleared/ hardstand areas.
- Major equipment moves will be planned from weed-free areas to infested areas and not the other way around.
- Staff members responsible for preventing, identifying and managing weeds to be appropriately trained.
- Contractors have procedures covering weed prevention and management.
- Ensuring all material imported to or between sites is free of weeds.

Further information on Weed risk management is outlined in Section 6.4.4 and in the Weed Management Plan provided in **Appendix B**.

2.9 Proposed contractors and equipment list

Preliminary estimates of the civil construction and water bore drilling crew and equipment are described in Table 6 below.

Table 6 Water bore drilling crew and equipment (estimate)

Task	Proposed Contractor	Crew List	Equipment and Machinery
Civil Construction	Arnhem Earthmoving and Mechanical Pty Ltd (AEM) ABN 49 134 418 670 10 Spencely Road Humpty Doo NT 0836	1 x Origin Supervisors (HSE + Construction) 1 x Project Manager/Project Engineer (Contractor) 6 x plant operators 2 x truck drivers 2 x water bore contractors 2 x fencing contractors 1 x Surveyor	- Excavator x 1 - Dozer x 1 - Grader x 2 - Water Cart x 2 - Haulage trucks (Water and/or gravel) - Bob cat (Fencing contractor) - 3 x Light 4wd vehicles
Water Bore Drilling	ALLWELL (NT) Pty Ltd ABN 69 605 851 358 PO Box 1821 Howard Springs NT 0835	1 x Origin Supervisors 1 x Rig Supervisors 2 x Drillers 1 x Assistant Drillers 1x water truck operator	- Truck mounted drill rig (Water bore) - Caravans/ dongas for accommodation x2 - Water Cart x1 - Cement truck x2
Groundwater monitoring	Origin Energy or other contractors	2x Samplers	- 1x light vehicle - 1x groundwater pump - 1x dip meter - 1x calibrated water quality meter (EC, pH, DO, REDOX)

Task	Proposed Contractor	Crew List	Equipment and Machinery
			- Sampling equipment (Sample bottles, esky, field filters, decon etc.)

2.10 Timeframes

The key activity dates for the water bore drilling program are detailed as follows:

Activity	Estimate Start Date
Civil Works	November/ December 2018
Groundwater Monitoring Bore Installation	November/December 2018

Subject to obtaining necessary approvals and consents, Origin is anticipating commencing the civil work and drilling activities in November 2018. Some or all of this work may be transferred to 2019 if required.

On-ground conditions, initial drilling results, wet weather, equipment and operator availability and delays in obtaining required approvals and consents may delay the commencement date and / or extend the duration of the planned works.

3. Environmental Legislation and other Requirements

3.1 Regulatory Framework

In the NT, the granting of exploration permits and approval to commence petroleum exploration activities rests with the Department of Primary Industry and Resources (DPIR), through its administration of the *Petroleum Act 2016* on behalf of the NT Minister for Primary Industry and Resources.

Alongside the DPIR approval process, the Northern Territory Environment Protection Authority (NT EPA) administers the *Environmental Assessment Act 2013*; which allows for all proposals to be assessed as to the level of significance of potential impacts.

The application to drill water monitoring bores and the required civil works on access tracks and leases will be submitted to DPIR, and they may engage the relevant authorities for advice, including the NT EPA.

It is not expected the proposed works will require referral to the NT EPA or the Commonwealth Department of the Environment (DOTEE), under the provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), as amended 2013 due to the low impact activities proposed by the water bore drilling program.

A range of Territory and Commonwealth legislation, agreements, operating consents, guideline's and codes of practice are relevant to the activities described in this EMP. These are summarised in Table 7 , Table 8 and Table 9.

Table 9

Table 7 Key Legislation

NT Legislation	Administered By:
Petroleum Act 2016, Petroleum (Environment) Regulations 2016 and Schedule of Onshore Petroleum Exploration & Production Requirements 2016 - Provides legal framework within which persons are encouraged to undertake effective exploration for petroleum and to develop petroleum production so that the optimum value of the resource is returned to the Territory. - Regulates the exploration for, and production of petroleum, including environmental protection measures which should be employed during exploration and production activities, including protection of parks and reserves and rehabilitation. - Most current petroleum permits and licences are governed by the *Petroleum Act* (Act). - Subject to section 82 of the Act, where a person is given the right to occupy land as a permittee or licensee, he shall have, for himself, his employees, agents and contractors, a right to construct a road or carry out other work to ensure access to the exploration permit or licence area by the shortest practicable route to a road, within the meaning of the *Control of Roads Act*, a railway line, the sea or a waterway. - In addition, the Act is supported by the *Petroleum (Environment) Regulations* 2016 and the *Schedule of Onshore Petroleum Exploration and Production Requirements 2016* (Requirements). - The *Petroleum (Environment) Regulations* 2016 provides requirements that regulated activities are carried out in a manner consistent with the principles of ecologically sustainable development, and by which the environmental impacts and environmental risks of the activities are identified and reduced to an acceptable level. - The Act, Regulations and Requirements are administered by the Northern Territory Petroleum Registry (Registry) which forms part of the DPIR. The Minister for Primary Industry and Resources (Minister) is the applicable Minister for the purposes of the Act.	Department of Primary Industry and Resources
Petroleum (Prospecting & Mining) Regulations 2001 - These Regulations are made for the purposes of the *Petroleum (Prospecting and Mining) Act* that in accordance with section 119 of the Petroleum Act continues in force in respect of leases granted under Petroleum (Prospecting and Mining) Act (referred to as the repealed Act in section 119). - Relates to the rent increase to cover GST component from period after 30 June 2000.	Department of Primary Industry and Resources
Aboriginal Land Act 2013 - Provides for access to Aboriginal land, certain roads bordered by Aboriginal land and the seas adjacent to Aboriginal land. - Provides that a person shall not enter onto or remain on Aboriginal land or use a road unless he has been issued with a permit to do so in accordance with *Part II Entry onto Aboriginal land* of the Act. - Land Council for the area in which Aboriginal land or a road is situated may issue a permit to a person to enter onto and remain on that Aboriginal land or use that road subject to such conditions as the Land Council thinks fit.	Land Council established by or under the Aboriginal Land Rights (Northern Territory) Act 1976 of the Commonwealth.
***Biological Control Act* 2016** - Provides for the biological control of pests in the NT and related purposes.	Department of Primary Industry and Fisheries
Bushfires Management Act 2016 and associated Regulations - Provides for the protection of life, property and the environment through the mitigation, management and suppression of bushfires, and for related purposes.	Bushfires NT, Department of

- The Regulations outline infringement notices and prescribed amounts for certain acts relating to lighting fires.	Environment and Natural Resources
Control of Roads Act 2018 - Provides for the administration and control of roads, including the maintenance of roads, construction and opening and closing of roads. - The use of Road Bores will require a permit to work within a road reserve from the Department of Transport.	Department of Infrastructure, Planning and Logistics
Dangerous Goods Act 2012 and Regulations - Provides for the safe storage, handling and transport of certain dangerous goods.	NT Worksafe, Department of the Attorney-General and Justice
Environmental Assessment Act 2013 **and associated Regulations** - Provides for the assessment of the environmental effects of development proposals and for the protection of the environment. - Ensures to the greatest extent practicable that each matter which could reasonably have a significant effect on the environment is fully examined and considered. - Defines environment as being "all aspects of the surroundings of man including the physical, biological, economic, cultural and social aspects".	Northern Territory Environmental Protection Authority, Department of Environment and Natural Resources
Environmental Offences and Penalties Act 2011 - Establishes penalties for certain offences under prescribed Acts (such as an environmental offence) and for related purposes.	Department of Environment and Natural Resources
Fire and Emergency Act 2016 - Provides primarily for the establishment of the NT Fire and Rescue Service, the operational and emergency response activities of the Service, the protection of life, property and the environment against fires and other emergencies and for related purposes.	Northern Territory Fire and Rescue Service
Heritage Act 2016 **and associated Regulations** - Protects the Territory's cultural and natural heritage. - Establishes the Heritage Council (consisting of eleven members). - Establishes the NT Heritage Register. - Sets the process by which places become heritage places. - Allows for interim protection of places. - Sets out the process for getting permission to do work to heritage places. - Allows for fines and imprisonment for offences against the Act. - Declares classes of places and objects of heritage significance to be protected. - Provides for heritage agreements to encourage the conservation, use and management of heritage places and objects. - Regulates work on heritage places and objects. - Establishes enforcement and offence provisions.	Heritage Branch, Department of Tourism and Culture
National Environment Protection Council (Northern Territory) Act - Provides for the establishment of a National Environment Protection Council, and for related purposes. - The object of this Act is to ensure that, by means of the establishment and operation of the National Environment Protection Council: (a) people enjoy the benefit of equivalent protection from air, water or soil pollution and from noise, wherever they live in Australia; and (b) decisions of the business community are not distorted, and markets are not fragmented, by variations between participating jurisdictions in relation to the adoption or implementation of major environment protection measures.	The NT EPA assists Department of Environment and Natural Resources with it responsibilities under this Legislation.
Northern Territory Aboriginal Sacred Sites Act 2013 **and associated Regulations** - Provides a practical balance between the recognized need to preserve and enhance Aboriginal cultural tradition in relation to certain land in the Territory, and the aspirations of the Aboriginal and all other peoples of the Territory for economic, cultural and social advancement. - Establishes a procedure for the protection and registration of sacred sites, through:	Aboriginal Areas Protection Authority (AAPA); Minister for Environment and Natural Resources

• providing entry onto sacred sites and the conditions to which such entry is subject • procedures for avoidance of sacred sites when developing and using land • establishing an Authority for the purposes of the Act • procedures for the review of decisions of the Authority by the Minister, and for related purposes.	
Pastoral Land Act 2016 and associated Regulations - Provides for the conversion and granting of title to pastoral land and the administration, management and conservation of pastoral land, and for related purposes.	Department for Environment and Natural Resources
Plant Health Act 2015 - Provides for the control of pests, certification of plant health and related purposes.	Department of Primary Industry and Resources
Public and Environmental Health Act 2016 and Associated Regulations - To monitor, assess and control environmental conditions, factors and agents, facilities and equipment and activities, services and products that impact on or may impact on public and environmental health. - Outlines requirements for camps, specifically waste and wastewater (sewage and greywater)management	Department of Health
Public Health (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention) Regulations 1988 - Relates to public health and is directed at preventing pollution of water courses and water supplies in the northern territory. Wastewater treatment systems may be subject to requirements under the Public Health Act and regulations. Sewerage plants need to meet the NN code of Practice from Small On Site Sewage and Sullage Treatment Systems and the disposal and reuse of sewage effluent.	Department of Health
Soil Conservation and Land Utilisation Act 2016 - Provides for the prevention of soil erosion and for the conservation and reclamation of soil.	Soil Branch, Department of Environment and Natural Resources
Territory Parks and Wildlife Conservation Act 2014 (TPWC Act) and associated Regulations - provides for the protection, conservation and sustainable utilisation of wildlife. - Provides protection of CEEVNT listed species.	Flora and Fauna Division of the Department of Environment and Natural Resources
Waste Management and Pollution Control Act 2016 and associated Regulations - Provides for the protection of the environment through encouragement of effective waste management and pollution prevention and control practices and for related purposes. - To protect, and where practicable to restore and enhance the quality of the NT environment - To encourage ecologically sustainable development - To facilitate the implementation of National Environment Protection Measures established by the National Environment Protection Council (Northern Territory) Act. - Section 12 of the Act places obligation on a person to ensure they take all practicable measures to prevent or minimise pollution when undertaking an activity that could cause pollution and environmental harm.	Northern Territory Environmental Protection Authority, Department of Environment and Natural Resources
Water Act 2016 - Provides for the investigation, allocation, use, control, protection, management and administration of water resources, including extraction of groundwater, waste water management and water pollution. - Provides for water allocation plans, beneficial uses within Water Control Districts, drilling licences, bore construction permits, water extraction licences, waste discharge licences, fees and charges, and penalties for offences against the Act.	Water Resources Division, Department of Environment and Natural Resources
Weeds Management Act 2013 - Protects the Territory's economy, community, industry and environment from the adverse impact of weeds.	Weed Management Branch, Department

- Identifies declared weeds (those which must be controlled) and provides a framework for weed management.	of Environment and Natural Resources
Work Health and Safety (National Uniform Legislation) Act 2014 - Provides for a balanced and nationally consistent framework to secure the health and safety of workers and workplaces.	NT WorkSafe
Commonwealth Legislation	**Administered By:**
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 - Provides for the preservation and protection of places, areas and objects from injury or desecration of particular significance to Aboriginal people in accordance with Aboriginal tradition.	Department of the Environment and Energy
Aboriginal Land Rights (Northern Territory) Act 1976 - Provides for the granting of Traditional Aboriginal Land in the Northern Territory for the benefit of Aboriginals, and for other purposes.	Department of Prime Minister and Cabinet
Australian Heritage Council Act 2003 - Establishes the Australian Heritage Council which is the principal adviser to the Australian Government on heritage matters. - The Council's major role is to assess the heritage values of places nominated for the National Heritage List and the Commonwealth Heritage List, and to advise the Minister on promotion, research, education, policies, grants, conservation and other matters. - The Council also makes assessments under the EPBC *Act*, and performs any other functions conferred on the Council by the *EPBC Act.*	Department of the Environment and Energy
Environment Protection and Biodiversity Conservation Act 1999 - Provides for the protection of the environment and conservation of biodiversity, particularly species and places of national significance. - Invoked only if a development is likely to have environmental impacts of national significance.	Department of the Environment and Energy
National Environment Protection Council Act 1994 - The object of this Act is to ensure that, by means of the establishment and operation of the National Environment Protection Council: a) people enjoy the benefit of equivalent protection from air, water or soil pollution and from noise, wherever they live in Australia; and b) decisions of the business community are not distorted, and markets are not fragmented, by variations between participating jurisdictions in relation to the adoption or implementation of major environment protection measures. - Provides national standards for ambient air quality, movement of controlled wastes, and contaminated sites. - The Commonwealth, the States, the Australian Capital Territory, the Northern Territory and the Australian Local Government Association have entered into an Agreement known as the Intergovernmental Agreement on the Environment setting out certain responsibilities of each party in relation to the environment.	Department of the Environment and Energy
National Greenhouse and Energy Reporting Act 2007 - An Act to provide for the reporting and dissemination of information related to greenhouse gas emissions, greenhouse gas projects, energy consumption and energy productions of corporations.	Department of the Environment and Energy
Native Title Act 1993 - Provides for the recognition and protection of native title for Indigenous peoples. - Establishes ways in which future dealings affecting native title may proceed and to set standards for those dealings. - Establishes a mechanism for determining claims to native title. - Provides for the validation of past acts, and intermediate period acts, that have been invalidated because of the existence of native title.	Prime Minister and Cabinet

Table 8 Codes of Practice and Relevant Guidelines

Codes of Practice
Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent (NT Department of Health, 2014) - Provides guidance of the management of effluent. - It is noted that Territory Health Services will issue any amendments to the above Code on an annual basis.
Guidelines
AS 1940: The storage and handling of flammable and combustible liquids, 2004 - Provides guidance for the operation and handling of flammable and combustible liquids.
Best Practice Erosion and Sediment Control (International Erosion Control Association, 2008) - Facilitates the identification of those issues that should be considered when formulating and evaluating strategies for best practice erosion and sediment control. - Facilitates best practice stormwater management. - Facilitates active avoidance or minimisation of soil erosion resulting construction activities. - Facilitate best practice soil and sediment control management on sites.
Bores, drilling and dams - Provides information on water drilling licences, bore construction permits, licensed drillers and other information regarding drilling water bores in the NT. - https://nt.gov.au/environment/water
Guideline for the Preparation of an Environmental Management Plan (NT EPA, 2015) - Details the environmental protection measures to be included in Environmental Management Plans.
Northern Territory Natural Resource Management Plan 2016-2020 (Territory Natural Resource Management, 2016) - Describes the management direction for the NT's natural resources for the five year period and beyond. - Four regional plans provide an overview of the current land condition, use and threats, key areas to monitor and improve approaches, and the level of coordination that occurs across key organisations responsible for implementing actions.
ISO 19011: Guidelines for auditing management systems, 2018 - Provides guidance on environmental auditing to a certifiable standard.
Leading Practice Sustainable Development Program for the Mining Industry (Australian Government, 2016) - The LPSDP provides guidance to the mining industry through a series of handbooks including: - Airborne Contaminants, Noise and Vibration - Biodiversity Management - Community Engagement and Development - Hazardous Materials Management - Risk Management - Water Stewardship - Working with Indigenous Communities.
Minimum Construction Requirements for Water Bores in Australia (National Water Commission, 2012) - Developed by the National Uniform Drillers Licensing Committee, this document outlines the minimum requirements for constructing, maintaining, rehabilitating, and decommissioning water bores in Australia.
Northern Territory Land Clearing Guidelines (NRETAS, 2010) - Although clearing for roads or tracks is a significant cause of erosion on pastoral leases, there is no requirement to obtain formal approval from the Pastoral Land Board. Instead, clearing must be carried out in accordance with Land Clearing Guidelines.
Northern Territory Noise Management Framework Guideline (NT EPA, 2018) - Provides guidance to the community and industry about the noise regulatory framework as it applies in the NT.
Weed Management Planning Guide - Onshore Shale Gas Development Projects (DENR, 2018) - Provides guidance to the industry about the weed management planning required to undertake Onshore Shale Gas Developments in the NT.

Table 9 Relevant agreements and operating consents

Agreements	Administered By:
Native Title Petroleum Exploration Agreement (between NLC and Origin [Falcon Energy]) - Includes clauses for the protection of Sacred Sites, objects and sensitive areas related to Aboriginal activities in the area, including cultural, hunting and foraging activities. Site clearance will occur prior to any on ground activities. The Native Title Agreement also includes clauses for the protection of the environment and rehabilitation.	Northern Land Council
Exploration Permits - Details the environmental protection measures to be included in Exploration EPs. - Permit EP76, 98 and 117 applies to this scope of work.	Department of Primary Industry and Resources
Environmental Management Plan - This EMP, which details the environmental protection measures to be included in the water bore program across the propsoed locations.	Department of Primary Industry and Resources
AAPA Certificates The most current clearance certificates issued for the Origin exploration program include: - AAPA 2018\651 provides approval of Origin's 2018/19 Monitoring bore drilling program	Aboriginal Areas Protection Authority
Apply for permit to work within a road reserve - Road bores are usually used for road construction and maintenance work, however application to access water in the bores can be made to the Department of Transport for approval. - Approval to access the bore will be dependent if the bore has sufficient capacity to meet future needs for road construction and maintenance.	Department of Infrastructure, Planning and Logistics (DIPL)

3.2 Referral Assessment

Approval for the proposed action has considered the need for referral under the NT Environmental Assessment Act and the Commonwealth Environmental Protection and Biodiversity Conservation Act. Impacts associated with the proposed activity will be largely centred on vegetation clearing, bushfires, introduction of weeds and erosion and sediment control.

3.2.1 NT Environmental Assessment Act

In the NT, proposed actions that have the potential to have a significant effect on the environment require environmental impact assessment (EIA) under the Environmental Assessment Act. In such cases, a Notice of Intent (NOI) is required to be submitted to the NT Environmental Protection Agency outlining the relevant information to allow a decision on whether the proposed action requires a Public Environmental Report (PER) or an Environmental Impact Statement (EIS). Where the environmental impacts of the proposed activity are not significant, a PER or EIS will not be required.

An assessment of whether the proposed activity requires a NOI was undertaken in accordance with the NT *Referring a Proposal to the NT EPA* guideline. This is summarised in Table 10.

Three project specific factors were applicable to the proposed activity covered under this EMP. These included:

- Potential risks to terrestrial flora and fauna associated with vegetation clearing activities, bushfire and introduction of weeds;
- Potential risks to Terrestrial Environmental Quality associated with access track construction and erosion and sediment control; and
- Potential risk to inland waters associated with monitoring bore drilling and sediment releases

Due to the low impact nature associated with the proposed groundwater monitoring bore work program, no significant impacts on any of the NT Environmental factors and objectives are anticipated. Origin does not believe referral to the NT EPA is required.

3.2.2 Commonwealth Environmental Protection and Biodiversity Conservation Act

Under the Commonwealth Environmental Protection and Biodiversity Conservation Act (EPBC) an action that has, will have or is likely to have a significant impact on Matters of National Environmental Significance (MNES) must be referred to the Australian Government Minister for the Environment (the Minister) for assessment. A self-assessment in accordance with the EPBC Act was undertaken under this EMP. The environment and heritage assessment confirmed significant impacts to EPBC listed threatened species or threatened ecological communities were unlikely.

The proposed program will not require referral under the EPBC Act.

Table 10 Assessment against environmental factors and objectives

Environmental Factors	Project Specific Environmental Factors	Environmental Objectives at Risk	Receiving Environment	Potential Impacts	Mitigation Measures	Potential significant effect on an environmental factor?	Assumptions
Land	Terrestrial Flora and Fauna	Protect NT's flora and fauna so that biological diversity and ecological integrity are maintained.	Refer Section 4.2	Vegetation clearing resulting in: •Disturbance to environmentally sensitive areas and/or flora and fauna species • Loss or endangerment of Threatened species • Loss of habitat • Introduction or spread of weeds.	Section 6.4.3 and 6.4.4	No- Assessment summarised in section 6.4 indicates activity unlikely to result in significant impacts on threatened flora and fauna or areas essential habitat.	Assessment based upon field surveys. Threatened fauna may be present in the area which were not identified during the surveys
Land	Terrestrial Environmental Quality	Maintain the quality of land and soils so the environmental values are protected	Refer Section 4.2	Land disturbance through access track construction resulting in soil erosion and sediment releases	Section 6.4.1	No- Assessment summarised in 6.4.1 indicates activity unlikely to result in significant impacts from increased erosion and sediment releases	Assumes international accepted erosion and sediment controls are sufficient to manage risk of erosion within the NT
Water	Inland Water Environmental Quality	Maintain the quality of groundwater and surface water so that environment values including ecological health, land uses, and the welfare and amenity of people area protected.	Refer Section 4.1	Contamination of groundwater and surface waters resulting from water bore drilling and sediment releases	Section 6.4.2	No- Assessment summarised in section 6.4.2 indicates activity unlikely to result in significant impacts to surface and ground water	Assumes groundwater bore standard sufficient manage groundwater risk

3.3 Alignment with the Principles of Ecological Sustainable Development (ESD)

This EMP aims to align with the principles of ESD through the adoption of responsible practices that are designed to maximise social benefit, whilst minimising the level of impact on the surrounding ecosystems. Ecological Sustainable Development (ESD) is defined by the NT EPA as:

"Using, conserving and enhancing the communities' resources so that ecological processes, on which life depends, are maintained, and the total quality of life now and in the future is increased. ESD is development that aims to meet the needs of Australians today, while conserving our ecosystems for the benefit of future generations."

The proposed water bore drilling program aim is to obtain baseline groundwater quality and quantity data within the proposed future drilling and stimulation lease sites to meet Recommendation 7.11 of the *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory*. This is a key component of demonstrating all future petroleum exploration and development activities will not adversely impact on current and future groundwater users.

4. Environment Description

4.1 Physical Environment

4.1.1 Climate

The climate of the permit areas is 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 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.

4.1.2 Geology

The geology within and surrounding the permit areas (Plate 1) was primarily formed over three main periods – the Precambrian (> 550 million years ago), the Cambrian (500 million years ago) and the Cretaceous (100 million years ago) (refer Plate 1).

Pre-Cambrian rock formations, known as the Roper Group, are located at depth across the permit areas, beneath the younger formations, and are exposed only in the bedrock hills located to the north east of EP98 (Tickell, 2003).

Cambrian formations are expressed only in the south west region of the study area. They predominantly fall outside of the identified permit areas, and comprise of limestone, siltstone and sandstone. The rock formation is near flat, rarely cut by faults and forms distinct layers. The Cambrian sediments contain the sub-artesian water storage, pedocalcic soils, Cambrian dolomite, limestone, and tertiary alluvium (Tickell, 2003).

The majority of the permit area is located within the McArthur Basin, which was formed during the Mesoproterozoic period, over 1,000 million years ago. Soft clays and sandstone are the primary rock formation in the basin and overly the older Pre-Cambrian and Cambrian rocks. Small and patchy occurrences of freshwater limestone accumulations, formed during the Miocene Period (15 million years ago) when erosion and the gradual sinking of some areas produce isolated fresh-water lakes.

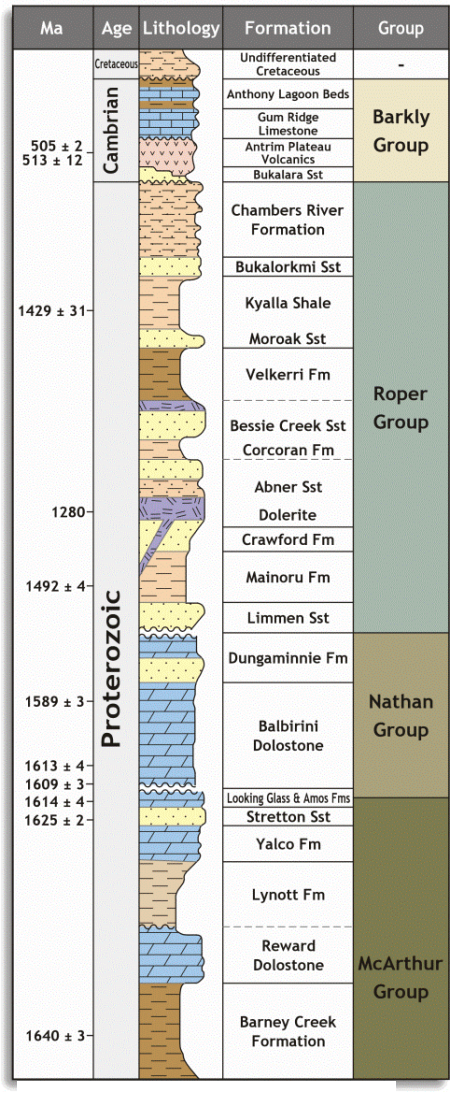

Plate 1 Beetaloo Sub-Basin Stratigraphic Column

Following the deposition of Cretaceous sediments, a period of geomorphic activity occurred during the Tertiary period. This resulted in the area, being gently folded and warped, which exposed it to a long period of erosional forces (Christian et al., 1951). These forces resulted in the area being dominated by undulating plains that contain extensive swampland and lakes.

Following a period of lateritization during the end of the Tertiary period, rivers were at grade and erosion was reduced to a state that allowed deep stable soil profiles to be established and be preserved (Christian et al., 1951), resulting in the 'black' soil clay plains and the lateritic and non-lateritic rises that are in the region today (Randal, 1967). With the onset of a more arid climate during the post–Miocene period, lakes and swamps dried up, resulting in high concentrations of lime and silica deposits that were leached from the lateritic soils into the ground and surface waters, which in turn formed a number of Tertiary limestone outcrops within the permit area. During the Quaternary period, which occurred less than 2 million years ago, the minor alluvial and lake deposits throughout the permit area were formed.

The target formations for the water bore drilling program are described below:

- Undifferentiated Cretaceous (if present) – The Cretaceous claystone located near the surface in the Beetaloo Basin can be extremely unstable and may be very wet under the surface, retaining water from the previous wet season. The formation poses a risk during the spudding of the well due to its propensity to slough into the hole and wash out.
- Anthony Lagoon Beds - The Anthony Lagoon Beds are made up of dolomitic siltstones and limestones. They pose no specific drilling risk.
- Gum Ridge Limestone - The Gum Ridge formation is described as a cavernous limestone. It is the regional aquifer for local domestic and commercial use and is therefore extremely important to isolate from any potential cross-flow contamination. Given its description as a cavernous limestone, it is highly likely that total losses would be taken during drilling.

4.1.3 Soils

The Sturt Plateau bioregion covers an area of 103,857 km and comprises undulating plains on sandstones, with mostly neutral sandy red and yellow earth soils (ANRA, 2008).

The soils within the Sturt Plateau have been derived from ancient rock formations and ancestral soils that were formed during earlier weathering cycles. The soils have been deeply weathered, leached and are relatively infertile because they have not been enriched by any recent geological events (Orr and Holmes, 1984). The distribution and diversity of soils in the plateau have been influenced by:

- the past wetter conditions of the region that formed relict Tertiary plains which comprise of highly leached and generally lateritic soils
- extensive areas of Post-Tertiary Alluvia on which a variety of mature soils formed
- the dissected hilly country which is dominated by skeletal soils or rocky outcrops
- the 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 soil types located within the plateau range from the very strongly leached lateritic soils of the Tertiary land surface to the calcareous deserts soils and desert loams in the southern drier areas.

The lateritic plains, located within EP98 and the northern part of EP117, are classed as very strongly leached soils of the Tertiary land surface. Three main soil types are located within this area, including:

- Tertiary Lateritic Red Earths, which occur on the gently undulating topography
- 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
- 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 and the Gulf Falls.

Other areas of 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.

Only a small section of the existing southern access tracks indicated the presence of Northern Heavy Grey Pedocals, also known as the black cracking clays, which are described as soils with poorer structure in the surface and fine manganiferous concretions throughout the profile. They occur in high rainfall areas or poorly drained areas.

The soil erosion susceptibility is generally 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.

Soil samples 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 the Land Condition Report in **Appendix C**.

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. 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.

4.1.4 Hydrology

The proposed 2018 lease sites all fall within the Wiso River Basin. The Wiso River Basin covers the southern half of EP98 (south of the Carpentaria Highway) and the majority of EP76 and EP117 and is internally drained by Newcastle Creek and a number of small ephemeral creeks. Newcastle Creek ultimately 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 (HLA, 2005). 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).

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 **Appendix C**). 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.

Only one intermediate stream crosses the Beetaloo Access track at one location and three intermediate and Newcastle Creek cross the proposed new access track to Velkerri 76 S2-1. 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. Gravel pits located nearby would be utilised to provide stability where creeks and streams are crossed.

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).

4.1.5 Hydrogeology

Origin commissioned CloudGMS to undertake a desktop hydrogeological study of the Beetaloo Basin (CloudGMS, 2015). The study objective was to compile an up to date summary of the hydrogeology of Beetaloo and adjacent groundwater basins, including geological setting, previous studies, aquifer characterisation, groundwater use and the regulatory framework. 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 11). The Roper Group is estimated to reach of 5,000 m in thickness in the centre of the basin and 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), a significant water supply aquifer. The Georgina Basin is capped by Cretaceous mudstone and sandstone (145 – 66 Ma) and recent alluvial and laterite deposits.

Table 11 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 mbgl.

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/yr 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.

4.2 Biological Environment

4.2.1 Bioregions

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 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.

4.2.2 Vegetation Communities

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. The August 2018 survey focused on the proposed lease areas for water bore drilling and the associated access tracks. The methodology used for the assessments is presented in Appendix C.

The existing vegetation at the proposed sites have been evaluated through detailed habitat assessments. Habitat assessments included identification of vegetation community, dominant flora species at each strata, habitat condition, disturbance factors (fire, weeds, erosion, feral fauna species), and fauna attributes (e.g. tree hollows, logs, grass cover, mistletoe abundance).

The main vegetation communities within the exploration permit areas are woodlands, typically dominated by Bloodwoods (*Corymbia spp*.) and tall shrublands and woodlands of Bullwaddy and Lancewood with open grassland understorey (Cofinas and Creighton, 2001; ANRA, 2008). Other less common vegetation communities within the area include Acacia shrubland over spinifex and Bullwaddy-dominated woodland.

Lancewood/Bullwaddy communities are important as they represent Gondwanan remnants of the once dominant rainforests of the Australian tertiary period and are limited in distribution (PWCNT, 2005). Lancewood forests are the most extensive acacia dominated communities across northern NT. The Lancewood/Bullwaddy communities typically have a dense shady shrub layer, a few vines and creepers and a sparse grass understorey, compared to the sparse canopy and tall grass understory of other tall dense grasslands (PWCNT, 2005).

Bullwaddy is a unique plant with a multi-stemmed habit, very small leaves crowded along the branches and a very dense and heavy wood. Whilst technically being a shrub it can grow up to six metres tall with massive individual stems (PWCNT, 2005).

The Lancewood/Bullwaddy vegetation associations are fire sensitive. Inappropriate fire regimes may result in a community succession from Bullwaddy through Lancewood to a Eucalypt dominated open woodland (PWCNT, 2005). This process may be accelerated by the invasion of exotic pasture grasses such as Buffel Grass (*Cenchrus ciliaris*).

Detailed condition description and photographs of each of the proposed water bore sites and access are provided in Appendix C.

4.2.3 Flora

A total of 805 plant species have been recorded within the wider region, during the August 2018 survey 28 dominant flora species were identified across the proposed lease areas. 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 or NRM Infonet search. 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.

4.2.4 Weeds

Weed baseline surveys were completed by AECOM in August 2018 covering all proposed access tracks and lease pad areas. This section provides a summary of weed related information pertinent to the project, with detailed information provided as a part of the Land Condition Assessment in **Appendix C**.

Weed prevention and control within the NT is regulated under the *Weeds Management Act*. The aim of the Act is 'to protect the Territory's economy, community, industry and environment from the adverse impact of weeds'. The act identifies several weed declaration classes, designed to eradicate, control or prevent the introduction of certain weed species in the NT. These declaration classes are:

- 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.

Regional Weed Management Plans (RWMP) have been developed for areas of the NT, with the Barkley and the Katherine RWMP overlapping Origin's Beetaloo exploration tenure. The aim of these regional plans is to assist in prioritising weed management by:

- identifying the region's priority weeds and associated pathways of spread to inform management priorities
- identifying landscapes that may need prioritised protection from weed impacts like river corridors or sacred Aboriginal sites
- containing information on alert weeds that are not yet found in the region, but could become major issues if they establish

The weeds species of high risk of introduction or spread through Origins activities are listed in Table 12. These high-risk weeds have been determined through consideration of the following criteria:

- Weed species that has been confirmed in the area within the relevant RWMP or through field surveys
- Weed species listed in a RWMP that is in close proximity to Origin tenure
- Weed species is at risk of introduction through the use of machinery sourced from other regions in the NT or from other states.

A survey undertaken in August 2018 and previously in 2014,15 and 16 did not detect any priority weeds in the area surrounding the proposed activity.

The low level of weed abundance suggests good habitat condition in the areas of the proposed sites. Primary controls for this program will therefore be focused on preventing the introduction of weeds and managing weeds promoted through site disturbance. The proposed weed control measures to prevent and manage weed infestations are outlined in Section 6.4.

Additional information on the full list of weeds and control measures for the development are provided in the Weed Management Plan in **Appendix B.**

Table 12 High priority weeds to be managed or prevented within the permit area

Scientific Name	Common Name	Status	Priority reason
Acacia nilotica	Prickly Acacia	Class A, WoNS	Mapped in the exploration lease within the Katherine RWMP
Andropogon gayanus	Gamba Grass	Class A WoNS	Mapped in the exploration lease within the Katherine RWMP
Calotropis procera	Rubber Bush	Class B and C	Mapped in the exploration lease within the Barkly RWMP
Hyptis suaveolens	Hyptis	Class B and C	Confirmed within exploration lease during previous weed Origin surveys
Jatropha gossypiifolia	Bellyache Bush	Class A, WoNS	Mapped in the exploration lease within the Katherine RWMP
Parkinsonia aculeata	Parkinsonia	Class B and C, WONS	Confirmed within exploration lease during previous weed Origin surveys and Mapped in the exploration lease within the Katherine RWMP
Prosopis pallida	Mesquite	Class A and C, WONS	Mapped in the area surrounding exploration lease within the Katherine and Barkly RWMP
Themeda quadrivalvis	Grader Grass	Class B and C, WoNs	Mapped in the area surrounding exploration lease within the Katherine RWMP. High potential introduction through sourcing of equipment from Katherine area.
Xanthium occidentale	Noogoora Burr	Class B and C	Weed Management Branch – Mapping data DLRM databases (DLRM *et al* 2018)
Parthenium hysterophorus	Parthenium	Class A and Class C, WoNS	Potential introduction through equipment sourced from QLD.

4.2.5 Fauna

Previous surveys and database searches indicate that the exploration area is 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 monitoring bore 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.

4.2.6 Significant 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 20 fauna species listed as threatened under the EPBC Act and/or the TPWC Act. 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 water bore 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 Appendix C.

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.

4.2.7 Feral and Pest 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.

4.3 Fire Regime

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.

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

- 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.

4.4 Environmental and Cultural Sensitivities

4.4.1 Native Title

Three Native Title claims have been determined as non-exclusive and one Indigenous Land Use Agreement (ILUA) are current over the permit areas (see Table 13).

Table 13 Native Title and IULA Agreements Current for the Permit Areas

Type	Well	Name	Summary
	Kyalla 117 N2-1	NTD21/2010 Shenandoah Pastoral Lease	Native Title exists in parts of the determination area and is held by the Kinbininggu and Bamarrngganja groups
Indigenous Land Use Agreement	All Sites	D12004/014 Jingaloo CLA ILUA	Registered for Community Living Area and Tenure resolution

The Native Title Petroleum Exploration Agreement between Origin and the NLC includes clauses for the protection of Sacred Sites, objects and sensitive areas related to Aboriginal activities in the area, including cultural, hunting and foraging activities. Site clearance will occur prior to any on ground activities. The Native Title Agreement also includes clauses for the protection of the environment and rehabilitation.

4.4.2 Archaeology Assessment

An archaeological assessment, involving searches of the NT Heritage Register and Australia Heritage Database and a field survey, has been carried out by AECOM archaeologist, Luke Kirkwood for the proposed water bore sites and associated tracks. The archaeological inspection involved a combination of both pedestrian and helicopter survey of the proposed lease areas and tracks. During the inspections notes were taken on landform, ground surface visibility and areas of exposure. The aim of the inspection was to identify any surface expressions of Aboriginal archaeological and cultural heritage values within the exploration area. Photographic records were taken at each proposed location.

A search of the Northern Territory Heritage Register identified 41 Aboriginal archaeological sites within a 125 km by 125 km area that encompasses the full Proposal area. No archaeological sites are recorded within proximity of the proposed lease area covered under this EMP.

A search of the Australia Heritage Database identified that no statutory listed heritage places within the proposed impact areas. Three sites listed on the now non-statutory Register of the National Estate are located within a 125 km x 125 km search area that encompasses the full permit area. None of these heritage places are located within 10 km of the proposed lease area.

No culturally sensitive landforms were identified during the August 2018 survey of the lease sites covered under this EMP.

The archaeological assessment is provided in Appendix D.

4.4.3 Areas of Cultural Significance

Sacred sites in the study area are primarily associated with drainage lines; natural landform features and stock routes, but there are also concentrations of sites nearby to old homesteads. The distribution of these sites may reflect historical patterns of Indigenous movements along drainage lines and subsequent development of stock routes on old Indigenous walking trails, or they may merely be indicative of the site clearance work undertaken along roads and tracks in the area. It is suspected that there will be a range of other sites also within the area, either not yet recorded, or known but not reported for cultural reasons.

Clearance survey by AAPA anthropologist and traditional owners have been completed. The AAPA clearance certificate AAPA 2018/651 is provided in Appendix E.

The APPA certificates did not identify any Restricted Work Areas (RWAs) or sacred sites within the proposed work area.

4.4.4 Natural Resources

In addition, previous cultural heritage surveys of the permit areas were undertaken with representatives of the traditional owners who identified a number of natural resources of importance to Aboriginal people of the area (Table 14).

Table 14 Natural Resources of Importance in the Permit Areas

Scientific Name	Common Name	Usage
Grewia retusifolia	Emu-berry/Dog's Balls, Turkey Bush and Diddle Diddle	Fruit eaten. Leaves can be boiled, and body bathed in the liquid for treatment of a number of ailments
Marsdenia australis	Bush Banana/Gillibi	Bush 'fruit' eaten when young, as it matures 'fruit' seeds becomes feathery for dispersal in the wind and are not eaten
Pterocaulon sp.		Used for treating flu
Acacia sp.	Acacia	Leaves boiled and used to treat the flu
Acacia holosericea	Soapbush Wattle or strap wattle	Leaves used for washing
	Termite (unknown species)	Mounds pulverised and mixed with water, used to treat diarrhoea

4.4.5 Non-Indigenous Heritage

In 1860 explorer John McDougall Stuart was the first European to penetrate the area now known as the Centre. The first written descriptions of the area come from Stuart during his second attempt to cross the continent from south to north (HLA, 2005).

Development in the area began as pastoral lands with an increased interest in land settlement following the completion of the Overland Telegraph Line in 1873. Most attempts were unsuccessful with the Lancewood - Bullwaddy vegetation found to be impenetrable and the lack of surface water making the land unsuitable for cattle. Daly Waters was thus recognised as one of the last watering stops on the Murranji Stock Route.

It wasn't until the 1930s to 1950s, that the area saw regional economic growth with Daly Waters becoming a significant hub of air and mail services into the territory. The wartime years saw this role increase with Daly Waters again playing a major role in cross country transport and communication. This role continued until the early 1970s when the airport was closed to commercial traffic. The town and surrounding areas subsequently reverted to a primarily agriculture-based existence following the decline of air travel, but has in recent times seen commercial interest from the exploration for gas in the Beetaloo Sub-basin and the growth of the 'grey nomad' tourism market.

4.4.6 Historic Heritage Assessment

A search of relevant historic heritage registers identified a number of historic heritage sites within a 125 km by 125 km area that encompasses the full Proposal area. No previously identified sites are located within 20 km of the proposed 2018 lease areas. No new sites of historic heritage were identified during the August 2018 survey.

4.4.7 Protected or Conservation Areas

There are no conservation areas within proximity to the proposed activities. 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 areas (EP76, EP98 and EP117).

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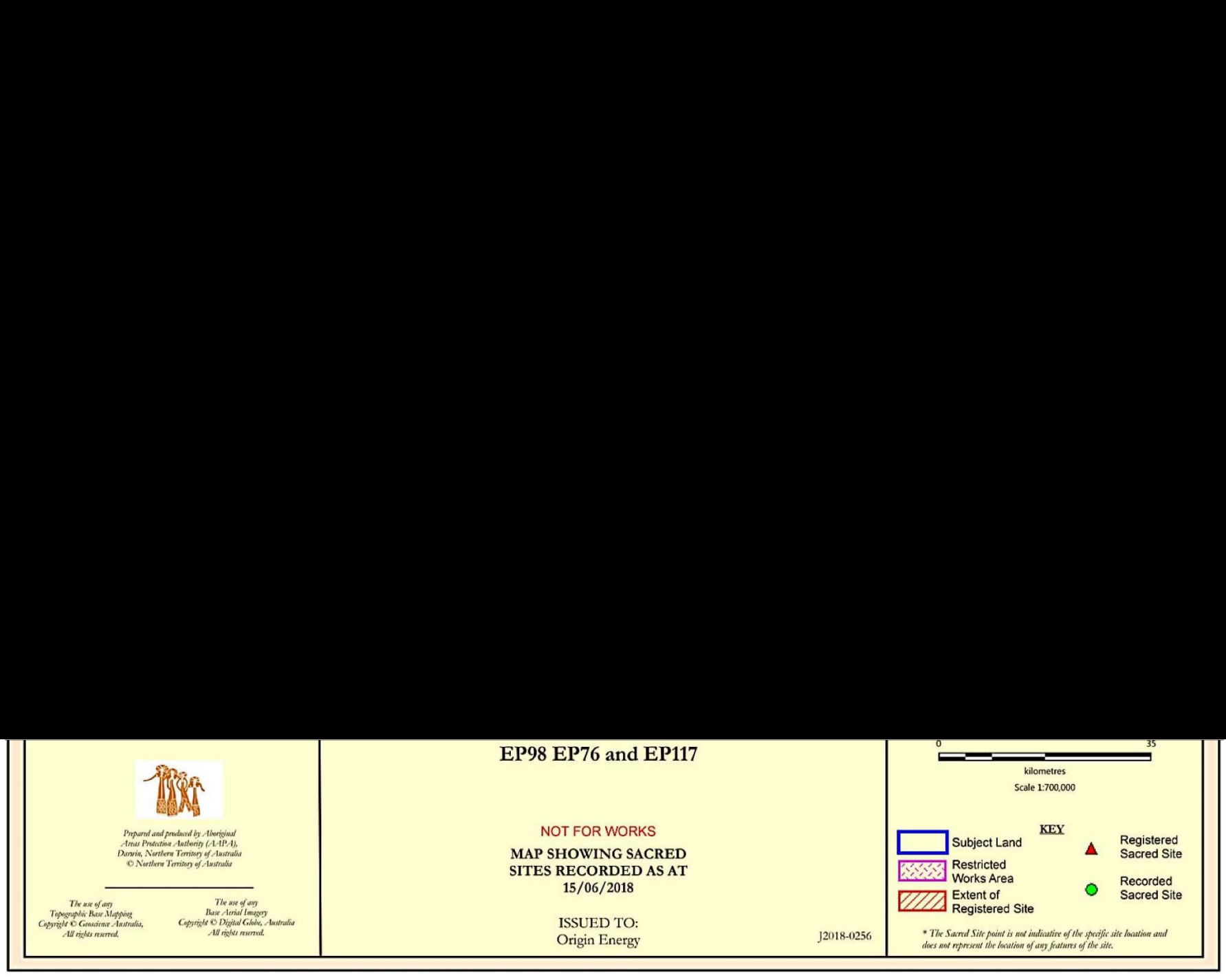

Figure 5 AAPA Abstract of Records or Registered and Recorded Sites (2018)

4.5 Social Environment

4.5.1 Social Context

The proposed water bore drilling program occurs within the Barkly Regional Council area, which covers 323,514 km^2. The approximate population is estimated for the Barkly Region of 8,137 people (Barkly Regional Council, 2018).

The potential social and economic impacts within the region where the exploration permits are located are varied. Considered at a regional level the impacts on the community from the proposed groundwater monitoring bore drilling program would be negligible. Origin's future activities within the permit area will likely contribute to broad socio-economic changes within the region which have potential for both positive and negative impacts.

The major communities which are in proximity to Origin's activities include Tennant Creek, Elliott, Daly Waters, Newcastle Waters, Mayfield, Dunmarra, various pastoral properties and Aboriginal outstations.

In 2014, the Tennant Creek Regional Economic Development Committee (REDC) released the *Tennant Creek and Barkly Region Strategic Action Plan (2014-2016)* which addressed social issues and economic development within the region, including oil and gas development.

4.5.2 Pastoral Activity

The current land use in the project area is pastoral with varying stocking rates and varying management practices. Within the permit area there are nine pastoral properties as shown in Table 15. All of the land within the permit area is Leasehold Land. There are no areas of Aboriginal Freehold land.

Table 15 Pastoral properties in the Permit Area

Pastoral Property	Permit Areas		
	EP76	EP98	EP117
Amungee Mungee	✓	✓	✓
Kalala		✓	✓
Tanumbirini	✓	✓	
Beetaloo	✓		✓
Hayfield/Shenandoah		✓	✓
Ucharonidge	✓		✓
Tandyidgee	✓	✓	
Nutwood Downs		✓	
Newcastle Waters			✓

The project area has been subject to pastoral activities for over 150 years (AECOM, 20). The average size of a Station in the Barkly Region is 8,186 km^2 (Bubb, 2004), which is large by global standards.

The proposed water bore drilling activities conducted on the proposed Kyalla 117 N2-1 lease are located on the Hayfield Shenandoah Station.

4.5.3 Other Land Uses in the Area

A range of other land-uses exists in the permit area or in the larger region, including a range of public utilities and facilities. These include the following:

- Tourism - Tourism is an important regional industry with the Sturt Highway being a major thoroughfare for tourists travelling in the area during the dry season. The local townships of Daily Waters, Dunmarra and Elliot provide consumables (food, fuel etc.) and accommodation. A number of heritage areas of importance to regional tourism are located in the broader region, including Elliott, Newcastle Waters and other heritage listed homesteads.

- Road networks – The Stuart Highway and Carpentaria Highway will be used to access the sites. In addition, there are numerous gravel roads connecting properties, and internal property tracks. All properties also have firebreaks on their boundaries and internally.
- Alice Springs to Darwin Railway - The railway line runs to the west of the gas pipeline and Stuart Highway, and does not cross into any of the permit areas.
- Townships - The township of Daly Waters and Dunmarra lie within EP98.
- Conservation areas – including the Bullwaddy Conservation Reserve, which lies within EP98 and Lake Woods and the Junction Stock Reserve just outside the permit area.
- Heritage – there are seven heritage sites within the exploration permit area. There are also number of heritage areas of importance to regional tourism are located in the broader region, including Elliott, Newcastle Waters and other heritage listed homesteads. These sites have been identified as part of the environmental assessment, and the proposed water bore drilling sites will not impact on these.
- Archaeological sites - the permit areas have a long history of Aboriginal association and 41 archaeological sites have previously been recorded within the permit areas, as well as 25 registered Sacred Sites.

5. Stakeholder / Community Consultation

Origin's local and directly impacted/affected stakeholders have been, and continue to be, consulted in a respectful, open and consistent manner. This has been the case since 2014, when Origin assumed operatorship of EP98, EP117 and EP76.

Origin's consistent approach to stakeholder engagement has been to ensure that those persons and/or groups most directly impacted/affected and/or influenced by permit commitments, have received Origin's full attention. Origin views the social acceptance and informed consent of these primary stakeholders of critical importance and relevance during this stage of low impact and small-scale exploration activities.

The collection of baseline groundwater monitoring data proposed under this EMP, extending the groundwater monitoring network Origin has had in place since 2014, is of importance and relevance to all parties; including community members, pastoralists, Traditional Owners and Origin. It provides interested stakeholders the ability to assess impacts given a data set will exist for before, during and after the Hydraulic Fracturing Stimulation (HFS) activity. For Origin, it is equally important to be able to demonstrate to the leaseholder, Traditional Owners and regulators that our extraction processes are robust and measurable and environmentally disciplined.

5.1 Community Engagement

Due to the nature of the activity, community engagement for the 2018 groundwater monitoring bore installation project has been with host Traditional Owners and host Pastoralists directly affected by the proposed activity. A summary of the engagement for the monitoring bore program is provided in Table 16. Detailed community and stakeholder engagement is underway covering future exploration activities which are beyond the scope of this EMP.

Detailed engagement has been undertaken with both the affected pastoralists and Traditional Owners via the NLC.

Traditional owner consent for the activities has been received from the NLC.

Land Access Agreements (LAA's) have been obtained for Hayfield/Shenandoah and are provided in Appendix H.

Origin recognises the growing community interest in ensuring onshore natural gas development takes place in a safe and environmentally sound way. Origin are committed to delivering operational excellence (which encapsulates our health, safety and environmental performance).

It should be noted that the water bore monitoring installation network is a recommendation of the NT Inquiry and as such the broader NT community is expecting the work program to be executed swiftly.

Table 16 Stakeholder engagement list and information summary

Stakeholder	Contact details	Method of communication	Date of Correspondence	Summary of information provided	Summary of stakeholder's response	Origin's assessment and response to stakeholder	Details of changes made to work program
Hayfield Shenandoah	[redacted]	- Face to Face Meeting - Email Correspondence - Email Correspondence	- 15 May-18 - 20 Aug 18 - 24 Oct 18 - 5 Sep 18	[redacted]	[redacted]	[redacted]	[redacted]
NLC / Traditional Owners	[redacted]	- Work Program Submission - Face to Face Meeting - Email Correspondence - Sacred Site Clearance Survey (In Field)	- 10 Jul 2018 - 3 Sep 2018 - 3, 4 and 9 Sep 2018 - 10 to 19 Sep 2018	[redacted]	[redacted]	[redacted]	[redacted]

6. Environmental Risks and Impacts, Description and Assessment

6.1 Origin's Risk Management Approach

Origin utilises a robust risk management process for all its activities to achieve the following key outcomes:

- Risks are understood, eliminated or reduced and controlled to an acceptable level.
- Controls are owned, assured and continuously reviewed for effectiveness.
- All activities are compliant with regulatory standards and are guided by best practice, and
- Origin and its stakeholders are confident in the way activities are conducted to manage risks.

Risk management processes are mandated through the Origin Risk Management Policy and Directive, which includes a risk rating toolkit that is utilised from the Board through to frontline activity owners (Figure 6). The toolkit considers the requirements of ISO 31000 and addresses risk identification, assessment and management.

Assessment of risk are completed using Origin's Risk Matrix (Figure 7) to assess and rate risks by assessing the combination of frequency of occurrence and the severity of the outcome of an event. This allows quantification of the risk and determination can then be made about whether the risk can be accepted, or whether further mitigation is required.

Origin risk management processes requires regular assessment of underlying (unmitigated) risk from an activity, the residual risk once controls are applied, the effectiveness of controls and the likelihood and consequence of a risk event. A risk is either accepted in accordance with strict delegations of authority or the activity does not proceed.

6.2 Risk Acceptance threshold- ALARP

A risk can be considered to have been reduced to 'as low as reasonably practicable' (ALARP) when all reasonably practicable control measures (both preventative and mitigative) have been identified and implemented to reduce the risk of identified events. A key element of demonstrating ALARP is that good practice is followed, where good practice is defined as the recognised risk management practices and measures that are used by competent organisations to manage well understood hazards arising from their activities. This definition incorporates good practice as defined in codes and standards, and a consensus of good practice within the industry. ALARP is not a final position over the life of an asset or project.

The practicability and the reasonability of control measures can change over time due to changes in technology (that can make measures more readily available or less expensive), industry standards (that can commoditise once-cutting-edge technology) and the socio-technical landscape (that can modify societal expectations).

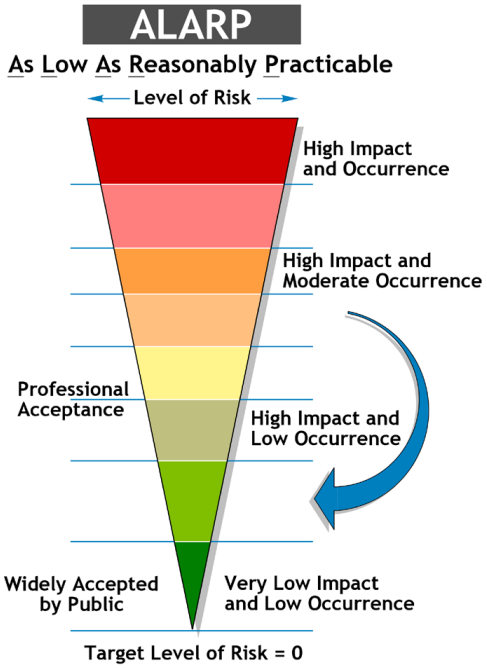

Figure 6 Origin's risk tool kit which describes the approach to identify, assess, control, treat and accept risks

Origin Risk Rating Toolkit

How to use this toolkit

Step A – describe the risk
Identify and describe the risk in terms of what could happen, its causes and potential effect/impact on Origin's objectives.

Step B – identify and assess controls
Identify and assess existing controls using the Control Assessment Ratings. Consider any related significant incidents, near miss events and assurance activities when assessing controls.

Step C – assess the level of consequence
Decide on the level of consequence that best represents the risk. Determine the highest credible consequence level in all relevant consequence categories in the Risk Matrix, taking into account current control assessment.

Step D – assess the likelihood of the risk
Determine the likelihood level in the Risk Matrix that represents the chance of the risk occurring at each consequence level identified, taking into account current control assessments.

Step E – determine a level of risk
Use the Risk Matrix to determine the level of risk.

Step F – determine the priority for risk treatment and approval
Using the Risk Treatment and Acceptance Criteria, determine the risk treatment required and who can approve/accept the risk at its current level.

Step G – assess the potential maximum consequences
Estimate the potential maximum consequence (plausible worse case level assuming all current controls fail) using the consequence categories.

Control Assessment Ratings

Rating	Explanation
Effective	▪ All controls are well designed and address the root cause/s of the risk. ▪ All controls operate to the required level. ▪ Ongoing monitoring required.
Can be improved	▪ Majority of controls are well designed and address the root cause/s of the risk. ▪ Majority of controls operate to the required level. ▪ Certain controls can be improved. ▪ Ongoing monitoring required.
Needs to be improved	▪ Majority of controls are not well designed and do not address root cause/s of the risk. ▪ Majority of controls do not operate to the required level. ▪ Majority of controls require improvement.

Risk Treatment and Acceptance Criteria

Level of risk	Action required	Acceptance authority
VERY HIGH	▪ Risk treatment must be in place immediately ▪ Review risk quarterly at a minimum	EMT member*
HIGH	▪ Risk treatment must be considered (having regard to current business priorities) ▪ Review risk annually at a minimum	General Manager
MEDIUM	▪ Risk treatment may be considered ▪ Review risk two yearly at a minimum	Group/Asset/ Project Manager
LOW	▪ No risk treatment required ▪ No ongoing review required unless determined by the relevant Group Manager	Site/Activity Manager

* Managing Director acceptance required for risks with a Catastrophic consequence and Likely or above Likelihood

Figure 7 Origin's Risk Matrix

Risk Matrix

CONSEQUENCE	IMPACT ON ORIGIN OPERATIONS – Conduct Business with Due Care: People	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	LIKELIHOOD: 1 REMOTE – <1% chance of occurring within the next year. Only occurs as a '100 year event' or less frequent.	2 HIGHLY UNLIKELY – <10% chance of occurring within the next year. Could occur within decades.	3 UNLIKELY – <30% chance of occurring within the next year. Could occur within the next few years.	4 POSSIBLE – <60% chance of occurring within the next year. Could occur within months to years.	5 LIKELY – <90% chance of occurring within the next year. Could occur within weeks to months.	6 HIGHLY LIKELY – Likely to happen multiple times a year
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	HIGH	HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
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.	MEDIUM	MEDIUM	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
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.	MEDIUM	MEDIUM	MEDIUM	HIGH	VERY HIGH	VERY HIGH
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.	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	HIGH
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.	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM
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.	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.

6.3 Risk Assessment Outcomes

The environmental, heritage and social risks associated with the proposed water bore drilling activities have been assessed utilising the Origin risk assessment framework described in Section 6.1. The detailed risk assessment presents the range of potentially impact-causing activities, corresponding mitigation measures and residual risk ratings based on their assessed worst-case consequence and likelihood of occurrence.

There were no residual risks above a medium, with 16 out of the 18 risks identified as being considered low. The medium risks identified were consistent with standard civil construction activities completed across the NT, being the potential spread of weeds and ignition of bushfires from the proposed activities.

Table 17 provides a count of the post-treatment environmental risks associated with the water bore drilling program. A copy of the risk assessment is provided in Appendix E.

Table 17 Count of Post-Treatment Environmental Risks for the Water Bore Drilling Program

	Post-treatment Environmental Risk Level			
	Low	Medium	High	Very High
Count	16	2	0	0

6.4 Environmental Risk Management Summary

The following section provides a summary of how the risks associated with each environmental aspect will be managed. For aspects with multiple individual risks, these are summarised in the relevant aspect table with the highest residual risk being used. The risk assessment provided in Appendix E should be consulted where an overview of each individual risk is required.

The risk management summary tables include an overview of the environmental values, management objectives, activities, potential impacts, management controls, performance measures and monitoring and records. In addition, the residual risk rating and a statement on the effectiveness of the proposed controls to manage the environmental risk is also provided. The rationale for how each risk control effectiveness has been determined is provided in Table 18.

Table 18 Risk control effectiveness definition

Rating	Explanation
Effective	• Controls are well designed and address the root cause/s of the risk • Controls are recognised industry best practice • All controls operate at the required level • All controls are within the power of Origin, with few external factors beyond control • Ongoing monitoring required
Can Be Improved	• Majority of controls are well designed and address the root cause/s of the risk • Majority of controls operate at the required level • Some controls are outside the power of Origin, with multiple external factors beyond control • Ongoing monitoring required • Certain controls can be improved or have elements below industry best practice.
Must Be Improved	• Most controls are not well designed and do not address the root cause/s of the risk. • Most controls are not operating to the required level. • A large number of controls are outside the power of Origin, with multiple external factors • The majority of controls require improvement and are well below industry best practice.

6.4.1 Soils and erosion

Table 19 Environmental Values and Objectives – Land

Environmental Values	• Suitability and stability of land for existing uses (Erosion and Sediment Controls implemented). • Stability of land to preserve existing water quality, landscapes and ecosystems.	
Management Objectives	• Minimise disturbance to land and land use (including soils and terrain, flora and fauna). • Protection of waterways. • Avoid site contamination and remediate land areas disturbed by water bore drilling activities, including contaminated land. • Optimise (in order of most to least preferable) waste avoidance, reduction, reuse, recycling, treatment and disposal and remove and disposal of regulated waste as soon as practicable to a licensed waste disposal facility or recycling facility. • Return disturbed areas to a stable condition such that they are returned to a condition as close as practicable to the surrounding area (or pre-disturbance state) within an acceptable time frame.	
Activity	**Potential impacts without management controls**	**Management Controls**
• Civil works • Water bore drilling activities • Storage and transportation of wastes • Sewerage treatment and disposal • Disposal of drill cuttings and muds to excavated sumps • Fuel and chemical handling and storage	• Localised soil contamination • Soil erosion and sedimentation	• Ecological assessment undertaken to identify environmentally sensitive areas. • Erosion control measure to be implemented and maintained as per erosion and sediment control plan (appendix I). • The retention of vegetation buffers surrounding streams and creek, as outlined in the NTG Land Clearing Guidelines 2010 • Bed level creek crossings as per section 2.2. • Regular inspections will be conducted to identify erosion and repair where observed. • Fuel, lubricants and chemicals will be stored appropriately in lined and bunded areas and transported, handled and used in accordance with the relevant MSDS. • Spill kits will be in place and clean-up equipment will be onsite and available in relevant areas. • No off lease or off-road driving. • All solid and regulated waste to be removed offsite. • Following completion of works, disturbed areas to be restored and/or rehabilitated. • Gravel borrow pits to have topsoil returned and re-profiled; • All compacted areas will be ripped and scarified to promote regeneration of vegetation. • Disturbed areas to be restored will be monitored for weed infestation, and progress towards specified rehabilitation goals.
Performance Measures	• Land disturbance equal to or less than planned. • Minimum incidences of erosion and sedimentation occurring. • Areas left safe, stable and non-polluting.	
Monitoring and Records	• The extent of disturbances will be measured and uploaded to the Origin's Geographic Information System (GIS). • Monitoring for soil erosion and related issues is best undertaken at critical stages, such as: - During siting of access track and water bore areas– this is when there is greatest opportunity to avoid erosion problems. - After completion of a specific phase of activity all areas disturbed should be inspected for early signs of compaction, erosion and soil degradation (generation of bulldust). - When accessing the site after the wet season look for signs of erosion. If significant impacts are identified remediation works may need to be conducted prior to continued vehicular access. - After more than 20 mm of rainfall. • Where rehabilitation of a site is undertaken, rehabilitation monitoring will be undertaken annually to assess the rehabilitation success and determine where additional remedial works are required. Success criteria is defined as: ○ Safe for humans and wildlife ○ Non polluting ○ Stable, with appropriate vegetation cover and erosion and sediment controls in place and functioning	

	○ Land condition suitable for existing pastoral land use		
Residual Risk	**Low**	**Risk control effectiveness**	**Effective**

6.4.2 Surface Water and Groundwater

Table 20 Environmental Values and Objectives – Surface Water and Groundwater Resources

Environmental Values	• Suitability for agricultural use. • Suitability for human consumption (where applicable).	
Management Objectives	• Minimise impacts to groundwater and maintain surface and groundwater values. • Minimise erosion and sedimentation of waters as a result of water bore drilling activities.	
Activity	**Potential impacts without management controls**	**Management Controls**
• Equipment failure • Groundwater monitoring bore design • Down hole problems • Casing failure • Cement failure • Drill pipe failure • Leak or loss of containment onsite • Disposal of waste – cuttings, associated water and produced water • Groundwater usage	• Aquifer contamination • Loss of aquifer pressure • Contamination of soil, shallow groundwater or surface water body	• Adherence to the Minimum Construction Requirements for Water bores in Australia. Monitoring bore designed and drilled as per requirements and suit the hydrogeological conditions on the site, be appropriate to protect aquifer and suitable for intended purpose as a monitoring bore. • Licensed drilling to be engaged. • Spill response measures shall be implemented for spills or leaks. Spills of dangerous goods will be collected for treatment and disposal at an approved facility. • Spill kits will be made available where hazardous materials are used and personnel will be trained in correct use. • Emergency response systems shall be in place for responding to contaminant release. • Dangerous goods will be stored, handled, separated and signed as required by the Flammable and Combustible Liquids Regulations and AS1940. • Hazardous goods will be stored in bunded areas away from watercourses. • Refuelling of equipment will not occur within 100m of a water course. • Waste which cannot be recycled will be transported to a designated, approved disposal site. • All refuelling of equipment will have spill kits available. • Plant and equipment shall be inspected and maintained regularly to detect and prevent leakage of liquid contaminants. • Earthworks disturbance to drainage lines will be minimised/avoided wherever possible. Bed level crossing constructed in accordance with section 2.2. • The retention of vegetation buffers surrounding streams and creeks, as outlined in the NTG Land Clearing Guidelines – Northern Territory Planning Scheme 2010. • Stabilise stream and creek crossings where unavoidable. • A buffer of 2 km will be maintained between operations and stock water bores. • Surface water will not be used for activities. • No discharges to watercourses. • All grey and treated sewerage waste will be appropriately managed. • Agreements to be reached with land holders and/or Department of Transport for the use of groundwater resources.

		• Sustainable use of groundwater measures will be implemented including the monitoring and recording of water used for any approved construction, drilling and stimulations.	
Performance Measures	• No unacceptable risk or long-lasting change to surface and/or groundwater resources (quantity and quality). • No release of site stormwater or wastewater exceeding baseline surface water quality • No long-lasting change in soil and surface water quality from base line conditions. • Stream and creek crossings disturbance minimised.		
Records	• Records of releases, leaks and associated clean ups are to be managed using Origins Incident Management System (OCIS). • Rectification work requirements and actions will be recorded in OCIS.		
Residual Risk	**Low**	**Risk control effectiveness**	**Effective**

6.4.3 Vegetation, Flora, Fauna and Habitat

Table 21 Environmental Values and Objectives – Vegetation, Flora, Fauna and Habitat

Environmental Values	• Maintain the integrity of significant ecosystems and agriculture productivity. • Maintain habitat elements for native flora and fauna, including species protected by EPBC Act and TPWC Act. • Avoid clearing high value habitat.	
Management Objectives	• Minimise disturbance to flora and fauna. • Minimise disturbance to sensitive areas.	
Activity	**Potential impacts without management controls**	**Management Controls**
• Vehicle and water bore Rig movements • Clearing of vegetation • Rehabilitation	• Disturbance to environmentally sensitive areas and/or flora and fauna species • Disturbance of fauna • Loss or endangerment of Threatened species • Loss of habitat • Vehicle collisions with fauna – fauna mortality	• Ecological assessment to be undertaken to identify environmentally sensitive areas (flora and fauna habitat). • Clearing to avoid large habitat trees. • Spotter catcher or equivalent to be present when clearing vegetation. • No off-lease driving, stay to approved access tracks. • Personnel will be prohibited from bringing firearms or traps into the lease areas. • Water bore leases will be fenced. • Personnel will be prohibited from interfering with wildlife. • Personnel will be prohibited from bringing domestic pets onto the Program area. • Adequate fire breaks shall be maintained around Monitoring bores to protect asset. • Appropriate fuel and chemical handling and storage measures will be implemented. • Fire extinguishers and firefighting equipment will be provided at each site and for vehicles. • Fire bans will be complied with. • Driving at dawn and dusk to be avoided in accordance with Origin Travel Management Plan. • Rehabilitate back to sites natural state once activities are completed (if required). Monitoring post-disturbance.
Performance Measures	• Monitoring bore lease located to minimise impacts to fauna habitat and sensitive vegetation. • No native fauna impacts (injury or fatality) reported in OCIS during civil and water bore drilling related activities. • Security bond maintained until such time DPIR is satisfied remediation of site. • No loss of sensitive vegetation resulting from Origin's activities.	
Records	• Records of disturbance will be maintained within Origin's GIS. • Records of inspections will be maintained.	

	• All incidents will be reported in Origin's OCIS and corrective action initiated.		
Residual Risk	**Low**	**Risk control effectiveness**	**Effective**

6.4.4 Weeds

Table 22 Environmental Values and Objectives – Weeds (Biosecurity)

Environmental Values	• Maintain the integrity of significant ecosystems and agricultural productivity	
Management Objectives	• Avoid the introduction of weeds • Avoid the spread of existing weeds	
Activity	**Potential impacts without management controls**	**Management Controls**
• Vehicle and water bore Rig movements • Civil construction activities	• Introduction or spread of weeds.	• Activities will adhere to the guidelines within the NT Weed Management Handbook • Weed desktop and field-based surveys undertaken to identify existing weed areas. • Weed management and control measures to be implemented in alignment with existing landholder biosecurity procedures. • All equipment will have certified equipment wash-down completed prior to entry to the field. • New activities will be planned to address prevention of weedor non-indigenous plant spread. • Machinery to be preferentially sourced locally, with machinery sourced from surrounding areas or Queensland being the 2nd and 3rd preferred option respectively. • Pre and post wet (February to May) inspections and periodic audits will be conducted to identify and report weed outbreaks. • Weeds will be actively controlled in cleared/ hardstand areas. • Major equipment moves will be planned from weed-free areas to infested areas and not the other way around. • staff members responsible for preventing, identifying and managing weeds to be appropriately trained. • Ensuring all material imported to or between sites is free of weeds.
Performance Measures	• No introduction or spread of declared weeds resulting from Origins activities.	
Records	• Records of weed distribution will be maintained within Origin's GIS and if required provided to the Weeds Officer at DENR. • Records of weed inspections will be maintained. • All weed outbreak incidents will be reported in Origin's OCIS and corrective action initiated. • It is noted that under the Weeds Management Act that: *'The owner and occupier of land must… within 14 after becoming aware of a declared weed that has not previously been, or known to have been, present on the land, notify and officer of the presence of the declared weed'.*	
Residual Risk	**Medium**	**Risk Control Effectiveness**	**Effective**

6.4.5 Waste Management

Table 23 Environmental Values and Objectives – Waste

Environmental Values	• Maintain the integrity of ecosystems and agricultural productivity. • Minimise the amount of waste generated.	
Management Objectives	• To minimise impacts on soil, surface water, groundwater, sensitive habitat and air quality. • To minimise creation of food sources or habitat for pest species. • To minimise waste generation through reduce, reuse, recycle programs.	
Activity	**Potential impacts without management controls**	**Management Controls**
• Civil construction works • Water bore drilling and camp operations	• Contaminated land • Encouragement of pest species to waste sites	• Designated waste storage and handling area to be provided onsite. • Consider recycling capabilities when awarding waste contract for civil construction and drilling program. • Removal and disposal of hazardous wastes to be in accordance with NT hazardous waste disposal requirements. • Ensure the availability of spill clean-up equipment for operations. • Undertake inspection of waste storage areas regularly, or after significant rainfall event (greater than 20 mm in 24-hour period). • Grey water from kitchen and showering facilities will be managed in accordance with Part 6 of the DoH *Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent, 2014*. • Domestic refuse to be disposed of in accordance with NT waste guidelines. No incineration of wastes on site. • Identify and remediate the affected area where applicable in accordance with the National Environmental Protection Measure (NEPM) requirements. • Drilling fluids considered acceptable for water bore drilling include water-based drilling fluids and air-based drilling fluids • The make up water shall be fresh non-polluted water for all water bore drilling fluid preparations. • Mud tanks will be utilised, instead of pits. • Waste (excluding muds and cuttings) to be removed off site for appropriate disposal at licensed landfill facility. • Waste Contractors to be used to be listed on the NT EPA waste handling contractors register (http://www.ntepa.nt.gov.au/waste-pollution/approvals-licences/ep-licences).
Performance Measures	The outcomes of waste management practices can be assessed against the performance criteria for: • The absence of wastes remaining on site at completion of operations (i.e. general rubbish, waste chemicals, workshop wastes including oily rags, containers etc.). • Waste registers maintained for the duration of the project. • Pest species not encouraged to the site.	
Records	• Waste disposal records to be kept for audit purposes and to be provided to DPIR.	
Residual Risk	**Low**	**Risk control effectiveness** **Effective**

6.4.6 Air Quality – Dust and Emissions

Table 24 Environmental Values and Objectives – Air Quality (Dust and Emissions)

Environmental Values	• Rural air environment with qualities conducive to suitability for the life, health and wellbeing of humans.		
Management Objectives	• Minimise environmental nuisance due to dust for sensitive receptors resulting from Origin's activities. • Minimise greenhouse gas emissions.		
Activity	**Potential impacts without management controls**	**Management Controls**	
• Civil construction works • Water bore drilling and camp operations	• Dust emissions • Release of atmospheric contaminants from exhausts • Aesthetic impacts	• Reducing the speed of vehicles on dirt tracks • Monitor road conditions to ensure deterioration with possible increase in dust creation, does not occur and undertake road rehabilitation as required. • Watering of roads when appropriate and agreed with landholders. • All equipment and machinery to be in good working order to minimise vehicle exhaust emissions	
Performance Measures	• Minimal complaints regarding dust/air quality. • Amicable resolution of complaints.		
Records	• All complaints and subsequent actions are to be recorded in Origin's OCIS incident management system.		
Residual Risk	**Low**	**Risk control effectiveness**	**Effective**

6.4.7 Lighting, noise, vibration and visual amenity

Table 25 Environmental Values and Objectives – Lighting, noise, vibration and visual amenity

Environmental Values	• A rural acoustic, lighting, vibration and visual amenity environment conducive to the wellbeing of the community, including its social and economic amenity, and an individual, including the opportunity to have sleep, relaxation and conversation without unreasonable interference from civil works and water bore drilling operations.		
Management Objectives	• Minimise the environmental nuisance for sensitive receivers as a result of civil and water bore activities, including Tourist visual amenity.		
Activity	**Potential impacts without management controls**	**Management Controls**	
• Civil works • Water bore drilling activities	• Noise generation causing and environmental nuisance • Light pollution impacting sensitive receptors • Visual amenity impacts on tourism	• Low impact water bore drilling activity surrounded by vegetated areas. • Drill sites selected to minimise noise and visual amenity impacts on sensitive receptors/ local community. • 6am to 7pm work, with no night time drilling anticipates. • Complaints shall be recorded in OCIS, investigated and responded to appropriately.	
Performance Measures	• Minimal nuisance-related complaints received from sensitive receptors, including landowners. • Amicable resolution of complaints.		
Records	• All complaints and subsequent actions are to be recorded in OCIS		
Residual risk	**Low**	**Risk Control Effectiveness**	**Effective**

6.4.8 Bushfires

Table 26 Environmental Values and Objectives – Bushfire

Environmental Values	• Maintain a natural fire regime of the region. • Protection of public, private infrastructure and equipment.	
Management Objectives	• Minimise the risk of causing bushfires from Origin's activities. • To minimise impacts on environmental habitat and fauna, soil erosion, impacts on stakeholders, impacts on culturally significant sites, public infrastructure and community lands. • To ensure proper health and safety plan for activities. • To prevent accidental fire risk and ensure safe storage of chemicals to prevent fire damage.	
Environmental Aspects	**Potential impacts without management controls**	**Management Controls**
• Civil works • Water bore drilling	• Increased incident and intensity of bushfires can lead to vegetation degradation and habitat modification • Damage to or loss of public infrastructure, private infrastructure and equipment or community lands • Damage to or loss of culturally significant sites	• Fire extinguishers to be fitted to all vehicles. • Fire trailer to be on hand to respond to fire. • Emergency response plan developed and implemented to deal with fire. • Establish firebreaks around water bore infrastructure (4 m fire break in accordance with NT requirements. • Firebreaks around production wells must be maintained for life of the lease area. • Access tracks and roads will serve as firebreaks to limit the spread of fire and the availability of water and firefighting equipment on site will assist in fire control.
Performance Measures	• Successful fire management will be indicated by having no uncontrolled fires occurring as a result of civil works and water bore drilling activities.	
Records	• All incidents of fire to be recorded in OCIS	
Residual Risk	**Medium**	**Risk control effectiveness** **Effective**

6.4.9 Cultural Heritage and Sacred Sites

Table 27 Environmental Values and Objectives – Cultural Heritage and Sacred Sites

Environmental Values	• Maintain cultural heritage values of the region, both Indigenous and non-Indigenous	
Management Objectives	• To avoid disturbance of or damage to Aboriginal or cultural heritage artefacts or Sacred Sites. • To minimise impacts upon or disruption to activities of Indigenous stakeholders in culturally significant areas. • To ensure adequate background information and training is provided to employees and contractors working in culturally significant areas. • To ensure that the health and safety of exploration workers and the community is not compromised through management of cultural and environmental awareness.	
Environmental Aspects	**Potential impacts without management controls**	**Management Controls**
• Civil works • Water bore drilling	• Disturbance to cultural heritage sites	• Cultural Heritage Clearance (and identification of sites of Aboriginal significance in conjunction with NLC and AAPA) will be conducted prior to commencement of disturbance activities or operations • Activities will be conducted in accordance with the NLC Agreement. • Prepare a Code of Conduct for employees and contractors to assist in the prevention of any possible anti-social behaviour that will affect the local residents. • Identify location of culturally sensitive areas and ensure design avoids these areas where applicable. • Where avoidance is not possible, such as in the case of existing access tracks, an artefact collection protocol is to be implemented in collaboration with traditional owners and NLC.

		• An unexpected heritage finds stops related work activities within the vicinity of the find (within a 500 m radius) for assessment and direction by an NLC representative. • Ensuring appropriate behaviours are employed outside of work hours. • Site inductions are to ensure that all personnel are aware of the Code of Conduct prepared for social interactions with the community.
Performance Measures	• No incidences of disturbance of archaeological sites or sites of cultural significance, or if disturbance is required, an application to disturb is submitted and approved prior to disturbance	
Records	• A register should be kept of all occurrences of archaeological sites identified during the Project for provision to the NLC, the AAPA and Heritage Branch within DLPE. • Ensure that site personnel and contractors report all new discoveries of archaeological or cultural artefacts, as per Origin's Unexpected Aboriginal Cultural Heritage Find procedure (OEUP-Q1000-PRO-BUS-001). Cease work and effect practical protection measures until the area can be assessed by DLRM personnel.	
Residual Risk	**Low**	**Risk Control Effectiveness** **Effective**

6.4.10 Community

Table 28 Environmental Values and Objectives – Community

Environmental Values	• Livelihood and well-being of local communities and towns.	
Management Objectives	• Minimise impacts upon environmental values of the local community. • Minimise impacts on cultural heritage. • Minimise safety risks to the public and other third parties. • Maintain and enhance partnerships with the local community, including using local contractors.	
Activity	**Potential impacts without management controls**	**Management Controls**
• Civil activities • Water bore drilling activities	• Damage to third party infrastructure • Loss of visual amenity-landholder and tourists • Possible danger to health and safety of the community • Increased traffic within the region impacts landholder and tourists	• All areas to be located away from sensitive receptors with lease layouts designed to minimise visual amenity impacts. • Emergency response systems will be in place. • All personnel and site visitors will complete the appropriate inductions. • All activities to be undertaken in accordance with land access agreements. • Use contractors that have high Indigenous participation in their workforce. • An approved DIPL Traffic Management Plan or exemption to be provided to DPIR prior to commencement of activities.
• Performance Measures	• An absence of issues arising, which have the potential to affect the work program, is a good indication of successful communications • No unresolved reasonable complaints • An overall social and economic benefit as compared to perceived adverse impacts as derived from consultations with community advisory groups • High level of satisfaction with complaint outcomes and complaint resolution processes. • Where suitable, include Aboriginal employment in the proposed program.	
Records	• Register should be kept of all incidences relating to access issues, unauthorised access and requirements of pastoralists, recognising that these requirements may change seasonally • OCIS complaint register • Land access agreements closed out at completion.	
Residual Risk	Low	**Risk Control Effectiveness** **Effective**

7. Implementation Strategy

7.1 Corporate Environmental Policy

Origin's activities are governed by the Origin Health, Safety and Environment Management System (HSEMS). This system is underpinned by Origins Health, Safety and Environment (HSE) Policy (Figure 8) which is designed to:

> *"Conduct our business sin a way that causes no harm to the health and safety of people and has no unforeseen impacts to the environment.*

7.2 Environment, Health, and Safety Management Systems

Origin has a mature Health, Safety and Environment Management System (HSEMS) which contains the systems, policies and procedures that Origin has in place to manage and minimise the impact from its activities. In addition to meeting legal requirements, Origin's activities are also governed by several additional internal directives and risk control directives designed to ensure best practice in environmental risk management.

An overview of the Origin HSEMS and the associated directives is provided in Figure 9.

OUR HEALTH, SAFETY AND ENVIRONMENT POLICY

OUR PRINCIPLE OF DUE CARE

We care about the wellbeing of our people and our impact on the environment.

OUR HSE ASPIRATION

To conduct our business in a way that causes no harm to the health and safety of people and has no unforeseen impacts to the environment.

OUR HSE ACTIONS

We all believe that our HSE aspiration is achievable and we embrace our responsibility for supporting it by:

Always mindful of risk

Recognising that risk is present in every task we do and taking the time to identify and understand these risks and manage them safely and responsibly.

Enabled and accountable

Taking ownership and using our authority, resources, systems and competencies to manage the risks associated with our work. We stop work when confronted by an unknown hazard and proceed only when satisfied we can continue safely and responsibly.

Continuously learning

Being open and transparent about how well we are doing and relentless in learning from our experience to manage our risks. We work together effectively, welcome any feedback and recognise that we can always do better.

Our Compass and HSE Management System set out how we will implement this policy.

Frank Calabria
CEO
Origin Energy

ORG-HSE-POL-001 November 2016

Figure 8 Origins Health, Safety and Environment (HSE) Policy

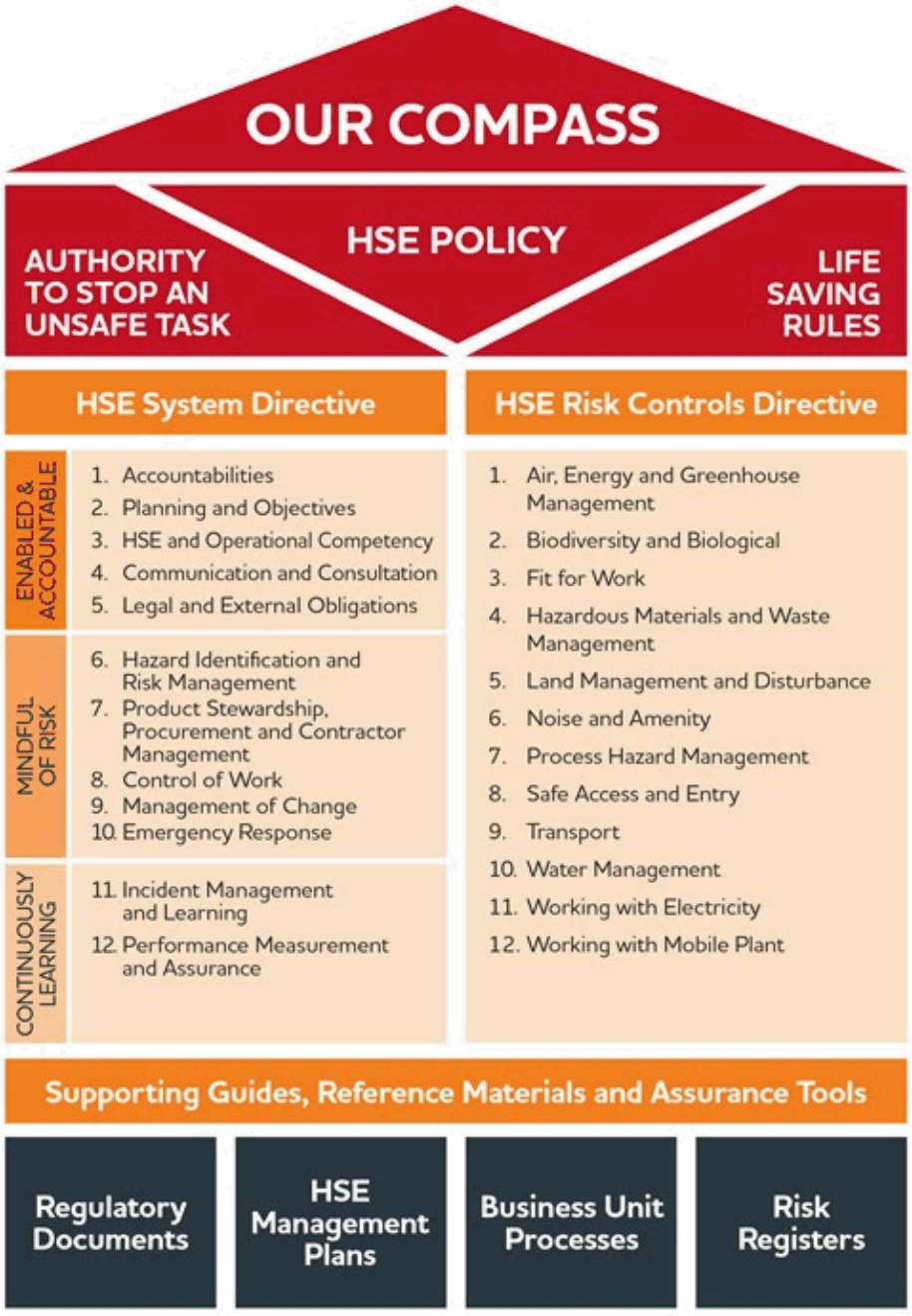

Figure 9 Origins HSEMS Structure

7.3 Roles and Responsibility

The following sections describe in detail the management strategies for specific components of the landscape, such as soil, ground water and vegetation, and the cultural and social environment, in relation to the different impact-causing activities that may occur.

Each management area has been assigned to specific positions within the exploration team, as follows:

- **Asset Manager** – responsible for the overall operations in the Origins activities in the exploration permit area.

- **Project Manager** – oversees the whole planning and execution of the exploration program and is the person ultimately responsible for ensuring all other parties are working within the HSE guidelines. The Project Manager's role is predominantly office-based.
- **Civil Construction Superintendent** – person based in the field responsible for ensuring all areas of operations and construction are carried out in accordance with the EMP and Origin' HSE Policy. All contractors report to this position, who is responsible to the Project Manager.

  This role will also cover the role of the weeds officer, who will be responsible for:

  - Planning and execution of weed monitoring requirements, including baseline weed assessments and ongoing monitoring both during periods of gas related activities as well as during the target identification period of February to May.
  - Facilitate training all workers (including contractors) in weed management requirements, with support from the Northern Territory Government Regional Weed Officer - Onshore Shale Gas Development.
  - Oversight of implementation of weed control mechanisms including but not limited to wash-downs and proactive weed control programs.
  - Ensuring all reporting requirements are met.
  - Act as the designated point of contact for and rapidly responding to any weed related complaints and incidents in accordance with the pre-determined strategies in this WMP and additional strategies as required developed in consultation with the Regional Weed Officer - Onshore Shale Gas Development and affected landholders.
  - Review and update of WMP's to remain effective in communication with relevant landholders and Regional Weed Officer - Onshore Shale Gas Development in consideration of monitoring results and emerging weed issues for both gas and pastoral operations.
- **Water Bore Driller** – Water Bore contractor responsible for contractor's equipment and personnel, adherence to the current version of the *Minimum Construction Requirements for Water bores in Australia* National Uniform Drillers Licensing Committee to minimise impact of activities on the environment and in accordance with this EMP.
- **Civil Design Consultant** – An individual or organisation that provides professional or expert advice in the field of civil engineering and design. They determine the best locations, design, materials and construction techniques for undertaking a project to ensure it meets the needs of the end user.
- **Health Safety and Environment Representative (HSE Representative)** – Origin representative providing guidance and advice to site personnel on the day-to-day management of the environment. This role is the will also support the nominated weeds officer, specifically in the planning and reporting phases.
- **Field Personnel** – All staff including Origin and contractors that are working on in the exploration permit areas.

7.4 Training and Awareness

Origin HSEMS outlines the policies and procedures governing the training and competency of all personnel (staff and contractors) to ensure they can fulfil their obligations under this EMP and the broader Origin HSEMS.

These systems include:

- General Origin HSE induction
- Contractor HSE prequalification process
- Contractor management system -
- Site specific inductions
- Task specific training and competency requirements

As most activities completed under this EMP will be implemented by contractors, contractors will be required to demonstrate they have appropriate systems, procedures and training to manage specific risks covered under this EMP prior to award. The following aspects will be considered during tender award:

- Maturity of HSE systems and process.
- Previous HSE performance
- Existing procedures and training:
    - Weed identification and management
    - Refuelling procedures
    - Procedures for avoidance of potential fauna habitat and any identified heritage sites
    - Hazardous material and waste management procedures
    - Incident notification and management processes
- Internal training programs
- Internal auditing processes.

All staff and contractors entering the site will be required to attend a site-specific induction. The induction covers the following aspects:

- Regulatory requirements, for the area, including specific conditions on the exploration permits and agreements with the NLC.
- Environmental considerations and special procedures to be used for environment protection, as well as, protection of archaeological and cultural sites within the permit areas.
- Safety procedures covering the safe use of vehicles, equipment and explosives first aid and
- HSE in remote area operations.
- Landowner sensitivities, including Aboriginal communities and their specific cultural requirements.
- Procedures for handling any culturally or archaeologically sensitive materials that may be discovered.
- Provide training in safe storage and handling of flammable and combustible liquids.

7.5 Environmental Commitment Summary

The responsibility for general environmental monitoring rests with all personnel engaged on the project. More specifically the Origin Project Manager shall ensure each element of the groundwater monitoring bore drilling programs are monitored to ensure that appropriate environmental protection/procedures are in place.

The program environmental commitments are outlined in Appendix G and are sourced from the risk management controls specified in Section 6.4. The implementation and compliance against these risk controls will be assessed as part of the annual environmental report (refer Section 7.9).

Specific commitments will be to:

- recording of information to track performance, including non-conformances and corrective actions.
- inspection and monitoring of operational controls on site via regular environmental monitoring
- assessing the level of conformance with objectives and targets detailed in this EMP.

The Operating Company Representative shall undertake random site inspections and direct such action as may be considered necessary to protect, minimise or rectify any environmental concerns.

7.6 Incident Reporting

Incident reporting and investigation provides the mechanism to prevent a recurrence. Personnel are required to proactively report all incidents, near-misses and identification of potential hazards.

Origin utilises an online incident management and reporting system. Any environmental incident, near miss or observation is reported through the online incident reporting system. All personnel are encouraged to report minor events to act as an alert to environmental risks and to maintain a program of continual improvement.

7.6.1 Recordable incidents

The Regulations define a recordable incident as an incident arising from the activity that breaches an environmental objective or performance standard in the EMP that applies to the activity, and is not a reportable incident.

7.6.2 Reportable Environmental Incident Reporting

As per Part 3, Division 1 of the Petroleum (Environment) Regulations, a reportable incident means an incident arising from a regulated activity that has caused, or has the potential to cause, material environmental harm or serious environmental harm as defined under the Petroleum Act. The interest holder must notify (this may be oral or in writing) DPIR of a reportable incident as soon as practicable but no later than 2 hours after the first occurrence of the incident or after the time the interest holder becomes aware of the incident

DPIR will be notified through the DPIR Operations Term Emergency number 1300 935 250.

The verbal report to DPIR will be followed up by a written report from the Project Manager within 3 days in accordance with the NT Petroleum Act.

7.7 Monitoring, assurance and Non-conformance management

In addition to regular monitoring as set out in this document, audits assessing compliance with this EMP will be undertaken by a suitably qualified person during the commencement of the activity. System deficiencies, adverse or potentially adverse environmental conditions arising from site activities may be subject to the issue of Environmental Non-conformances or Corrective Action Requests. These non-conformances or corrective actions shall be logged, and remedial actions identified and implemented. The status of corrective actions will be tracked and reported annual in the annual environmental report.

Due to the limited scope of the works within this EMP, it is proposed that audits will be restricted to weekly site/compliance inspections during the construction of access tracks and drilling of monitoring bores. Assurance audits of implementation of the EMP commitments will be completed annually and included in the annual environmental report.

Table 29 EMP Audit Schedule

Audit Type	Scope of Audit	Frequency	Responsibility
Site Inspections	Significant issues to be inspected as required with results recorded on checklist. Items to be actioned as required	Weekly	HSE Representative, Civil Construction Supervisor and Operating Company Representative
Annual Assurance	Compliance against EMP commitments and risk management controls	Annually	OE HSE Representative

Origin shall also comply with any auditing regime set by relevant external Authorities.

7.8 Emergency Response Plan

An Emergency Response Plan (ERP: OEUP-NT2000-PLN-SAF-001) has been developed covering the proposed activities within the EMP. The ERP provides a broad framework for managing potential emergency incidents to minimise the potential risk to human safety and the environment.

The ERP covers the following aspects pertinent to the drilling of groundwater monitoring bores and associated infrastructure:

- Spills and loss of containment
- Bushfires
- Medical emergencies.
- Emergency incident reporting

7.9 Reporting

Internal and government reporting on performance standards will be carried out by the Origin authorised representative, and distributed to Origin management and the DPIR, in accordance with condition 11 and 35 of the NT Petroleum (Environment) Regulations 2016. Quarterly and annual reports shall be completed to summarise the compliance with this EMP, whether the environmental outcomes and performance standards in the plan were met and summarise the details of any recordable and reportable incidents.

Table 30 EMP Reporting Schedule

Frequency	Report name	Recipient
Quarterly	Quarterly incident report summarising recordable incidents during the period	DPIR
Annual	An annual environmental report shall be prepared and submitted to the regulator covering the following: - Summary of the works completed under the EMP during the reporting period. - Compliance against performance criteria and standards. - A summary of environmental incidents that occurred during the year (i.e. reportable and recordable incidents that occurred). - Any environmental studies or research associated with the activity. - Technical improvements. - Consultation undertaken. - Results of related research or of an ongoing monitoring program, etc.	Origin management DPIR

7.10 Record Keeping

The following records shall be retained within Origins Document Management system for a period of 5 years

- records linked to measurement criteria, commitments and statutory reporting requirements;
- induction records;
- waste records;
- hazardous goods manifests;
- fuel usage;
- weed inspections;
- non-compliances and corrective action records;
- internal audits and inspection records; and
- management of change records.

7.11 Rehabilitation

The proposed leases and water bores will form a part of Origin's ongoing Exploration program.

Once a determination has been made to decommission an asset, a site-specific rehabilitation plan shall be developed for each disturbed area. Transfer of ownership of an asset to a landholder for beneficial use will be the priority. A transfer of ownership shall be

- Assessment of the current status of the asset and whether it can be beneficially used by the local landholder
- Where a beneficial use is anticipated, identify works required to be undertaken to ready asset for transfer (i.e. any repairs, site remediation, equipment removal etc.)

- Obtain written consent with landholder to take ownership of asset and any stipulated liabilities. accepts all ongoing liabilities (which will be documented)
- Where an asset cannot be beneficially utilised, the site shall be rehabilitated using assisted natural regeneration back to a safe, stable landform consistent with surrounding land use. This may include
    - Removal of all weeds and contaminated materials/ wastes
    - Re-spreading of stockpiled topsoil
    - Reshaping the site to as close to natural form as possible
    - Ripping or scarifying any compacted surface
    - Spreading seed of suitable local native species.

Where rehabilitation of a site is undertaken, rehabilitation monitoring will be undertaken annually to assess the rehabilitation success and determine where additional remedial works are required.

7.12 EMP Review

Implementation of this EMP will be continually monitored and revised as required based on monitoring and audit results, complaints, employee and stakeholder feedback, change to the proposed work program or a material increase in risk level.

A formal review, update and resubmission of this EMP will be undertaken every 5 years.

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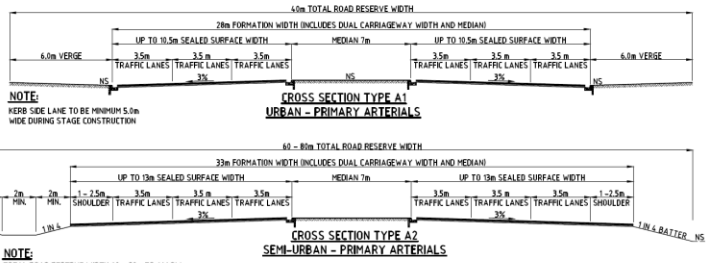
9. Acronyms & Abbreviations

Acronym	Meaning
°C	Degrees Celsius
%	Percentage
AAPA	Aboriginal Areas Protection Authority
ABS	Australian Bureau of Statistics
AICS	Australian Inventory of Chemical Substances
ALA	Atlas of Living Australia
ANZECC	Australian and New Zealand Environment Conservation Council
API	American Petroleum Institute
APPEA	Australian Petroleum Production and Exploration Association
AS	Australian Standard
CAS number	Chemical Abstracts Services number
CDEP	Community Development Employment Program
CEEVNT	Critically Endangered, Endangered, Vulnerable and Near Threatened
CLA	Cambrian Limestone Aquifer
CLC	Central Land Council
Cth	Commonwealth
DoH	Department of Health (NT)
DOTEE	Department of The Environment and Energy (Cmwlth)
DPIR	Department of Primary Industries and Resource (NT)
DLPE	Department of Lands, Planning and the Environment (NT)
EPA	Environment Protection Authority (NT)
EIS	Environment Impact Statement
EP##	Exploration Permit (e.g. EP76, EP98 and EP117)
EMP	Environmental Management Plan
EPBC	Environmental Protection and Biodiversity Conservation
ERS	Emergency Response Plan
GPS	Global Positioning Device
Ha	hectare
HSE	Health, Safety and Environment
HSEMPs	Health, Safety and Environmental Management Plans
HSEMS	Health, Safety and Environment Management System
IBA	Important Bird Area
ILUA	Indigenous Land Use Agreement
ISO	International Organisation for Standardisation

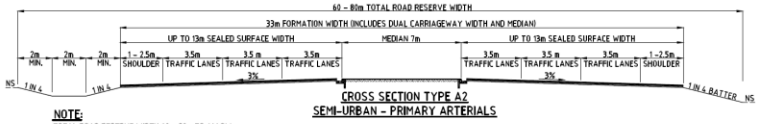
Acronym	Meaning
JV	Joint Venture
Km	Kilometre
km²	Square Kilometres
km/hr	Kilometre per hour
LAG	Local Aboriginal Group
m	metre
MD	Measured Depth
MNES	Matters of National Environmental Significance
MSDS	Material Safety Data Sheet
mTVD	metre True Vertical Depth
Mm	millimetre
NATA	National Association of Testing Authorities
NEPM	National Environmental Protection Measure
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NLC	Northern Land Council
NORMs	Naturally Occurring Radioactive Materials
NT	Northern Territory
OHS	Occupational Health and Safety
PER	Public Environment Report
RWA	Restricted Work Area
SIA	Social Impact Assessment
SMS	Safety Management System
SWL	Standing Water Level
TDS	Total Dissolved Solids
TMP	Traffic Management Plan
TO	Traditional Owner
TPWC Act	*Territory Parks and Wildlife Conservation Act*
TRH	Total Recoverable Hydrocarbons
TSS	Total Suspended Solids
UCS	Unconfined Compressive Strength
VOCs	Volatile Organic Compounds
WoNS	Weed of National Significance

Appendix A Typical Cross Sections For Urban and Rural Environments (NTG, Sept 2017)



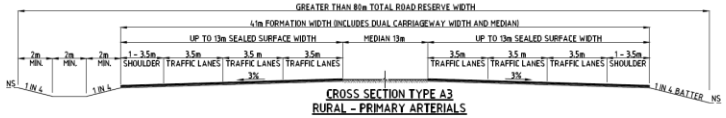
NOTE:
KERB SIDE LANE TO BE MINIMUM 5.0m WIDE DURING STAGE CONSTRUCTION

CROSS SECTION TYPE A1
URBAN - PRIMARY ARTERIALS



NOTE:
TOTAL ROAD RESERVE WIDTH 60 - 80m TO ALLOW FOR SIDE DRAINS AND POSSIBLE SERVICES. SHOULDERS TO BE SEALED, MINIMUM 1.0m.

CROSS SECTION TYPE A2
SEMI-URBAN - PRIMARY ARTERIALS



CROSS SECTION TYPE A3
RURAL - PRIMARY ARTERIALS

URBAN ENVIRONMENT

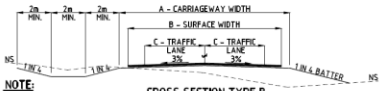
TYPICAL CROSS SECTIONS - URBAN ENVIRONMENT

ROAD CLASSIFICATION	AUSTROAD CLASS	TYPE CROSS SECTION	FORMATION (DUAL CARRIAGEWAY)	TRAFFIC LANES		SEAL WIDTH (m)	COMMENTS
				WIDTH (m)	SURFACE		
URBAN - PRIMARY ARTERIALS:							
URBAN	CLASS 6	TYPE A1	28.0	UP TO 3 x 3.5	SEALED	UP TO 10.5 EACH WAY	KERB SIDE LANE TO BE MINIMUM 5.0m WIDE DURING STAGE CONSTRUCTION. TOTAL ROAD RESERVE WIDTH 40m
SEMI - URBAN	CLASS 6	TYPE A2	33.0	UP TO 3 x 3.5 EACH WAY	SEALED	UP TO 13.0 EACH WAY (INCFULL WIDTH SHOULDER SEAL	SHOULDER TO BE SEALED MINIMUM 1.0m. TOTAL ROAD RESERVE WIDTH 60 - 80m TO ALLOW FOR SIDE DRAINS AND POSSIBLE SERVICES.
RURAL	CLASS 6	TYPE A3	41.0	UP TO 3 x 3.5 EACH WAY	SEALED	UP TO 14.0 EACH WAY (INCFULL WIDTH SHOULDER SEAL)	SHOULDER TO BE SEALED MINIMUM OF 1.0m. PAVEMENT & SEAL TO EXTEND A MINIMUM OF 1.0m IN TO THE MEDIAN. TOTAL ROAD RESERVE WIDTH GREATER THAN 80m

TABLE AS PER THE DEPARTMENT'S POLICY FOR STANDARD ROAD CROSS SECTIONS - APRIL 2015 - VERSION 1.0

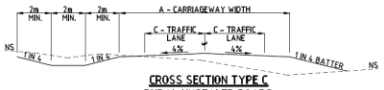
URBAN ENVIRONMENT NOTES:
1. REFER TO LOCAL GOVERNMENT GUIDELINES FOR URBAN SUB ARTERIALS (6000-12000 VPD), URBAN DISTRIBUTOR (LESS THAN 6000 VPD) AND URBAN COLLECTOR (LESS THAN 3000 VPD) ROADS.
2. REFER TO DEPARTMENT GUIDELINES FOR URBAN LOCAL AND URBAN SUBDIVISION REQUIREMENTS.

GENERAL NOTES:
1. REFER TO STANDARD DRAWING CS3002 FOR SHEET 1.



NOTE:
PAVEMENT AND SEAL TO EXTEND A MINIMUM OF 1.0m IN TO THE MEDIAN. SHOULDERS TO BE SEALED, MINIMUM 1.0m.

CROSS SECTION TYPE B
RURAL SEALED ROADS



CROSS SECTION TYPE C
RURAL UNSEALED ROADS

RURAL ENVIRONMENT

TYPICAL CROSS SECTIONS - RURAL ENVIRONMENT

ROAD CLASSIFICATION	AUSTROAD CLASS	TYPE CROSS SECTION	A CARRIAGE WAY WIDTH (m) (INCLUDING MEDIAN)	C TRAFFIC LANES		B SEAL/ GRAVEL WIDTH (m)	COMMENTS
				WIDTH (m)	SURFACE		
RURAL - NATIONAL HIGHWAY	CLASS 1	TYPE B	11.0	2 x 3.5	SEALED	8.0	NATIONAL STANDARDS UNDER REVIEW. SEAL WIDTH MAY BE INCREASED TO 9.0m DEPENDING ON LOCAL ISSUES
RURAL ARTERIAL AND SECONDARY ROADS	CLASS 3	TYPE B	10.0	2 x 3.5	SEALED	8.0	> 1000 VPD - 20 YEAR PROJECTED VOLUMES, SEE NOTE 1
	CLASS 4	TYPE B	9.0	2 x 3.0	SEALED	7.0	< 500 VPD - 20 YEAR PROJECTED VOLUMES, SEE NOTE 1
	CLASS 4	TYPE C	9.0	2 x 3.0	GRAVELLED	6.0	SEE NOTE 2
RURAL - LOCAL	CLASS 5	TYPE B	9.0	2 x 3.0	SEALED	7.0	FOR UNSEALED ROADS A 9.0m CARRIAGEWAY MAY BE APPROPRIATE IF FUTURE SEALING IS FORESEEABLE. SEE NOTE 2.
		TYPE C	8.0	2 x 3.0	GRAVELLED	6.0	
RURAL - SUBDIVISIONS	REFER TO CS3002						REFER TO DEVELOPMENT GUIDELINES BY THE TRANSPORT INFRASTRUCTURE PLANNING DIVISION.
PASTORAL ACCESS ROADS							
PASTORAL 1	CLASS 5	TYPE C	4.0	1 x 4.0	FORMED	-	SINGLE USER ACCESS
PASTORAL 2	CLASS 5	TYPE C	6.0	1 x 6.0	FORMED	-	MULTI USER ACCESS FOR UP TO 3 PROPERTIES
PASTORAL 3	CLASS 5	TYPE C	8.0	2 x 3.0	GRAVELLED	6.0	PROVIDES ACCESS TO GREATER THAN 3 PROPERTIES

TABLE AS PER THE DEPARTMENT'S POLICY FOR STANDARD ROAD CROSS SECTIONS - APRIL 2015 - VERSION 1.0

RURAL ENVIRONMENT NOTES:
1. FOR PREDICATED FUTURE VOLUMES OF 500 - 1000 VPD THE STANDARD WILL DEPEND ON TRAFFIC MIX (NUMBERS OF ROAD TRAINS/CARAVANS/BUSES) AND TOPOGRAPHY AND WILL BE ASSESSED ON A CASE BY CASE BASIS. SEAL WIDTHS MAY ALSO BE INCREASED DEPENDING ON LOCAL ISSUES SUCH AS SEASONAL VARIATIONS (TOURISM) AND ENVIRONMENT.
2. THE DECISION IN REGARD TO SEALED VERSUS GRAVEL STANDARD FOR A PARTICULAR ROAD WILL DEPEND ON FACTORS SUCH AS PROPOSED USE (IE HORTICULTURAL), ENVIRONMENT, PREDICTED USE AND THE LIKE AND SHOULD BE REFEREED TO TRANSPORT INFRASTRUCTURE PLANNING DIVISION.

No	DESCRIPTION	DATE	NAME	DEPT/COMPANY
0	ISSUED AS A STANDARD DRAWING	SEPT 2017	J.LEESON	EES/DIPL

AMENDMENTS

WARNING
BEWARE OF UNDERGROUND SERVICES.
THE LOCATIONS OF UNDERGROUND SERVICES ARE APPROXIMATE ONLY AND THEIR EXACT POSITION SHOULD BE PROVEN ON SITE. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN.

DRAWN J.LEESON	DATE MAR 2017	CHECKED S.HATZI	DATE MAR 2017
DESIGNED J.LEESON	DATE MAR 2017	CHECKED S.HATZI	DATE MAR 2017
DESIGN LEADER S.HATZI	DATE 1/09/2017	DESIGN DIRECTOR S.JACKSON	DATE 1/09/2017

Northern Territory Government

STANDARD DRAWINGS
TYPICAL CROSS SECTIONS

TYPICAL CROSS SECTIONS
FOR URBAN AND RURAL ENVIRONMENTS

FILE No	ASSET No	SHEET No	DRAWING No	AMEND	SHEET SIZE
-	-	2 OF 2	CS3003	0	A1

Appendix B Weed Management Plan

BEETALOO BASIN GROUNDWATER MONITORING BORE INSTALLATION PROJECT

Weed Management Plan

Review record

Rev	Date	Reason for issue	Author	Reviewer	Approver
0	05/10/2018	Issue for release	A Court	M kernke	M Hanson

Review due: 18/05/2019

Weed Management Plan

NT-2050-15-MP-0016

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Review due: 18/05/2019

List of appendices

1. Introduction

1.1 Project summary

Origin proposes to install eight (8) water monitoring bores adjacent to proposed future exploration sites within the Beetaloo exploration area. These environmental monitoring bores will collect baseline groundwater level and quality data prior to the commencement of any future hydraulic fracturing activities. To support the installation of these bores, a series of access tracks will be constructed and groundwater monitoring leases will be established within the Permit Area.

The location of the proposed monitoring bores are shown on Figure 1.

1.2 Intent of the WMP

Weed control is considered to be a significant land management issue in the Northern Territory and has been identified as a significant risk for this project in Origin's Groundwater Monitoring Bore Installation Environmental Management Plan (EMP). As such, this Weed Management Plan (WMP) forms a core component of Origin's overarching Groundwater Monitoring Bore Installation EMP.

The movement of rigs, vehicles, machinery and other materials to and from the Permit Area may result in weeds being moved around the pastoral lease, into the lease from surrounding areas or interstate, depending on where the vehicles and materials are sourced from or returned to.

The focus of this WMP is therefore to ensure that infestations are eradicated, or at the very least controlled such that no further weed species colonise the Permit Area as a result of Origin's activities.

This document is based upon the Weed Management Planning Guide - Onshore Shale Gas Development Projects produced by the Department of Environment and Natural Resources (2018).

1.3 Objectives of the WMP

This WMP has been developed to ensure that the risk of weed introduction and spread, resulting from activities associated with this project are mitigated to protect the economic, community, industry and environmental interests of the Territory.

The plan provides an overview of:

- The project context (Section 2)
- Legal requirements in relation to weed management (Section 3)
- The appointment of a Dedicated Weed Officer (Section 4)
- Identified risks and proposed mitigation measures and management objectives (Section 5 and 6)
- The weed species that are considered likely or known to occur within the Permit Area (Section 6 and 7)
- The Annual Action Plan for those species that are known to occur with the Permit Area (Section 8)
- Control options for species known to occur within the Permit Area (Section 8).
- The monitoring, notification, recording and reporting requirements for the WMP (Sections 9 – 12).

This plan is supported by Appendices that provide guidance on how to identify weed species in the field and collect the necessary data to support the monitoring and reporting requirements of this WMP.

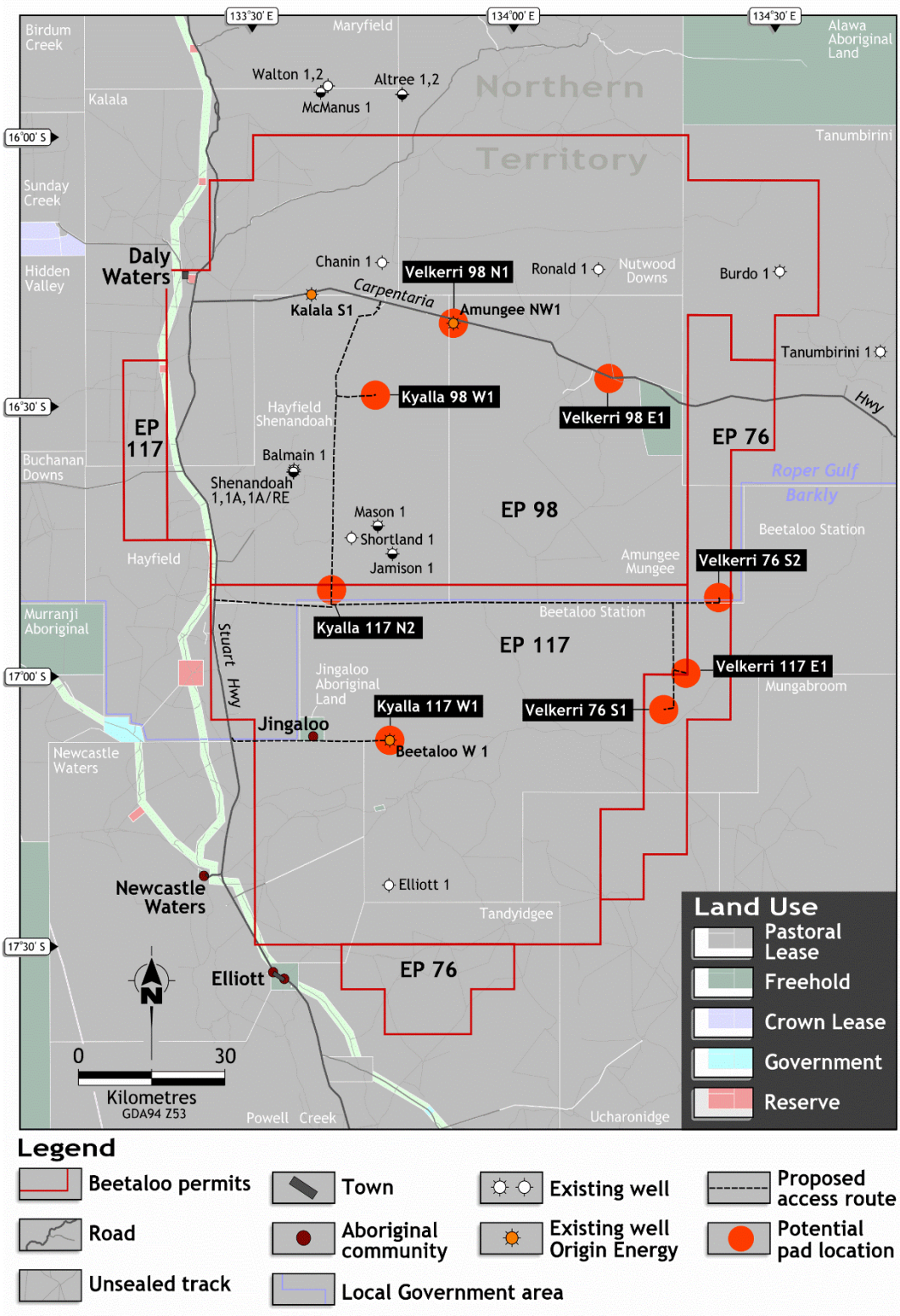


Figure 1 Location of Origin Permit Area

Review due: 18/05/2019

2. Project Context

For the purpose of this WMP, the project boundaries are restricted to:

- The eight 50 x 50 m groundwater monitoring bore lease sites.
- The use and upgrade of approximately 205 km of existing access tracks and boundary fence tracks to allow access for the water bore drilling rig.
- The installation of approximately 15km of new access tracks to connect the groundwater monitoring sites to the existing access tracks.

Table 1 Coordinates of centroid of proposed lease area for water monitoring bores

Exploration Permit	Well Name	Zone*	Easting	Northing	Approximate Disturbance Area (ha)
EP98	Velkerri 98 E1-1	53	415515	8180683	0.25
EP98	Kyalla 98 W1-1	53	364955	8177458	0.25
EP76	Velkerri 76 S1-1	53	424362	8113273	0.25
EP76	Velkerri 76 S2-1	53	435488	8136321	0.25
EP117	Kyalla 117 N2-1	53	356175	8137500	0.25
EP117	Velkerri 117 E1-1	53	428861	8120782	0.25
EP117	Kyalla 117 W1-2	53	368079	8106696	0.25
EP117	Kyalla 117 W2-1	53	358321	8108680	0.25
Total Disturbance Area for 2018 (Ha)					2 ha

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

The primary activities subject to this WMP are:

- Site preparation for up to eight 50mx50m groundwater monitoring lease areas containing up to 4 nested monitoring bores at each location.
- Use and potential upgrade of 205 km of existing access tracks/fencelines.
- Construction of up 15 km of new access roads.
- Drilling, completing and equipping of four groundwater water monitoring bores.
- Installation of fencing, gates and grids (as required).

3. Legal Requirements

The following presents the relevant legislation and statutory obligations for the project.

3.1 Northern Territory Petroleum (Environment) Regulations

Petroleum Act 2016, Petroleum (Environment) Regulations 2016 and Schedule of Onshore Petroleum Exploration & Production Requirements 2016

The *Petroleum Act 2016* provides legal framework within which persons are encouraged to undertake effective exploration for petroleum and to develop petroleum production so that the optimum value of the resource is returned to the Territory. It regulates the exploration for, and production of petroleum, including environmental protection measures which should be employed during exploration and production activities, including protection of parks and reserves and rehabilitation.

In addition, the Act is supported by the *Petroleum (Environment) Regulations 2016* and the *Schedule of Onshore Petroleum Exploration and Production Requirements 2016* (Requirements).

The *Petroleum (Environment) Regulations 2016* requires that regulated activities are carried out in a manner consistent with the principles of ecologically sustainable development, and by which the environmental impacts and environmental risks of the activities are identified and reduced to an acceptable level.

Under these regulations Origin is required to submit an EMP prior to any petroleum exploration or production activity.

EMP's must include:

- potential environmental risks or impacts (in this instance relating to the introduction and spread of weeds);
- appropriate environmental outcomes, environmental performance standards and measurement criteria;
- appropriate implementation strategy and monitoring, recording and reporting arrangements; and
- demonstrate that there has been an appropriate level of engagement with directly affected stakeholders in developing the plan.

This WMP is designed to support and implement the requirements of Origins (Draft) *Beetaloo Basin Groundwater Monitoring Bore Installation Program EMP* (2018).

3.2 Northern Territory Weeds Management Act

The aim of the *Weeds Management Act (2013)* is 'to protect the Territory's economy, community, industry and environment from the adverse impact of weeds'.

The purpose of the Act, as defined in section 3, is:

- To prevent the spread of weeds in, into and out of the Territory and to ensure that the management of weeds is an integral component of land management in accordance with the Northern Territory Weeds Management Strategy 1996 – 2005 or any other strategy adopted to control weeds in the Territory;
- To ensure there is community consultation in the creation of weed management plans; and
- To ensure that there is community responsibility in implementing weed management plans.

The Act identifies declared weeds (those which must be controlled) and provides a framework for weed management. It includes the following weed declaration classes:

Class A – to be eradicated
Class B – growth and spread to be controlled
Class C* – Not to be introduced into the Northern Territory
** All Class A and B weeds are also Class C.*

The Act enables the relevant Minister to approve statutory weed management plans. Management obligations in these plans must be adhered to.

Currently there are statutory management plans for 10 high priority weed species in the Northern Territory.

The WMP must address weeds in accordance with their declaration status and the statutory requirements of any relevant weed management plans.

3.3 Regional Weed Management Plans

Regional Weed Management Plans (RWMP) have been developed for areas of the NT, with the Barkly and the Katherine RWMP overlapping Origin's Beetaloo exploration tenure. the aim of these regional plans is to assist in prioritising weed management by:

- identifying the region's priority weeds and associated pathways of spread to inform management priorities
- identifying landscapes that may need prioritised protection from weed impacts like river corridors or sacred Aboriginal sites
- containing information on alert weeds that are not yet found in the region, but could become major issues if they establish

3.4 Commonwealth Environment Protection Biodiversity Conservation Act

The objectives of the *Environment Protection and Biodiversity Conservation (EPBC) Act* (1999) are, among other things:

- provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance; and
- promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and
- promote the conservation of biodiversity; and
- promote a co-operative approach to the protection and management of the environment involving governments, the community, land-holders and indigenous peoples; and
- assist in the co-operative implementation of Australia's international environmental responsibilities.

The *EPBC Act* provides for the identification and listing of key threatening processes. A threatening process is defined as a key threatening process if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community. Key threatening processes include invasive species, such as weeds, which have a major impact on Australia's environment, threatening our unique biodiversity and reducing overall species abundance and diversity (DOTEE 2018).

4. Dedicated Weed Officer

As per recommendation 8.3 of the Scientific Inquiry into Hydraulic Fracturing there must be a dedicated Weed Officer for each gas field.

The Weed Officer must have relevant skills and experience and availability to successfully manage weed related issues for the project, including:

- Knowledge of the biology/ecology of local weeds;

- Knowledge of relevant weed management frameworks including Northern Territory legislation and plans, the *EPBC Act*; and
- Understanding of existing weed management arrangements being undertaken by landholders.

The Weed Officer is responsible and accountable for delivery of all weed related requirements of the project in accordance with the WMP and the overarching Environmental Management Plan, including:

- Planning and execution of weed monitoring requirements, including baseline weed assessments and ongoing monitoring both during periods of gas related activities as well as during the target identification period of February to May.
- Facilitate training all workers (including contractors) in weed management requirements, with support from the Northern Territory Government Regional Weed Officer - Onshore Shale Gas Development.
- Oversight of implementation of weed control mechanisms including but not limited to wash-downs and proactive weed control programs.
- Ensuring all reporting requirements are met.
- Act as the designated point of contact for and rapidly responding to any weed related complaints and incidents in accordance with the pre-determined strategies in this WMP and additional strategies as required developed in consultation with the Regional Weed Officer - Onshore Shale Gas Development and affected landholders.
- Review and update of WMP's to remain effective in communication with relevant landholders and Regional Weed Officer - Onshore Shale Gas Development in consideration of monitoring results and emerging weed issues for both gas and pastoral operations.

Origin has appointed **Robert Wear** as the dedicated Weed Officer of the Beetaloo Groundwater Monitoring Bore Installation Program. Contact details are as follows:

Name:	Robert Wear
Title:	Construction Superintendent – Beetaloo Exploration
Mobile:	0467 679 003
Satellite Phone:	0147 612 733
Email:	Robert.Wear@upstream.originenergy.com.au

5. Weed Species Information

Weed surveys completed in august 2018 indicates the abundance of weeds within the proposed project area is low. *Hyptis suaveolens* (Hyptis), was the only weed identified and was found along the access track to the proposed Velkerri 98-E1-1 site. Previous surveys within the permit area completed in 2014, 2015 and 2016 also confirmed the presence of *Hyptis* in the vicinity of the Carpentaria highway near Velkerri 98 N1-2 (the former Amungee NW-1 lease pad) site. *Parkinsonia aculeata* (Parkinsonia) and *Calotropis procera* (Rubber Bush) have been previously identified along/in close proximity to the Beetaloo access track.

Parthenium (*Parthenium hysterophorus*) and Gamba Grass (*Andropogon gayanus)* both currently occur within the Permit Area, however they are not within close vicinity to the project area. The latest information indicates the Parthenium incursion is highly contained. It is under an intensive eradication program , led by the NT Weed Management Branch.

Parthenium, gamba grass and parkinsonia are all recognised as Weeds of National Significance due to their economic and environmental impacts and potential for spread. These species are specifically addressed in Section 8.

Figure 2 illustrates the weeds species confirmed in the region during field surveys, along with other weed species that are known to occur or likely to occur within the wider exploration Permit Areas. This information is based on.

- Origin exploration program weed survey data (2014-2018 results)
- Mapping data provided by the Weed Management Branch, DENR.
- Guidelines for the *Management of the Weeds of Beetaloo 2018* (DLRM et al 2018).
- Barkly and Katherine Regional Weed Management Plans (RWMP)
- Department of the Environment and Energy (DOTEE) EPBC Act Protected Matters Report database.

Table 3 has been separated into priority weeds, RWMP alert species and other species previously identified in the area. Priority weed species are considered higher risk of being introduced or spread through the following criteria:

- Weed species that has been confirmed in the area within the relevant RWMP or through field surveys
- Weed species listed in a RWMP that is in close proximity to Origin tenure
- Weed species is at risk of introduction through the use of machinery sourced from other regions in the NT or from other states.

Alert weed species are identified under the Katherine and Barkley RWMP. These species are not yet naturalised in the region, but have the potential to have a high level of impact to the region should it become established. The likelihood of the species naturalising and spreading in the region is perceived to be high (Department of Land Resource Management 2015).

It is noted that Parthenium (*Parthenium hysterophorus*) is a major problem in rangelands and cropping areas of Queensland and is estimated to cost farmers and graziers more than $22 million a year in reduced production and increased management costs. Vehicle, machinery and material movements from Queensland into the project area present a risk of spread of Parthenium if not managed correctly (Department of Primary Industry and Resources 2016).

Additional mapped locations of weeds within the Barkly and Katherine RWMP are provided in Figure 3 and Figure 4.

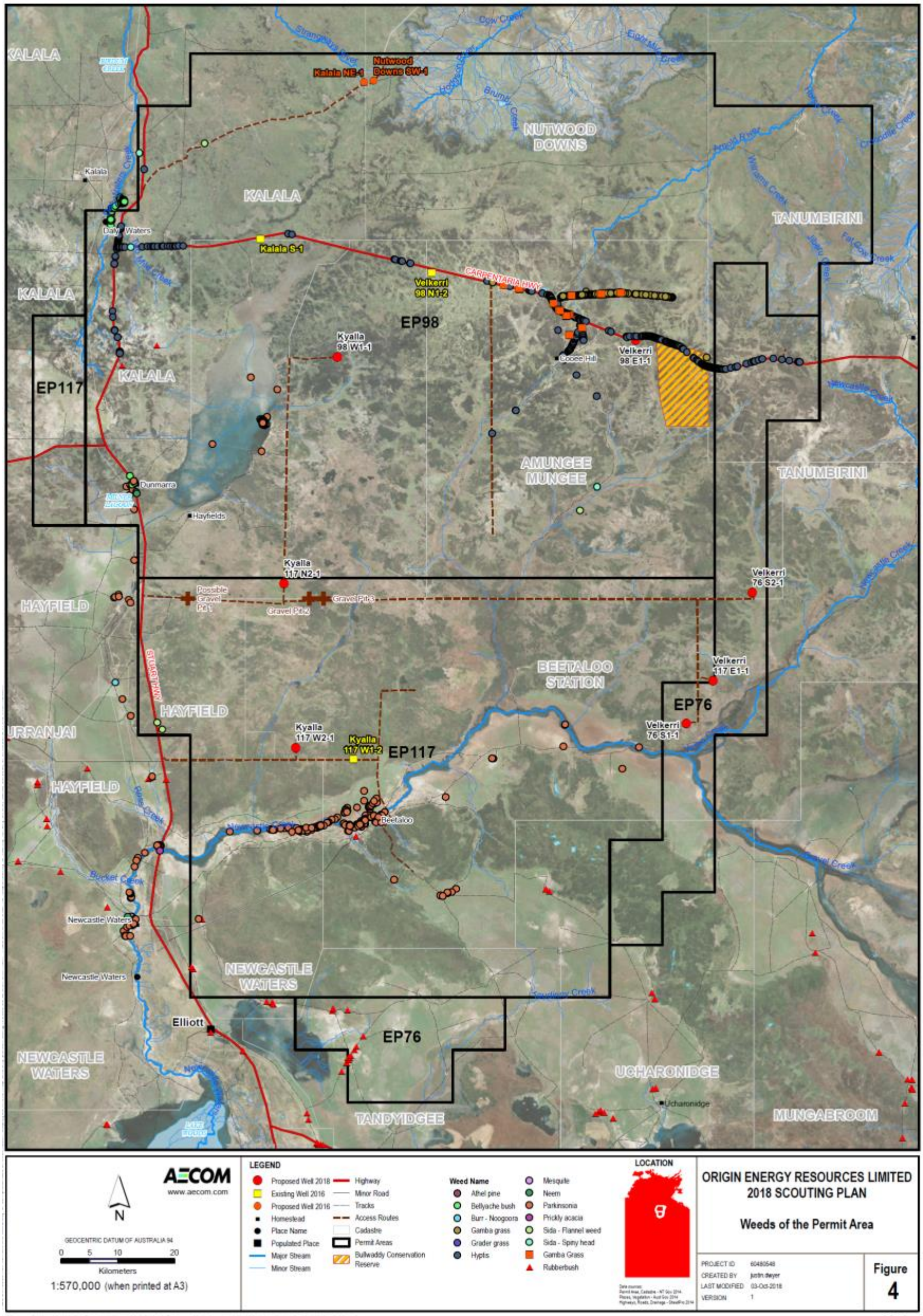


Figure 2 Location of Weeds Species in Permit Areas

Review due: 18/05/2019

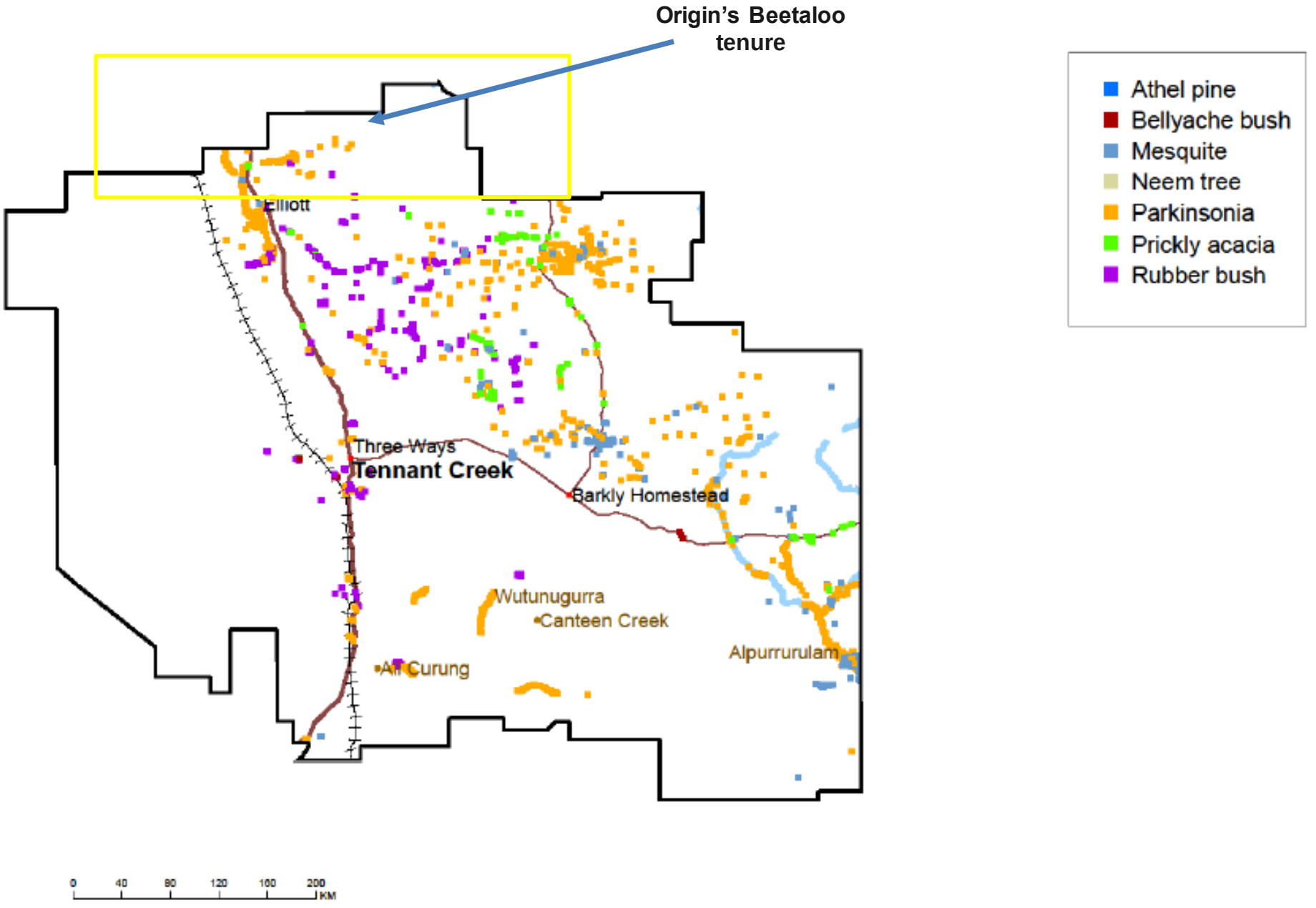


Figure 3 Barkly RWMP mapped priority weed locations

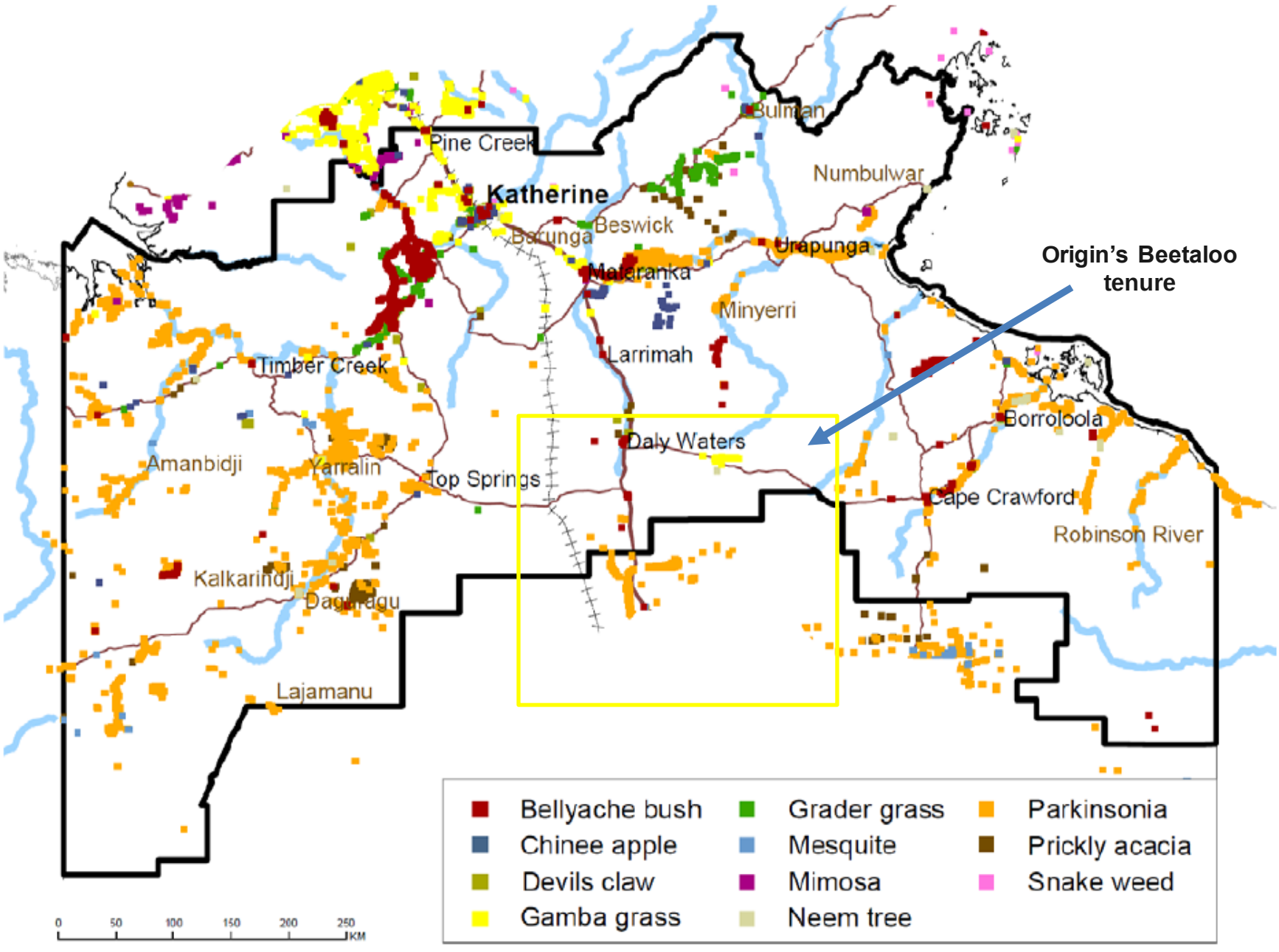


Figure 4 Katherine RWMP mapped priority weeds

Table 2 NT listed weeds known of likely to occur within the Permit Area

Scientific Name	Common Name	Status	Data Source
Priority Weed Species			
Acacia nilotica	Prickly Acacia	Class A, WoNS	Mapped in the exploration lease within the Katherine RWMP
Andropogon gayanus	Gamba Grass	Class A WoNS	Confirmed within exploration lease. High potential introduction through sourcing of equipment from Katherine and Darwin area.
Calotropis procera	Rubber Bush	Class B and C	Mapped in the exploration lease within the Barkly RWMP
Hyptis suaveolens	Hyptis	Class B and C	Confirmed within exploration lease during previous weed Origin surveys
Jatropha gossypiifolia	Bellyache Bush	Class A, WoNS	Mapped in the exploration lease within the Katherine RWMP. Potential introduction through sourcing of equipment from Katherine area.
Parkinsonia aculeata	Parkinsonia	Class B and C, WONS	Confirmed within exploration lease during previous weed Origin surveys and Mapped in the exploration lease within the Katherine RWMP. Potential introduction through sourcing of equipment from Katherine area.
Prosopis pallida	Mesquite	Class A and C, WONS	Mapped in the area surrounding exploration lease within the Katherine and Barkly RWMP
Themeda quadrivalvis	Grader Grass	Class B and C, WoNs	Confirmed within the exploration lease and mapped in the area within the Katherine RWMP. High potential introduction through sourcing of equipment from Katherine area.
Parthenium hysterophorus	Parthenium	Class A and Class C, WoNS	Confirmed by DENR to occur within the exploration lease. Potential introduction through equipment sourced from QLD.
Alert Species under RWMP			
Cenchrus setaceum	Fountain grass	Class B and C	Alert Species within the Barkly Region
Cryptostegia grandiflora	Rubber vine	Class A and C, WONS	Alert Species within the Barkly and Katherine RWMP
Chromolaena odorata	Siam Weed	Class C	Alert Species Katherine RWMP

Scientific Name	Common Name	Status	Data Source
Other species potentially found in region			
Alternanthera pungens	Khaki Weed	Class B and C	DLRM databases (DLRM *et al* 2018)
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)
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)
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*:

6. Weed Introduction and Spread Risks

As part of the development of the EMP for this project, Origin has undertaken a preliminary assessment of the risk of introducing or spreading weeds in the project area. This assessment and the corresponding proposed mitigation measures and management objectives are presented in Table 3 below. Due to the low abundance of weeds within the proposed project area, management controls will primarily focus on preventing the introduction of weed species through appropriate equipment sourcing cleaning and inspection.

Table 3 Risk of weed introduction and spread and corresponding mitigation measures

Environmental Values	Maintain the integrity of significant ecosystems and agricultural productivity		
Management Objectives	Avoid the introduction of weeds Avoid the spread of existing weeds		
Performance Measures	No introduction or spread of declared weeds resulting from Origins activities.		
Activity	**Potential Risks**		**Management Controls**
	Introduction of new weeds	**Spread of existing weeds**	
Vehicle movements	Vehicles sourced from other locations infested with weed species not found in or around Project Area	Traversing of weed infested areas with machinery	- Activities will adhere to the guidelines within the NT Weed Management Handbook. - Weed management and control measures to be implemented in alignment with existing landholder biosecurity requirements. - All equipment will have certified equipment wash-down completed prior to entry to the field. Wash-down would occur at Contractors depot or a commercial wash facility prior to mobilisation in a manner that prevents pollution of the surrounding environment. - Records of weed hygiene certification and any wash / blow down sites will be retained by Origin and made available upon request by NT Government Officers or landholders. - Machinery to be preferentially sourced locally, with machinery sourced from surrounding areas or Queensland being the 2nd and 3rd preferred option respectively. - Weeds will be actively controlled in cleared/ hardstand areas. - Major equipment moves will be planned from weed-free areas to infested areas and not the other way around. - Ensuring all material imported to or between sites is free of weeds.
Water bore rig movements	Water bore rigs sourced from other locations infested with weed species not found in or around EP area.	Traversing of weed infested areas with machinery	- Activities will adhere to the guidelines within the NT Weed Management Handbook. - Weed management and control measures to be implemented in alignment with existing landholder biosecurity requirements. - All equipment will have certified equipment wash-down completed prior to entry to the field. Wash-down would occur at Contractors depot or a commercial wash facility prior to mobilisation in a

Environmental Values	Maintain the integrity of significant ecosystems and agricultural productivity		
Management Objectives	Avoid the introduction of weeds Avoid the spread of existing weeds		
Performance Measures	No introduction or spread of declared weeds resulting from Origins activities.		
Activity	**Potential Risks**		**Management Controls**
	Introduction of new weeds	**Spread of existing weeds**	
			manner that prevents pollution of the surrounding environment. - Machinery to be preferentially sourced locally, with machinery sourced from surrounding areas or Queensland being the 2nd and 3rd preferred option respectively. - Ensure field staff, contractors and machinery operators are familiar with hygiene protocols and weed identification. - Weeds will be actively controlled in cleared/ hardstand areas. - Major equipment moves will be planned from weed-free areas to infested areas and not the other way around. - Ensuring all material imported to or between sites is free of weeds.
Construction of access tracks and monitoring bore pads	Importing materials from areas where weeds are present and creating opportunities for weed species to colonise disturbed areas	Traversing of weed infested areas and creating opportunities for weed species to colonise disturbed areas	- Activities will adhere to the guidelines within the NT Weed Management Handbook. - Weed management and control measures to be implemented in alignment with existing landholder biosecurity requirements. - All equipment will have certified equipment wash-down completed prior to entry to the field. - Ensure field staff, contractors and machinery operators are familiar with hygiene protocols and weed identification. - Machinery to be preferentially sourced locally, with machinery sourced from surrounding areas or Queensland being the 2nd and 3rd preferred option respectively. - Weeds will be actively controlled in cleared/ hardstand areas. - Stabilise disturbed areas.
Operational/ site management	Personnel unable to identify weeds or unaware of weed species present in areas where machinery and equipment is sourced from	Existing weed distribution not known due to: insufficient survey effort, surveys conducted at wrong time of year, surveyors	- Staff members responsible for preventing, identifying and managing weeds to be appropriately trained. - Weed desktop and field-based surveys to be provided to identify existing weed areas. - Pre-and post wet (February to May) inspections and periodic audits will be conducted to identify and report weed outbreaks.

Environmental Values	Maintain the integrity of significant ecosystems and agricultural productivity		
Management Objectives	Avoid the introduction of weeds Avoid the spread of existing weeds		
Performance Measures	No introduction or spread of declared weeds resulting from Origins activities.		
Activity	**Potential Risks**		**Management Controls**
	Introduction of new weeds	**Spread of existing weeds**	
		not familiar with / unable to identify declared weed species	
	Insufficient management control to prevent the introduction of weeds	Insufficient management control to prevent the spread of weeds	- Staff members responsible for preventing, identifying and managing weeds to be appropriately trained. - Ensure field staff, contractors and machinery operators are familiar with hygiene protocols and weed identification. - Weeds will be actively controlled in cleared/ hardstand areas. - Weed management and control measures to be implemented in alignment with existing landholder biosecurity requirements. - New activities will be planned to address prevention of weed or non-indigenous plant spread.

7. Statutory Weed Management Plans

No statutory weeds have been identified during surveys of the Project Area, however the following plans apply to species that have been found/ could be potential found in the broader region.:

- Weed Management Plan for Athel pine (*Tamarix aphylla)*
- Weed Management Plan for Mesquite (*Prosopis spp.*)
- Weed Management Plan for Prickly Acacia (*Acacia nilotica*)
- Weed Management Plan for Bellyache Bush (*Jatropha gossypiifolia*)
- Weed Management Plan for Neem (*Azadirachta indica*)
- Weed Management Plan for Gamba Grass (*Andropogon gayanus*)
- Weed Management Plan for Grader Grass (*Themeda quadrivalvis*).

The weed management plans detail the legislated obligations of all land owners, land managers and land users in the Northern Territory to eradicate or manage and avoid further spread of the weed species. Conducting land management practices in accordance with the weed management plans will secure compliance with the requirements of the Act (Department of Land Resource Management 2015).

8. Annual Action Plan

An action plan for each of the weed species identified in the Project Area is presented in Table 4. Treatment options as contained in the Northern Territory Weed Management Handbook are presented in Section 8.1 to Section 8.3.

This section will be undated if new weed species are discovered over the life of the program to ensure that statutory requirements with relation to declaration status and relevant weed management plans are addressed (refer to Section 7).

Table 4 Annual Weed Management Action Plan

Management objective	- Avoid the introduction of weeds - Avoid the spread of existing weeds			
Weed species	**Survey time/s**	**Treatment time/s**	**Control options**	**Where located**
Hyptis *Hyptis suaveolens*	6 monthly- pre-and post wet season	- Preferred Dec – Mar - Also Nov and April	Refer to section 7.1.	Beetaloo access track Access track to Velkerri 98-E1-1 site
Parkinsonia *Parkinsonia aculeata*	6 monthly- pre-and post wet season	- Preferred Mar – May - Also all year round	Refer to section 7.2.	Beetaloo access track
Rubber Bush *Calotropis procera*	6 monthly- pre-and post wet season	- Preferred October – March - April - July	Refer to section 7.3.	Close proximity to the Beetaloo access track

8.1 Hyptis (*Hyptis suaveolens*) treatment options

Table 5 includes herbicide and non-chemical treatment options for Hyptis *(Hyptis suaveolens) (*Northern Territory Government 2015).

Table 5 Hyptis *(Hyptis suaveolens)* treatment options

Weed Species	Hyptis *(Hyptis suaveolens)*		
Control Methods	**Chemical and concentration**	**Rates**	**Weed growth stage, method and comments**
Herbicides	**2, 4-D amine 625 g/L** Various trade names	320 mL / 100 L	**Seedling or adult (individuals or infestation):** Foliar spray - apply when actively growing.
	Glyphosate 360 g/L Various trade names and formulations	15 mL / 1 L	**Seedling or adult (individuals or infestation):** Foliar spray - apply when actively growing.
Non-chemical applications	- Manually remove all plant material; slash to encourage competition from desirable species.		

Source: Northern Territory Weed Management Handbook (Northern Territory Government 2015).

8.2 Parkinsonia (*Parkinsonia aculeata*) treatment options

Table 6 includes herbicide and non-chemical treatment options for Parkinsonia *(Parkinsonia aculeata)* (Northern Territory Government 2015).

Table 6 Parkinsonia *(Parkinsonia aculeata)* treatment options

Weed Species	Parkinsonia *(Parkinsonia aculeata)*		
Control Methods	**Chemical and concentration**	**Rate**	**Weed growth stage, method and comments**
Herbicides	**Aminopyralid 8 g/L + Triclopyr 300 g/L + Picloram 100 g/L** Grazon™ Extra	350 mL / 100 L or 3 L / ha	**Seedling (individuals and infestation)** Foliar spray – avoid spraying if plants are stressed or bearing pods – Uptake Spraying Oil required Foliar spray – plants up to 2 m or 2 years old - Uptake Spraying Oil required.
	Triclopyr 240 g/L + Picloram 120 g/L Access™	1 L / 60 L (diesel) 1 L / 60 L (diesel)	**Seedling or adult (individuals or infestation)** Basal bark < 5 cm stem diameter Cut stump > 5 cm stem diameter
	Tebuthiuron 200 g/kg	1.5 g / m2	**Seedling or adult (individuals or infestation)** Granulated herbicide - ground applied Do not use within 30 m of desirable trees or apply to continuous area > 0.5 ha. Do not use if fire is eminent. Apply when there is soil moisture or prior to rain.
Non-chemical applications	- Blade-ploughing, stick-raking, bulldozing and chaining can be effective if the root layer is removed from the soil. - Cultivation of pasture or native vegetation after mechanical control will help to prevent re-sprouting and seedling establishment. - Fire destroys seed in the soil surface and can be used as a follow-up to remove seedlings after other control efforts. - Fire may also be used to manage mature trees. Hand grubbing for single plants or small outbreaks, ensure removal of the root system. - Biocontrol options are available with Uu establishing slowly in some areas.		

Source: Northern Territory Weed Management Handbook (Northern Territory Government 2015).

8.3 Rubber bush (*Calotropis procera*) treatment options

Table 7 includes herbicide and non-chemical treatment options for Rubber bush *(Calotropis procera)* (Northern Territory Government 2015).

Table 7 Rubber bush *(Calotropis procera)* treatment options

Weed Species	Rubber bush *(Calotropis procera)*		
Control Methods	**Chemical and concentration**	**Rate**	**Weed growth stage, method and comments**
Herbicides	**Triclopyr 300 g/L + Picloram 100 g/L** **Conqueror®** **+ Aminopyralid 8 g/L** Grazon™ Extra	750 mL / 100 L (water) 500-750mL / 100 L (water)	**Seedling (individuals or infestation):** Foliar spray. Check label for recommended adjuvant product. More effective on plants <2m as thorough coverage on all leaves is required
	Triclopyr 240 g/L + Picloram 120 g/L Access™	 1 L / 60 L (diesel) 1 L / 10 L (diesel) 1 L / 60 L (diesel)	**Adult (individuals and infestation):** Basal bark < 5cm stem diameter. Spray all stems. Spray to point of runoff. ThinLine up to 5cm stem diameter. Cut stump > 5cm stem diameter.
	Tebuthiuron (200g/kg) Graslan Pending registration. Please check with Weed Management Branch for status confirmation.	1.5-2g/m2	**Seedling or adult:** Application to black clay soils in conjunction with seasonal rainfall. Spread granules according to density of the infestation.
	Fluroxypyr (333g/L) Starane™ Advanced	3 L / 100 L (diesel)	**Adult:** Cut stump method for plants up to 10cm diameter and 3m high.
Non-chemical applications	- This plant is difficult to eradicate as the deep roots survive almost any treatment. - Maintenance of a dense pasture sward will assist in preventing invasion.		

Source: Northern Territory Weed Management Handbook (Northern Territory Government 2015).

9. Notification Procedure

The Regional Weed Officer – Onshore Shale Oil Gas Development at the Weed Management Branch of the DENR should be notified within 48 hours of the discovery of a new weed species in the Project Area.

Initial notification may be verbal, with follow-up written notification provided within seven working days. The notification should include a preliminary species identification and location information. The Regional Weed Officer will advise what further action is required.

It is noted that some species spread rapidly so immediate action may be required to control spread. For example, as stated above *Parthenium (Parthenium hysterophorus) is a Class A (to be eradicated) and Class C (not to be introduced) weed in the Northern Territory as well as being classified as a Weed of National Significance. Early detection is crucial in not allowing this species to spread in the Northern Territory* (Department of Primary Industry and Resources 2016).

In addition, it is noted that under the *Weeds management Act* that:

'The owner and occupier of land must… within 14 days after becoming aware of a declared weed that has not previously been, or known to have been, present on the land, notify an officer of the presence of the declared weed'.

All weed outbreak incidents will be reported in Origin's OCIS and corrective action initiated.

10. Recording

Records of weed inspections will be maintained by Origin.

Data on weed distribution will be maintained within Origin's GIS and provided to the Weeds Officer at DENR as part of the annual report on performance against the Weed Management Plan, or as requested.

Data will be collected as per the requirements of the Northern Territory Weed Data Collection Manual - Section One Technical Data Description (Weed Management Branch, 2015).

Data will be recorded using the guidelines provided in Appendix A using the data sheet provided in Appendix B (Weed Management Branch, 2015).

The Northern Territory Weed ID Deck (Northern Territory Government 2017) will be referenced to assist with identification of species that have been identified as likely or know to occur in the Permit Area.

Field data will be submitted directly to the Weed Management Branch in a shapefile format or as an Excel spreadsheet.

11. Reporting

All weed outbreak incidents will be reported in Origin's OCIS and corrective action initiated.

A report on the performance against this Weed Management Plan will be submitted to DENR on an annual basis.

At a minimum, this should include:

a) Details of activities implemented to address weed spread and introduction risks (e.g. vehicle wash down/ blow down locations, examples of track construction from working from weed free areas into weed infested areas to reduce spread).

b) Details of survey and monitoring events, including dates, personnel, maps and track data.

c) Submission of all weed data collected.

d) Overview of weed control events and success rates (weed control should be captured in detail through the data collection process and submitted as a component of (a)).

12. References

Department of the Environment and Energy. 2018. *Key threatening processes under the EPBC Act.* http://www.environment.gov.au/biodiversity/threatened/key-threatening-processes accessed14 September 2018.

Department of Land Resource Management. 2015. *Barkly Regional Weed Management Plan 2015 - 2020.*

Department of Land Resource Management and Charles Darwin University. 2018, *Guidelines for the Management of the Weeds of Beetaloo 2018.*

Department of Natural Resources and Environment. 2018. *Weed Management Planning Guide - Onshore Shale Gas Development Projects.*

Department of Primary Industry and Resources. 2016. *Partheneum found in the NT.* https://dpir.nt.gov.au/news/2016/december/parthenium-found-in-the-nt accessed 14 September 2018.

Northern Territory Government. 2015. *NT Weed Management Handbook*.

Northern Territory of Australia. 2017. *Northern Territory Weed ID Deck.*

Northern Territory Government. 2018. *A – Z List of Weeds in the Northern Territory*. https://nt.gov.au/environment/weeds/weeds-in-the-nt/A-Z-list-of-weeds-in-the-NT accessed 13 September 2018.

Origin Energy Resources Limited. 2018. *Draft Beetaloo Basin Groundwater Monitoring Bore Installation Program EMP*.

Scientific Inquiry into Hydraulic Fracturing in the Northern Territory. 2018. *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory – Final Report.*

Weed Management Branch, Northern Territory Government. 2015. *Northern Territory Weed Data Collection Manual - Section One Technical Data Description.*

Appendix A Weed Data Collection Methodology

Field data collection for weed infestations

The following is a guide to efficiently evaluating and recording a weed site in the field.

Each record must identify the person or organisation taking the record, as well as the details explained below.

How to record weed area as a point record

1. Record the species.

When a weed is sighted, move to the area and confirm identification of the weed. If you cannot positively identify the weed record it as "Unknown weed" and take a sample or photograph, do not try to guess. If more than one weed species is present then repeat the process with separate records for each species.

2. Assess the size of the weed patch.

Look across the area of weeds to the furthest weed plant and decide the diameter. Decide if the area is best fits in a circle of either 20, 50 or 100 metres. If it is a single plant or small patch you would choose 20 metres. The size 100 metres extends about as far as you can see on the ground, if the weeds extend out of sight you will need to make another point further on. You may place overlapping circle areas to reflect different densities.

3. Assess the density of weeds within the circle.

Decide how much of the area is covered by weeds. Assign a score from 2 to 5 based on the percentage table below. It will be useful (if possible) to move into the centre of the weed circle. Consider the whole circle size chosen in step 2 deciding on the density score. Area covered should be determined by a 'projected canopy' method.

Density categories

1 = Absent, no weeds of this species in this area.
2 = < 1%, Very few, not many weeds eg: single plant, perhaps with seedlings.
3 = 1 -10%, More than one or two isolated plants but not a lot eg: a few small plants.
4 = 11-50%, A lot, up to half the area covered eg: a tree, dense patches of weeds.
5 = > 50%, Dominant cover is weed, more than half covered eg: thickets, monocultures.

4. Record the location.

Take the GPS location (ideally) from the centre of the circle. If weed seeds may be spread or it is difficult to access the centre it is acceptable to take the reading from the location as close to the centre as practical.

5. Record the treatment.

Record the method you apply a treatment to the weeds, or record 'No Treatment'.
Choose from the list of treatment methods
i.e: No treatment, Unknown, Treated, Foliar spray etc.

How to record weed area as a line (polyline) record

1. Record the species.

When a weed is sighted, move to the area and confirm identification of the weed. If you cannot positively identify the weed record it as "Unknown weed" and take a sample or photograph, do not try to guess. If more than one weed species is present then repeat the process with separate records for each species.

2. Assess the 'best fit' width in metres of the linear weed area.

Look along the area of weeds to the furthest weed plant and decide a width that best sums up the width of the infestation from values of 5, 20, 50 or 100 metres. If the width is too variable you may need to make more than one line or consider recording as points or as a polygon.

3. Assess the density of weeds within the line.

For the area of the line, being from start to finish at the designated width, decide the area covered by weeds. Assign a score from 2 to 5 based on the percentage table below. Consider the whole line area when deciding on the density score. Area covered should be determined by a 'projected canopy' method.

Density categories
1 = Absent, no weeds of this species in this area.
2 = < 1%, Very few, not many weeds eg: single plant, perhaps with seedlings.
3 = 1 -10%, More than one or two isolated plants but not a lot eg: a few small plants.
4 = 11-50%, A lot, up to half the area covered eg: a tree, dense patches of weeds.
5 = > 50%, Dominant cover is weed, more than half covered eg: thickets, monocultures.

4. Record the location.

Start the GPS track, or line sketch from one end of the linear weed area. Walk or sketch a line as best fit through the middle of the linear weed area and finish at the end point.

5. Record the treatment.

Record the method you apply a treatment to the weeds, or record 'No Treatment'.
Choose from the list of treatment methods
ie: No treatment, Unknown, Treated, Foliar spray etc.

How to record weed area as a polygon record

1. Record the species.

When a weed is sighted, move to the area and confirm identification of the weed. If you cannot positively identify the weed record it as "Unknown weed" and take a sample or photograph, do not try to guess. If more than one weed species is present then repeat the process with separate records for each species.

2. Assess the extent of the weed area an ensure it can be practically enclosed.

Polygons are good for clearly delineated areas of weeds, you should be able to walk around the edge of the weed area with confidence. Ensure the defined area of weed at a similar density can be delineated before attempting to create the area, you may need more than one polygon. If the area is poorly defined then the point method may be a more useful.

3. Assess the density of weeds within the polygon.

Assess the area covered by weeds for density, you may need to move to several vantage points to get a clear picture. Assign a score from 2 to 5 based on the percentage table below. Consider the whole area within the polygon when deciding on the density score. Area covered should be determined by a 'projected canopy' method.

Density categories
1 = Absent, no weeds of this species in this area.
2 = < 1%, Very few, not many weeds eg: single plant, perhaps with seedlings.
3 = 1 -10%, More than one or two isolated plants but not a lot eg: a few small plants.
4 = 11-50%, A lot, up to half the area covered eg: a tree, dense patches of weeds.
5 = > 50%, Dominant cover is weed, more than half covered eg: thickets, monocultures.

4. Record the location.

Start the GPS track, or polygon sketch from one point of the polygon weed area. It is useful to start from a landmark or flagging tape. Create the polygon edge line by walk a path or sketching along the outer edge of the weed area until you return to the start point. If using a GPS track to create the polygon ensure that you cross your start point so as to close the polygon.

5. Record the treatment.

Record the method you apply a treatment to the weeds in the area, or record 'No Treatment'. Choose from the list of treatment methods

ie: No treatment, Unknown, Treated, Foliar spray etc.

Appendix B Example Weed Data Collection Sheet

Weed Management Plan

NT-2050-15-MP-0016

RECORDER:					PROJECT:							LOCALITY:		
ORG_NAME:					GPS NAME/MODEL:							RECORDING METHOD :		
SITE_ID	DATE_REC	LAT_G94	LONG_G94	WEED_NAME	SIZE_DIA_M	DENS_CAT	SEEDLINGS	JUVENILES	ADULTS	SEED_PRES	PAST_TREAT	TREATMENT	HERBICIDE	COMMENTS

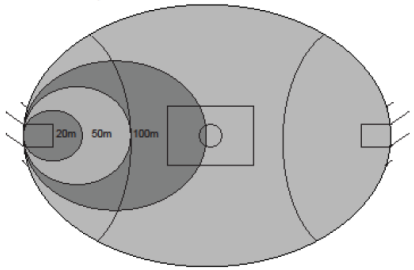
Notes:

Treatment method
Control method applied today as per below.
If none, record 'No treatment'

- Foliar spray
- Residual application
- Basal bark
- Cut stump
- Stem injection
- Aerial spray
- Slashed or cut
- Hand pull

Herbicide	The active ingredient(s) of the herbicide applied today (if any)
GPS waypt	Waypoint ID as entered in the GPS
Weed name	Common name or scientific name for the weed recorded
S (y/n)	Seedlings: Are seedlings visible?
J (y/n)	Juveniles: Are juvenile plants visible?
A (y/n)	Adults: Are there adult plants, or seeds, or evidence of past seeding present?
Seed (y/n)	Seeds: Are seeds visible today? Or plants with seeds or pods?
Treat (y/n)	Treatment: Did you apply treatment to this site?
Comment	Record any notes for yourself here.

Size dia m Size/diameter of the area you are recording information about (in metres). Use 20m, 50m or 100m.



Example of size/diameter compared to a football oval. (Sizes 20m, 50m, 100m)

Dens cat Density of weeds in the assessed area using categories described below

1 = No weeds (absent)	2 = Single plant or very few (<1%)	3 = A few plants (1-10%)
4 = Many weeds, up to half (11 – 50%)	5 = Mostly weeds, more than 50%	6 = Density not assessed

Density category (Dens cat) examples

(extracted from *Northern Territory Weed Data Collection Manual - Section One Technical Data Description.*

Review due: 18/05/2019

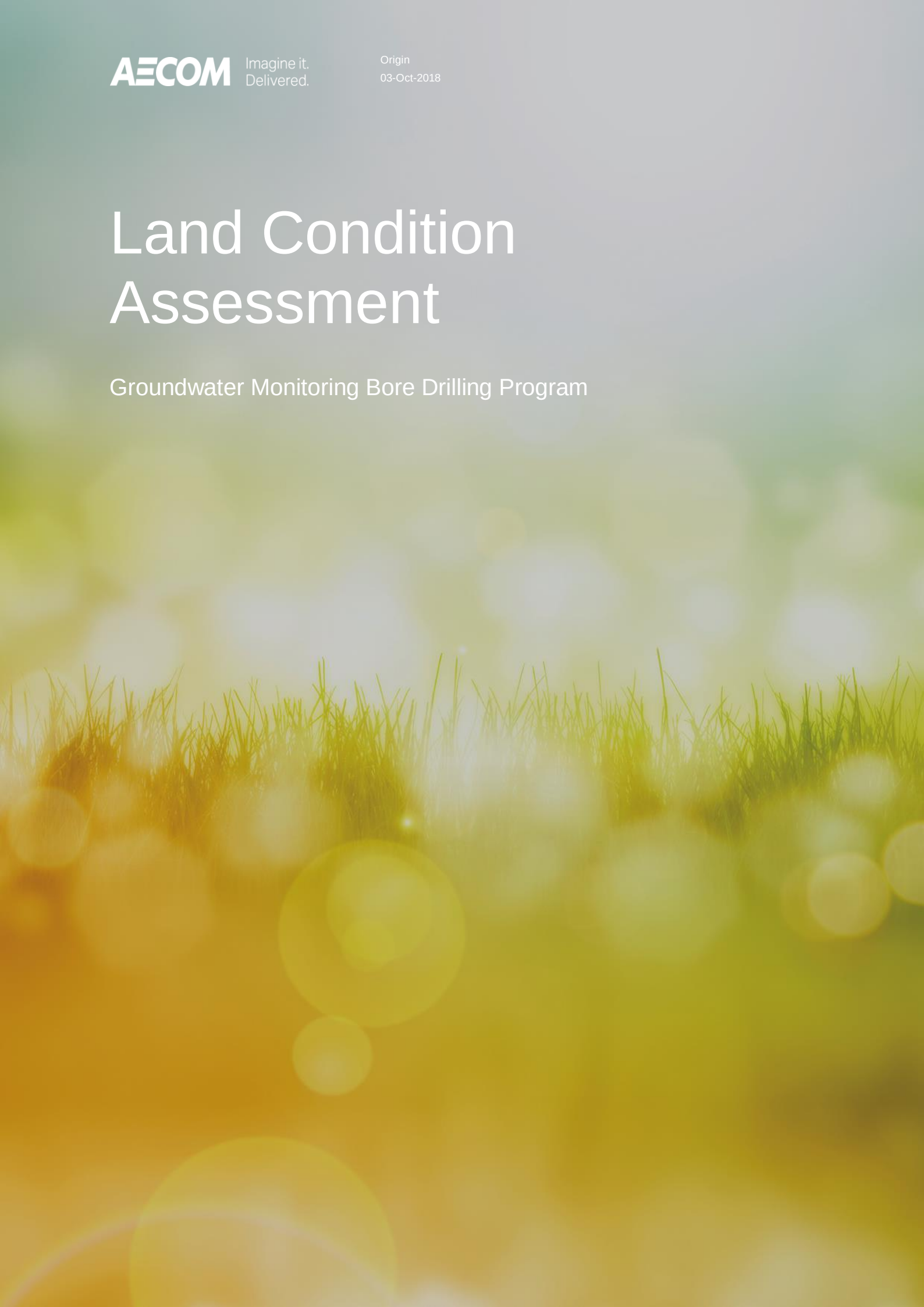
Appendix C Land Condition Assessment

AECOM Imagine it. Delivered.

Origin
03-Oct-2018

Land Condition Assessment

Groundwater Monitoring Bore Drilling Program



Land Condition Assessment

Groundwater Monitoring Bore Drilling Program

Client: Origin

ABN: 66 007 845 338

Prepared by

AECOM Australia Pty Ltd
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

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

Quality Information

Document	Land Condition Assessment
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Date	03-Oct-2018
Prepared by	Alana Court
Reviewed by	Karen Telford

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	03-Oct-2018	August 2018 Land Condition Assessment	Alana Court Principal Scientist	

Table of Contents

Table of Acronyms

Acronym	Meaning
^{o}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)
DPIR	Department of Primary Industry and Resources (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*
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 Primary Industry and Resources (DPIR). Origin's program is for the installation of groundwater monitoring bores located adjacent to current and proposed future exploration lease areas to collect baseline groundwater level and quality data in preparation for the 2019 exploration program.

The purpose of the LCA was to identify the ecological conditions of the proposed 2018/2019 work sites for the development of *Origin Energy's Groundwater Monitoring Bore Drilling Environmental Management Plan* (Origin, 2018).

1.2 Project Boundary

Origin are proposing to undertake a series of low impact activities required to expand its existing, four-year, baseline groundwater monitoring program in preparation for its 2019 exploration program. The groundwater monitoring program will involve the installation of up to four monitoring bores at eight (8) proposed lease sites within the Origin Beetaloo Exploration Area (refer Table 1 and Figure 1).

For the purpose of this assessment, the project boundaries were defined as the areas which may be affected by the groundwater monitoring bore installation project, including:

- The eight 50 x 50 m groundwater monitoring bore lease sites, including provision for fire breaks.
- The upgrade of approximately 205 km of existing access tracks and boundary fence tracks to allow the groundwater monitoring bore drilling rig access.
- The installation of approximately 15 km of new access tracks (approximately 10 m wide) to connect the groundwater monitoring sites to the existing access tracks.

Table 1 Proposed Lease Area for Groundwater Monitoring Bores and Disturbance Area

Exploration Permit	Bore Name	Station	Zone*	Easting	Northing	Disturbance Area (ha)
EP76	Velkerri 76 S1-1	Beetaloo	53	424362	8113273	0.25
			New Access Track			2.07
EP76	Velkerri 76 S2-1	Amungee Mungee	53	435488	8136321	0.25
EP98	Velkerri 98 E1-1	Amungee Mungee	53	412928	8181114	0.25
EP98	Velkerri 98 N1-2	Amungee Mungee	53	391676	8190013	0.25^
EP98	Kyalla 98 W1-1	Hayfield/Shenandoah	53	364955	8177458	0.25
			New Access Track			8.19
EP117	Kyalla 117 N2-1	Hayfield/Shenandoah	53	356175	8137500	0.25
EP117	Velkerri 117 E1-1	Beetaloo	53	428861	8120782	0.25
			New Access Track			2.95
EP117	Kyalla 117 W1-2	Beetaloo	53	368276	8106698	0.25^
Total Disturbance Area for 2018 (Ha)						**15.21 ha**

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

^ Existing Origin Leases, previously known as Amungee NW-1h and Beetaloo W-1.

Two of the well sites proposed, Velkerri 98 N1-2 (Amungee NW-1H) and Kyalla 117 W1-2 (Beetaloo W-1), are located on the existing Origin drill lease areas, where as the other six sites are located within proposed future exploration areas.

In addition, three proposed gravel pits locations have been identified along the central access track to Velkerri 76 S2-1. The proposed locations and disturbance areas are provided in **Table 2**.

Table 2 Proposed Lease Area for Water Monitoring Bores and Disturbance Areas

Exploration Permit	Gravel Pit	Station	Zone*	Approx Easting	Approx Northing	Disturbance Area (ha)
EP117	Gravel Pit 1	Shenandoah	53	339880	8134770	0.25 to 1
EP117	Gravel Pit 2	Shenandoah East	53	360420	8134916	0.25 to 1
EP117	Gravel Pit 3	Amungee Mungee	53	362876	8134932	0.25 to 1
Total Gravel Pit Disturbance Area for 2018 (Ha)						**Up to 3 ha**

1.3 Scope of works

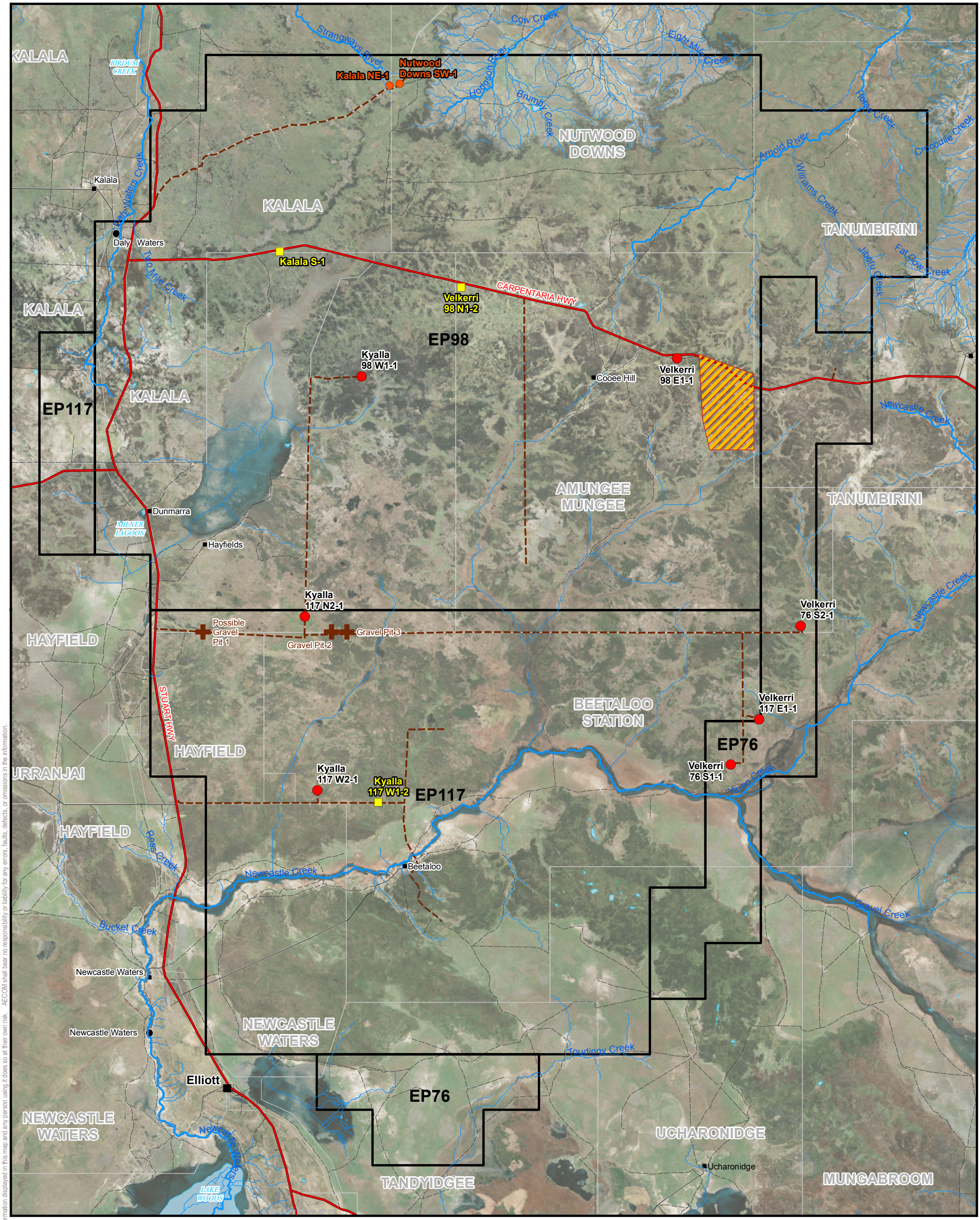
The scope of work for the LCA involved:

- 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 Northern Territory (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 groundwater monitoring bore drilling program.
- 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: Land Condition Assessment – a summary of the LCA data collected during the August 2018 field survey and desktop review
- Section 5: Conclusion and Recommendations – summary of the survey findings and recommendations
- Section 6: References
- Appendices.



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GEOCENTRIC DATUM OF AUSTRALIA 94

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Kilometers

1:570,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Existing Well 2016
- Proposed Well 2016
- Potential Gravel Pits
- Homestead
- Place Name
- Populated Place
- Major Stream
- Minor Stream
- Highway
- Minor Road
- Tracks
- Access Routes
- Cadastre
- Permit Areas
- Bullwaddy Conservation Reserve

LOCATION

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Site Location

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure 1

Filename: P:\604x\60480548\4. Tech Work Area\4.99 GIS\02_MXDs\August2018_Scouting\G60480548_Map1_Location_20180822_v1_A3.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 groundwater monitoring 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.
- 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 3 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 groundwater monitoring bore drilling activities within the Permit Area.

Table 3 Summary of existing Environmental Assessments and Reports for the Beetaloo Basin (2004 to 2016)

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.

2.2 Field assessment and reporting

The LCA of the proposed groundwater monitoring bore lease areas, including access tracks, was conducted on 28 to 29 August 2018 by Principal Environmental Scientist, Abe Francis. The survey involved helicopter and pedestrian survey of the proposed groundwater monitoring bore lease areas and access tracks. The field team also included AECOM Principal Heritage Consultant, Luke Kirkwood and the Department of Environment and Natural Resource (DENR) Regional Weed Officer (Onshore Shale Gas Development), Tahnee Hill.

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 groundwater monitoring bore pad 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 eight-groundwater monitoring bore sites 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 groundwater monitoring bore lease pads, plus an additional 500 m buffer to allow for future flexibility for the proposed Origin exploration activities. It is noted that for the current groundwater monitoring bore drilling program, only a 50 x 50 m pad is proposed (refer Appendix A).

In addition, the proposed program will require a series of existing access tracks and boundary fence tracks to be upgraded to allow for the groundwater monitoring bore rig and support vehicles to access the sites. 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 track was located on a property boundary, the buffer was extended 500 m out into the property the track was located on.

It is noted that not all of the nominated areas scouted for the groundwater monitoring bore lease pads and 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 Origin's Proposed Activities

The exploration permits cover 18,512 square kilometres (km^2) of pastoral lease on the Sturt Plain, part of the Barkly Tableland, approximately 500 km south-east of Darwin (refer Figure 1). Origin, as the Operator of exploration permit areas EP76, EP98 and EP117, propose to install up to four groundwater monitoring bores in a cluster on eight (8) of Origin's proposed lease sites within the Origin Beetaloo Exploration Area.

The network of up to four groundwater monitoring bores at each site will be used to obtain baseline groundwater quality and quantity data adjacent to the proposed future drilling and stimulation lease sites to meet Recommendation 7.11 of the *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory* and relevant guidelines published by NT DENR.

The number and aquifer monitoring zone 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 up to eight 50mx50m groundwater monitoring lease areas containing up to four clustered monitoring bores at each location.
- Upgrade of 205 km of existing tracks, fencelines and firebreaks to access the groundwater monitoring bore lease sites.
- Clearing and construction of up to 15 km of new access roads approximately 10 m wide.
- Groundwater monitoring bore drilling, completing and equipping of up to four groundwater water monitoring bores per lease area.
- Installation of fencing, gates and grids (as required and in accordance with access agreements with the land holders).

Further detail of the proposed activities is provided in the proposed Origin *Groundwater Monitoring Bore Drilling 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 2. During the helicopter survey, eight sites proposed for groundwater monitoring bore drilling 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, 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. 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 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 4.

Table 4 Annual rainfall 2016-2018

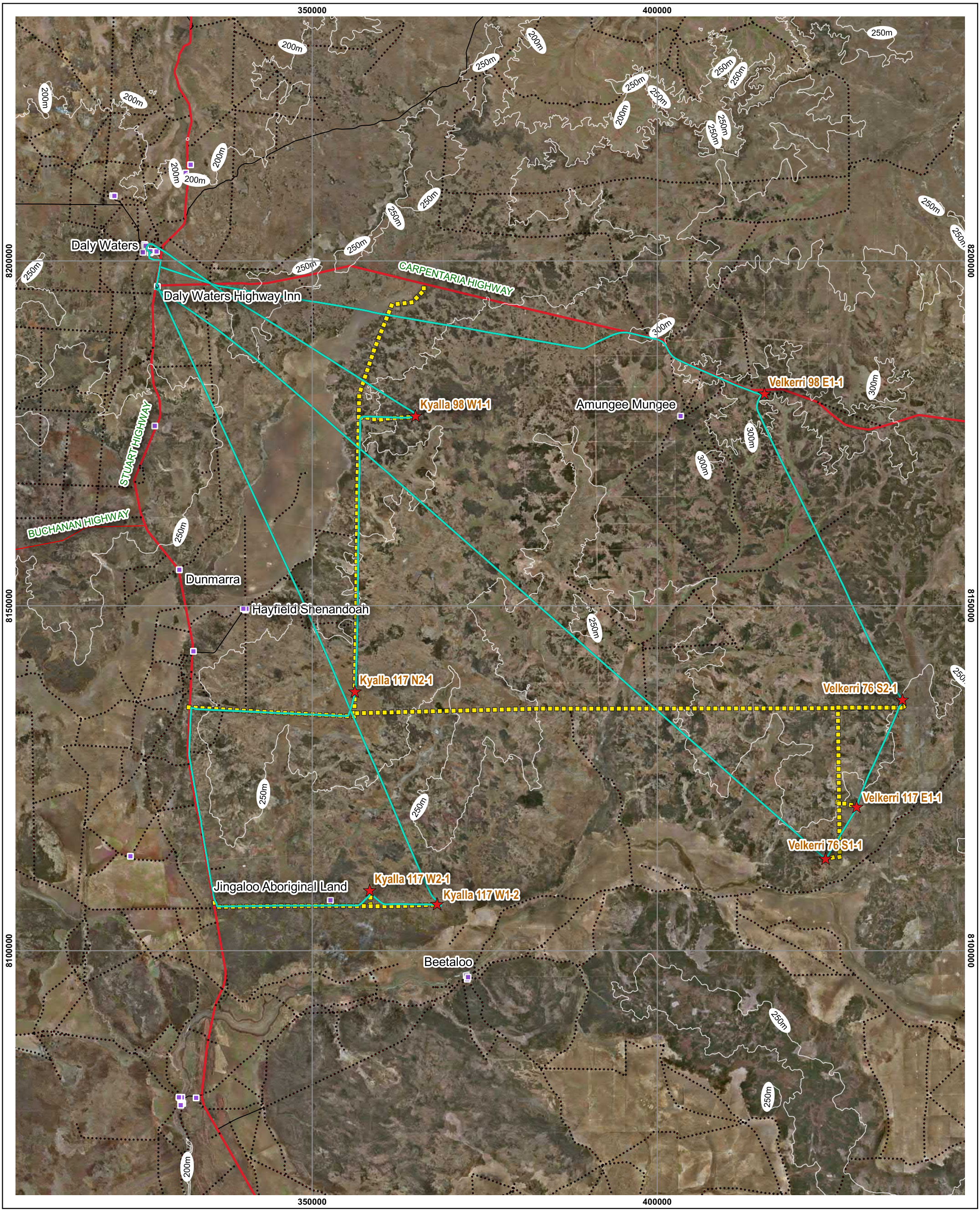
Year	Annual Rainfall (mm)		Months Rain was recorded	
	DW	NW	DW	NW
2016	608	570	12	9
2017	866	607	7	6
2018*	590	270	4	4

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 environmental protection.

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 creek lines within the permit area (refer to Section 4.2) and Origin are currently only anticipating dry season access. It is noted that some areas along the proposed access tracks have the potential to become inaccessible during the wet season because of soil integrity deterioration (saturated soils) and flooding. The long access tracks proposed in the central and southern lease areas will become difficult to traverse during the wet season due to some low-lying areas and black soil plains.



LEGEND

- Water Monitoring Wells
- Access Tracks
- Helicopter Survey Transects

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1:500,000(when printed at A3)

Data Sources:
ESRI
Geoscience Australia
Origin

Origin Propose Water Bore Drilling
Heritage Assessment Report
Survey Extent July 2018

PROJECT ID	60480548
CREATED BY	LK
LAST MODIFIED	20-9-2018
VERSION	1

Map 2

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 2018 proposed lease areas all occur within the lateritic plains and pre-dominantly 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 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.

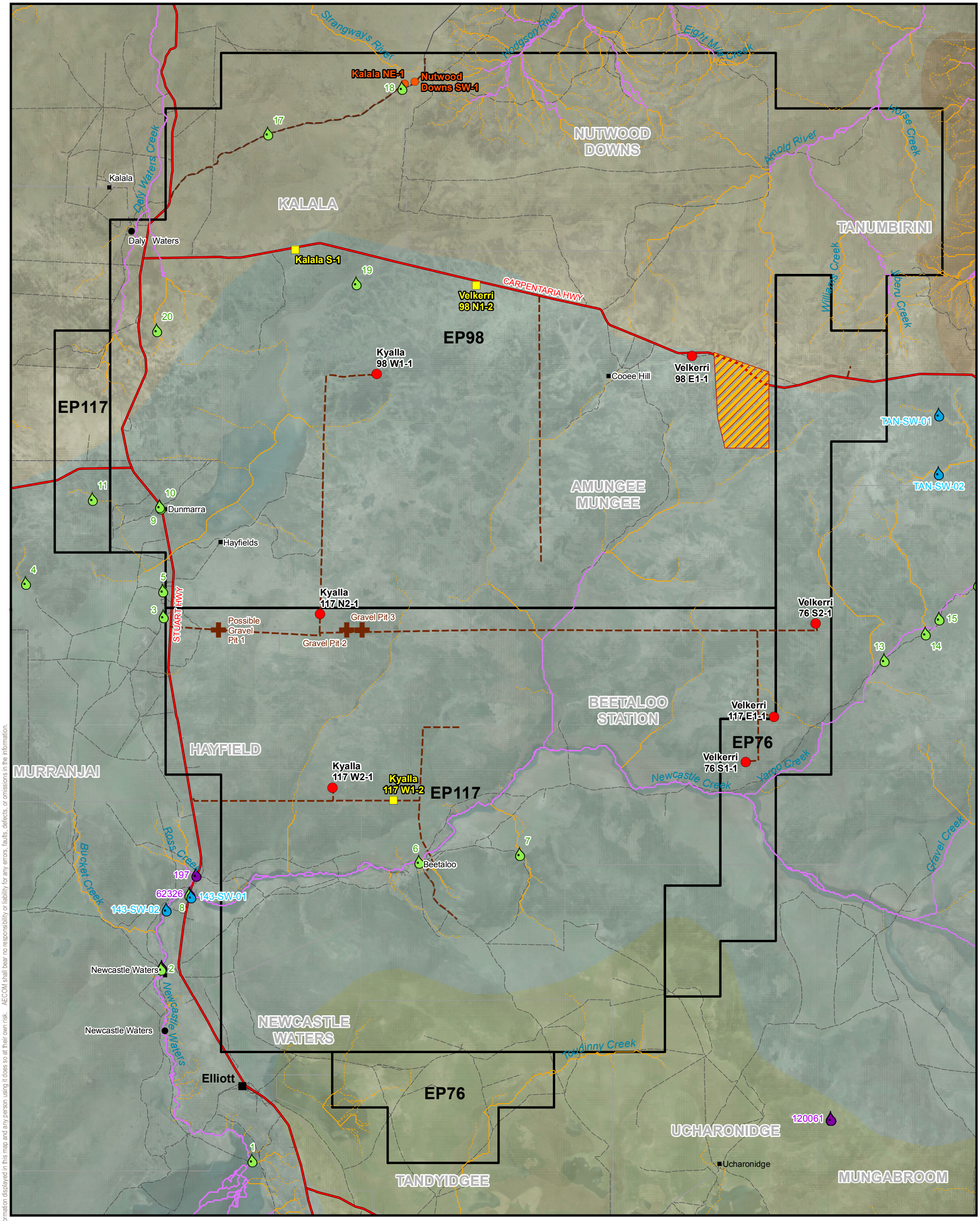
Lake Woods covers an area of inundation of approximately 50,000 ha in normal rainfall years, extending to 80,000 ha in exceptionally wet years, after which it can retain water for several years (AECOM, 2015). Lake Woods is described as a major quasi-permanent surface water body in the region, although 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).

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 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 their location from the surrounding plains.

Only one intermediate stream crosses the Beetaloo Access track at one location and three intermediate and Newcastle Creek cross the proposed access track to Velkerri 76 S2-1. 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. It is noted that this access track is an existing cleared property boundary.

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).



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GEOCENTRIC DATUM OF AUSTRALIA 94

0 5 10 20

Kilometers

1:570,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Existing Well 2016
- Proposed Well 2016
- Homestead
- Place Name
- Populated Place
- Potential Gravel Pits
- Surface Water 2007
- Surface Water 2015
- DLRM Surface Water
- Highway
- Minor Road
- Tracks
- Access Routes
- Bullwaddy Conservation Reserve
- Cadastre
- Permit Areas

River Basin

- 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

ORIGIN ENERGY RESOURCES LIMITED 2018 SCOUTING PLAN

Surface Water and Stream Order of Permit Area

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure 3

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A3 size

4.3 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 5). The Roper Group is estimated to reach 5,000 m in thickness in the centre of the basin and 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), a significant water supply aquifer. The Georgina Basin is capped by Cretaceous mudstone and sandstone (145 – 66 Ma) and recent alluvial and laterite deposits.

Table 5 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 litres/second. Shallow groundwaters have also been recorded within the permit area between 1 and 2 metres below ground level (mbgl).

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 monitoring 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.

As of the 20 July 2018 the Origin permit area 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 *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. Currently Petroleum and Mining activities are exempt from the *Water Act*.

Measures will be implemented throughout the exploration program to minimise impacts from Origin activities which includes the exclusion of utilising surface water bodies for any exploration activities.

4.4 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 developed for the permit area 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 proposed lease areas all occur in 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.

The only exception to this is the southern access track to the Kyalla 117 W1-2 lease area which crosses into the Joanundah Land System, described as very gently undulating northern heavy grey pedocals, also known as the black cracking clays.

4.5 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.

Only a small section of the southern access tracks indicated the presence of Northern Heavy Grey Pedocals, also known as the black cracking clays, which are described as soils with poorer structure in the surface and fine manganiferous concretions throughout the profile. They occur in high rainfall areas or poorly drained areas.

Other areas of 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.

Soil samples 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 are provided in Appendix B.

4.5.1 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 groundwater monitoring bore drilling program. The majority of the proposed monitoring bore sites were reported as non-dispersive soils and had high gravel content.
- 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 groundwater monitoring bore drilling locations were flat 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 6 and Table 7 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 (northern sites)

and Newcastle Waters (Kyalla 117 W1-2). The construction activities for the groundwater monitoring bore drilling is proposed to be completed prior to the onset of the 2018 wet season (October and November), when the overall risk of erosion from rainfall is considered very low to moderate.

Table 6 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)*

Table 7 Erosion Risk Rating based on average monthly rainfall at Newcastle Waters

Item	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	125.5	130.9	93.7	24.6	9.3	5.3	3.4	1.0	5.4	20.9	35.7	77.3
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)*

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 with the exception of a record of very minor evidence of scalds caused by sheet erosion at Velkerri 117 E1-1 which is consistent with natural processes.

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 4.2). Mitigation measures will need to be established to minimise the risk for erosion along the tracks and creeks and stream crossings are stabilised prior to the onset of 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 of erosion gullies along inappropriately placed tracks and fence lines, where a slope is 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.

4.6 Biological Environment

4.6.1 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 NT 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.

The main vegetation communities identified within the exploration permit areas are woodlands, typically dominated by bloodwoods (*Corymbia spp*.) and tall shrublands and woodlands of Bullwaddy and Lancewood with open grassland understorey (Cofinas and Creighton, 2001; ANRA, 2008). Other less common vegetation communities within the permit area include Acacia shrubland over spinifex and Bullwaddy-dominated woodland.

Lancewood/Bullwaddy communities are important as they represent Gondwanan remnants of the once dominant rainforests of the Australian tertiary period and are limited in distribution (PWCNT, 2005). Lancewood forests are the most extensive acacia dominated communities across northern NT. The Lancewood/Bullwaddy communities typically have a dense shady shrub layer, a few vines and creepers and a sparse grass understorey, compared to the sparse canopy and tall grass understory of other tall dense grasslands (PWCNT, 2005).

Bullwaddy is a plant with a multi-stemmed habit, very small leaves crowded along the branches and a very dense and heavy wood. Whilst technically being a shrub it can grow up to six metres tall with massive individual stems (PWCNT, 2005).

The Lancewood/Bullwaddy vegetation associations are fire sensitive. Inappropriate fire regimes may result in a community succession from Bullwaddy through Lancewood to a *Eucalyptus*/*Corymbia* dominated open woodland (PWCNT, 2005). This process may be accelerated by the invasion of exotic pasture grasses such as Buffel Grass (*Cenchrus ciliaris*).

Six of the proposed lease areas consisted of open *Corymbia* woodland (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). Only one of the proposed exploration lease areas, Kyalla 98 W1-1, will result in direct clearing of Lancewood forest, including the access track, as well as some patches occurring along the access tracks to the eastern sites (Velkerri 76 S2-1, Velkerri 117 E1-1 and Velkerri 76 S1-1).

Previous exploration activities in the permit area provided some understanding on how the vegetation communities regenerated following clearing and rehabilitation. Rehabilitation monitoring following previous exploration programs was 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 (refer Plate 1). By 2013, seven years after disturbance, the original seismic lines through the Lancewood were such that there was almost no difference in the canopy height to the surrounding Lancewood communities (refer Plate 2).

Plate 1 **HLA 2013 Condition Assessment of Sweetpea and HESS Seismic Line cross roads. The obvious line was the more recent HESS program. Line SP06-05 Amungee Mungee.**

Plate 2 **HLA 2013 Condition Assessment of Sweetpea Seismic Lines (approximately 7 years after completion of seismic program). Location SP06-24 Shenandoah.**

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

4.6.2 Flora

A total of 805 plant species have been recorded within the wider region. During the August 2018 survey 28 dominant flora species were identified across the eight proposed lease areas (Appendix C). 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 or NRM Infonet search (refer Appendix D and Appendix E). 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.

4.6.3 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 (DLRM, 2015).

Figure 4 and Table 8 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.
- 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 8 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)

Scientific Name	Common Name	Status	Data Source
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
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.

The survey undertaken in August 2018 of the proposed groundwater monitoring bore sites found only one weed species, *Hyptis suaveolens* (Hyptis) along the access track to the proposed Velkerri 98-E1-1 site. This suggests that the habitat condition in the areas of the proposed sites and surrounding areas is good.

Previous surveys within the Permit Area in 2014, 2015 and 2016 of the drill sites and access tracks also found that the proposed area had a low number of weed species also suggesting the habitat condition was fairly high in and around the Permit Area. Specifically, two listed species, *Parkinsonia aculeate* (Parkinsonia) and Hyptis were recorded during the survey. Parkinsonia was recorded at one site and incidentally along the Beetaloo access track and Hyptis was recorded at the access track entry to the now referenced Velkerri 98 N1-2 (previously known as Amungee NW-1) site.

Parkinsonia is considered a Weed of National Significance (WoNS), which are weed species that are the focus of national management programs for the purpose of restricting their spread and/or eradicating them from parts of Australia.

Calotropis procera (Rubber Bush) (Class B and C) was recorded in close proximity to the Beetaloo access track. It is possible that additional species are present but were present in low abundance or difficult to identify due to stage of growth.

These weed species surveyed within the Permit Area and their corresponding NT *Weeds Management Act 2016* declarations are listed in Table 9.

Table 9 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
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

In addition to these 18 species a range of annual grass weeds are known to occur along road corridors throughout the region. This includes Buffel Grass, a weed that has the potential to alter fire regimes, which was introduced and cultivated for livestock feed and is useful in soil stabilisation.

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 in Table 10. If located, the program EMP requires the Weed Management Branch to be contacted for identification and disposal.

Table 10 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

4.6.4 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 monitoring bore 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.

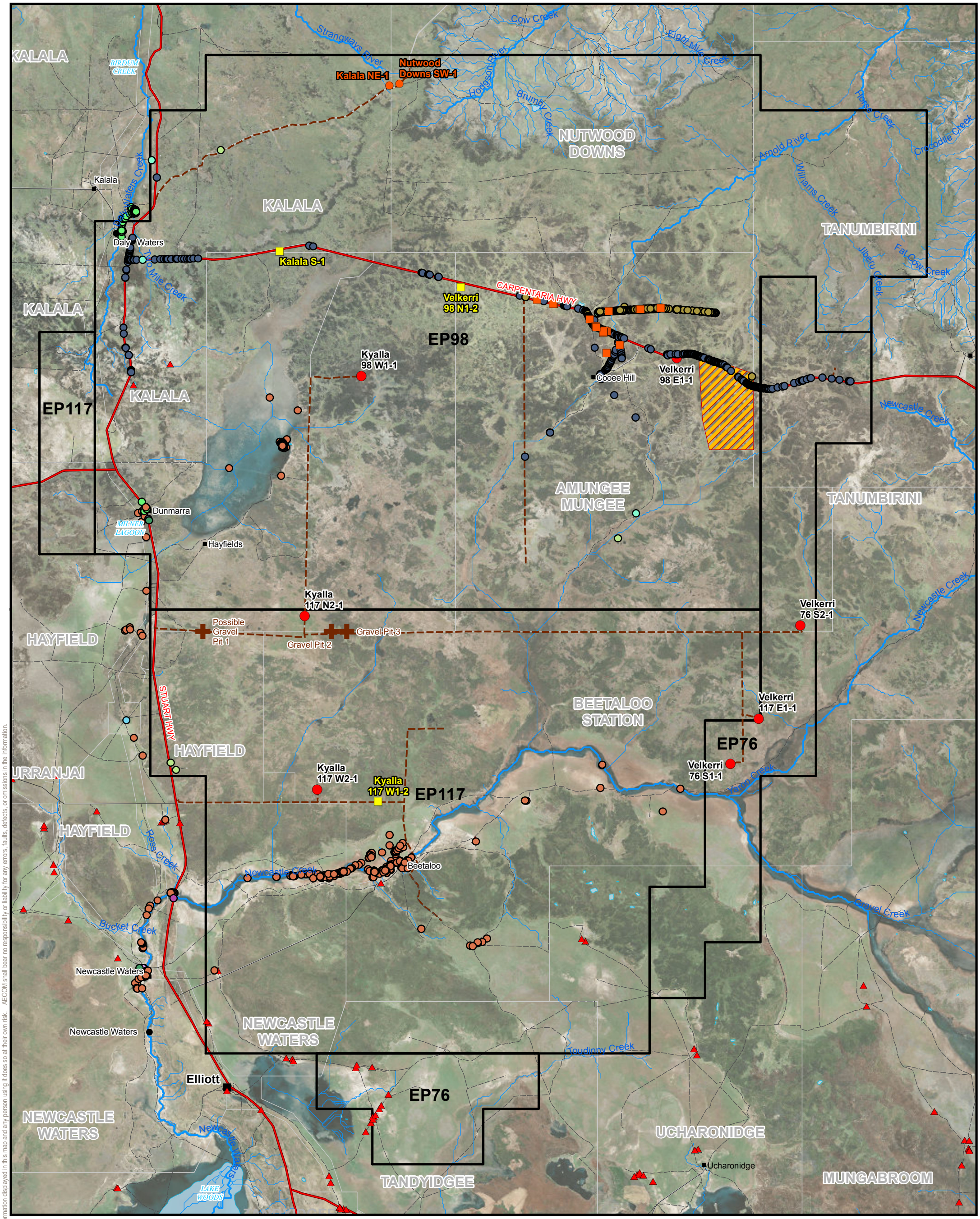
Eucalyptus/Corymbia woodland provides habitat for a range of species. The proposed sites had high native grass cover and included numerous species suitable for granivorous birds (seed eaters). Dense leaf litter and numerous logs provide suitable refuge and foraging sites for fauna such as reptiles. Although most of the species found in this vegetation type are widespread in the tropical savannas of the NT, 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.

4.6.4.1 Threatened Fauna

A search of the DotEE Protected Matters database of nationally significant fauna (PMST), the NTG 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 20 fauna species listed as threatened under the EPBC Act and/or the TPWC Act (Table 11). 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 groundwater monitoring bore 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.



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GEOCENTRIC DATUM OF AUSTRALIA 94

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Kilometers

1:570,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Existing Well 2016
- Proposed Well 2016
- Homestead
- Place Name
- Populated Place
- Major Stream
- Minor Stream
- Highway
- Minor Road
- Tracks
- Access Routes
- Cadastre
- Permit Areas
- Bullwaddy Conservation Reserve

Weed Name

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

LOCATION

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

ORIGIN ENERGY RESOURCES LIMITED 2018 SCOUTING PLAN

Weeds of the Permit Area

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure 4

Filename: P:\604x\60480548\4. Tech Work Area\4.99 GIS\02_MXDs\August2018_Scouting\G60480548_Map4_Weeds_20180913_v1_A3.mxd

A3 size

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 and 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, again 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 11 EPBC and TPWC Listed Threatened Species and Likelihood of Occurrence in EP136

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 groundwater monitoring bore sites)

4.6.5 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 at present or 1-2 years previously was recorded. In previous surveys of the permit area cat tracks were observed as the only non-native species recorded however 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 was 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 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 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 are the impacts on EPBC listed species such as reptiles, and ground-dwelling birds. Feral cats are believed to be one of the 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, with the potential to increase their abundance in the landscape, and their control should be taken into consideration during 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.

4.6.6 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:

- Velkerri 76 S1-1 – Fire Frequency absent, no damage.
- Vekerri 76 S2-1 – Fire Frequency 2-3 years previous, Intensity 1 (minor scars on some trees/shrubs and Height <1m.
- Velkerri 98 E1-1 – Fire Frequency 1-2 years previous, Intensity 2 (minor scars on most trees/shrubs) and Height 1-4 m.
- Velkerri 98 N1-2 - Fire Frequency absent, no damage.
- 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.
- Velkerri 117 E1-1 – Fire Frequency 2-3 years previous, Intensity 1 (minor scars on some trees/shrubs) and Height 1-4 m.
- Kyalla 117 W1-2 – Fire Frequency absent, no damage.
- Kyalla 98 W1-1 – (assessed from the air) Fire Frequency absent, no damage.

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

4.7 Land Condition Summary

Detailed land condition description and photographs of each of the proposed lease areas (Velkerri 76 S1-1, Velkerri 76 S2-1, Velkerri 98 E1-1, Velkerri N1-2, Kyalla 117 N2-1, Velkerri 117 E1-1 Kyalla 117 W1-2 and Kyalla 98 W1-1) are provided in Table 12 to Table 19

Table 12 Velkerri 76 S1-1 Condition Description

Site ID	Velkerri 76 S1-1	Habitat photos at central point of survey site (August 2018)
Location	-17°3' 48.91, 134°17' 21.05	   
Landform and soil	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils, some gravels.	
Broad habitat type	*Eucalyptus* low woodland	
Habitat description	*Eucalyptus* low woodland/*Eucalyptus* (mixed) low open woodland/Iseilema (mixed) tussock grassland	
Dominant flora species	Canopy dominated by *Corymbia dichromophloia, Bauhinia cunninghamii.* Shrub layer including *Acacia lysiphloia, Hakea arborescens, Terminalia canescens.* Ground layer species include *Aristida latifolia, Heteropogon contortus.*	
Habitat condition	Habitat in good condition with some evidence of recent grazing (5-25% growth removed). Scattered large hollow bearing trees and logs. The large hollows providng suitable nesting and shelter for numerous fauna species including reptiles, arboreal mammals, and nocturnal birds. The habitat contained abundant refuge opportunities in the form of dense grass cover, woody debris and scattered leaf litter. 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 13 Velkerri 76 S2-1 Condition Description

Site ID	Velkerri 76 S2-1
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.
Broad habitat type	*Eucalyptus low woodland*
Habitat description	*Eucalyptus* low woodland/low open tussock grassland
Dominant flora species	Canopy dominated by *Corymbia dichromophloia*, *Erythrophleum chlorostachys*. Shrub layer including *Eucalyptus sp*. Ground layer species include *Aristida latifolia, Pterocaulon sphacelatum, Triodia bitexta.*
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.
Potential Listed Threatened Species	Grey Falcon, Northern Shrike-tit, Plains Death Adder, Gouldian Finch.

Habitat photos at central point of survey site (August 2018)




Additional Habitat Photos across survey site (August 2018)


Table 14 Velkerri 98 E1-1Condition Description

Site ID	Velkerri 98 E1-1	Habitat photos at central point of survey site (August 2018)
Location	-16°27' 14.28, 134°12' 30.84	   
Landform and soil	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils	
Broad habitat type	Acacia woodland	
Habitat description	Acacia low woodland/Eragrostis (mixed) low open tussock grassland	
Dominant flora species	Canopy dominated by sparce stands of *Acacia shirlyi* (Lancewood), Bullwaddy, *Corymbia dichromophloia.* Shrub layer including *Acacia holosericea*, *Alphitonia pomaderroides*, *Petalostigma pubescens*, *Terminalia arostrata.* Ground layer species include Arostida sp, *Gomphrena canescens, Heteropogon contortus, Pterocaulon sphacelatum, Ptilotus clementii, Sehima nervosum*.	
Habitat condition	Good condition with evidence of recent grazing. Low density of large hollow bearing trees and logs. 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 15 Velkerri 117 E1-1 Condition Description

Site ID	Velkerri 117 E1-1	Habitat photos at central point of survey site (August 2018)
Location	-16°59' 45.09, 134°19' 54.12	   
Landform and soil	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils	
Broad habitat type	*Eucalyptus low woodland*	
Habitat description	*Eucalyptus* low woodland/*Eucalyptus* (mixed) low open woodland/*Iseilema* (mixed) tussock grassland	
Dominant flora species	Canopy dominated by *Corymbia dichromophloia, Eucalyptus sp*. and *Macropteranthes kekwickii* (Bullwaddy). Shrub layer including *Bauhinia cunninghamii, Erythrophleum chlorostachys.* Ground layer species included *Aristida latifolia* and *Pterocaulon sphacelatum.*	
Habitat condition	Good condition with evidence of recent grazing (<1% growth removed). Hollow bearing trees and logs were present throughout the area. The habitat contained moderate refuge opportunities in the form of leaf litter, grass cover, and woody debris. Good continuous cover adjoining adjacent woodland habitat. No evidence of weeds or feral animals. Trees noted to be in water stress.	**Additional Habitat Photos across survey site (August 2018)**  
Potential Listed Threatened Species	Grey Falcon, Northern Shrike-tit, Plains Death Adder, Gouldian Finch.	

Table 16 Velkerri 98 N1-2 Condition Description (previously Amungee NW-1H)

Site ID	Velkerri 98 N1-2	Habitat photos at central point of survey site (August 2018)
Location	-16°20' 38.17, 133°53' 2.76	   
Landform and soil	Two types: laterite, ferruginous rubble, some red soil and sandy and loamy soil with some lateritic material on undulating plain	
Broad habitat type	Very open eucalypt woodland	
Habitat description	Open woodland with dense shrub cover and grass cover. Denser woodland surrounds site	
Dominant flora species	Canopy dominated by *Corymbia drysdalensis*, *C. ferruginea* and *Erythrophleum chlorostachys*. Diverse subcanopy/shrub layer including *Petalostigma pubescens*, *Terminalia canescens*, *Atalaya hemiglauca*, *Hakea arborescens*, *Grevillea pteridifolia*, *Carissa lanceolata*, *Dodonea* sp., *Flueggia virosa*, *Grevillea striata*, *Alphitonia pomaderroides*. Very dense grass cover including *Themeda triandra*, *Chrysopogon fallax*, *Heteropogon contortus*, *Sarga plumosum.* Other species include *Grewia retusifolia*, *Ptilotus polystachyus*, *Evolvulus alsinoides*, *Cleome viscosa*.	
Habitat condition	Previous exploration activities (Amungee NW-1H). Habitat disturbances include grazing and prior clearing. No recent fire. The weed *Hyptis suaveolens* present on access track. Evidence of cattle from wet/early dry season. Very dense grass cover provides cover for small mammals and reptiles. Abundance of shelter sites in the form of hollow logs for mammals and reptiles.	**Additional Habitat Photos across survey site (August 2018)**    
Potential Listed Threatened Species	Grey Falcon, Northern Shrike-tit, Plains Death Adder, Gouldian Finch.	

Table 17 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	
Broad habitat type	*Corymbia* low woodland	
Habitat description	*Corymbia* low woodland/*Terminalia* (mixed) sparse shrubland/*Chrysopogon* (mixed) low tussock grassland	
Dominant flora species	Canopy dominated by *Corymbia dichromophloia, Eucalyptus setosa*. Shrub layer including *Acacia ancistrocarpa, Alphitonia pomaderroides, Brachychiton paradoxus.* Ground layer species include *Triodia bitexta*	
Habitat condition	Good condition with evidence of recent grazing. Vegetation appeared to have been 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. 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 18 Kyalla 98 W1-1 Condition Description (aerial assessment only)

Site ID	Kyalla 98 W1-1	Habitat photos at central point of survey site (August 2018)
Location	-16°28' 50.85, 133°44' 5.33	   
Landform and soil	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils	
Broad habitat type	Acacia woodland	
Habitat description	Acacia woodland/Eragrostis (mixed) low open tussock grassland	
Dominant flora species	*Acacia shirlyii*	
Habitat condition	Assessed from the air due to dense canopy of *Acacia shirlyii* Good condition with evidence of grazing. Unable to assess hollows, the habitat contained extensive refuge opportunities in the form of dense leaf litter 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, Painted Honey Eater, Plains Death Adder, Gouldian Finch.	

Table 19 Kyalla 117 W1-2 Condition Description (previously Beetaloo W-1)

Site ID	Kyalla 117 W1-2	Habitat photos at central point of survey site (August 2018)
Location	-17°7' 13.74, 133°45' 35.75	   
Landform and soil	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils	
Broad habitat type	Open eucalypt woodland	
Habitat description	*Open woodland with a dense shrub (Acacia) and grass layer*	
Dominant flora species	Canopy dominated by *Acacia shirlyi, Bullwaddy, Corymbia dichromophloia*. Shrub layer including *Acacia lysiphloia, Acacia polycarpa, Terminalia canescens.* Ground layer species include *Aristida latifolia, Gardenia ewartii, Triodia bitexta*	
Habitat condition	Good condition with evidence of grazing. Hollow bearing trees and logs were sparse throughout the area. The habitat contained moderate refuge opportunities in the form of leaf litter, grass cover, and woody debris. Good continuous cover adjoining adjacent woodland habitat. Vegetation is noted to be multi-aged with some fire scars, suggesting this is the cause of the age differences. No evidence of weeds or feral animals. No wetlands recorded, however it was noted that more bird calls were present at this location.	**Additional Habitat Photos across survey site (August 2018)**  
Potential Listed Threatened Species	Grey Falcon, Northern Shrike-tit, Australian Painted Snipe Plains Death Adder, Gouldian Finch.	

5.0 Conclusion

During August 2018, AECOM undertook a land condition assessment of the eight-proposed groundwater monitoring bore lease areas and access tracks to provide a baseline assessment of ecological conditions in support of Origin Energy's application to the NT DPIR. Origin's program for 2018 is for the installation of environmental monitoring bores located adjacent to current and proposed future exploration lease areas to collect baseline groundwater level and quality data in preparation for the 2019 exploration program.

The LCA identified the ecological conditions and documented the site condition prior to Origin commencement of exploration within their Permit Areas EP76, EP98 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 their natural state.

The proposed groundwater monitoring bore drilling program is a low impact activity due to the use of 205 km of existing access tracks of the total 220 km of tracks required to access the proposed sites.

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 assisted to develop mitigation measures to minimise Origin's impact on the environment.

During the survey, all proposed groundwater monitoring bore 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 groundwater monitoring bore 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 groundwater monitoring bore drilling EMP would assist in minimising the impacts from Origin's activities on EPBC listed species and communities.

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Appendix A

Field Maps

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8178400 8178200 8178000 8177800 8177600 8177400 8177200 8177000 8176800 8176600

EP98

Kyalla
98 W1-1

SHENANDOAH
EAST

AECOM
www.aecom.com

N

Projection: GDA94 MGA Zone 53

0 50 100 200

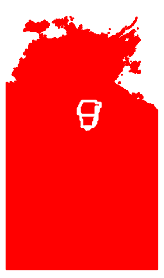
Meters

1:6,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

LOCATION



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Places, Vegetation - Aust Gov 2014
Highways, Roads, Drainage -

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Kyalla 117 N2-1

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
1A

A3 size

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8178400 8178200 8178000 8177800 8177600 8177400 8177200 8177000 8176800 8176600

EP98

Kyalla
98 W1-1

SHENANDOAH
EAST

AECOM
www.aecom.com

N

Projection: GDA94 MGA Zone 53

0 50 100 200

Meters

1:6,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

Vegetation Community

- Acacia low woodland/Eragrostis (mixed) low open tussock grassland
- Unknown

LOCATION

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Kyalla 117 N2-1
Vegetation Community

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
1B

A3 size

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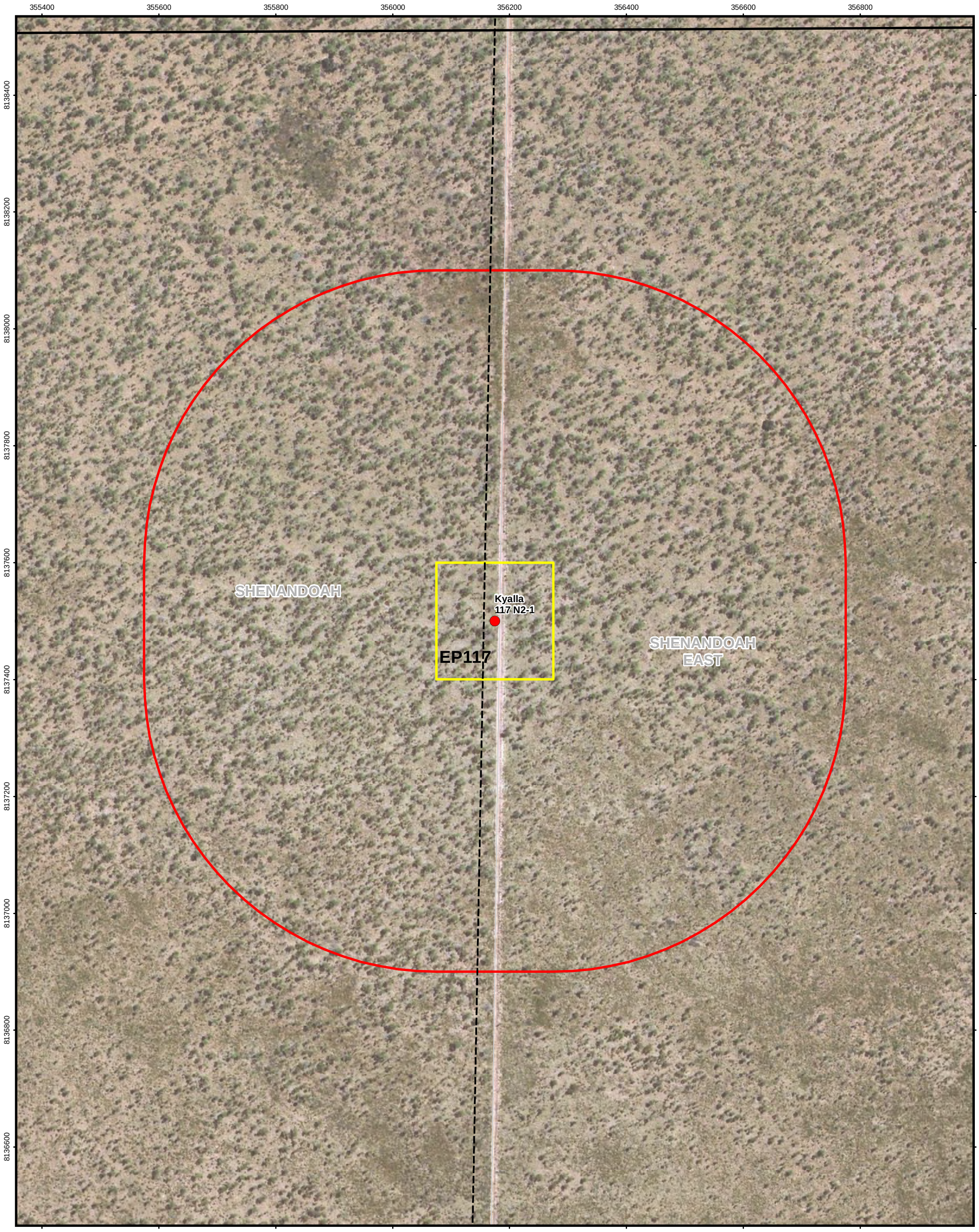

AECOM
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Projection: GDA94 MGA Zone 53

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Meters

1:6,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

LOCATION

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Kyalla 117 N2-1

PROJECT ID	60480548
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LAST MODIFIED	03-Oct-2018
VERSION	1

Figure 2A

A3 size

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SHENANDOAH

Kyalla
117 N2-1

EP117

SHENANDOAH
EAST

AECOM
www.aecom.com

N

Projection: GDA94 MGA Zone 53

0 50 100 200

Meters

1:6,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

Vegetation Community

- Corymbia low woodland/Terminalia (mixed) sparse shrubland/Chrysopogon (mixed) low tussock grassland

LOCATION

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Kyalla 117 N2-1
Vegetation Community

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
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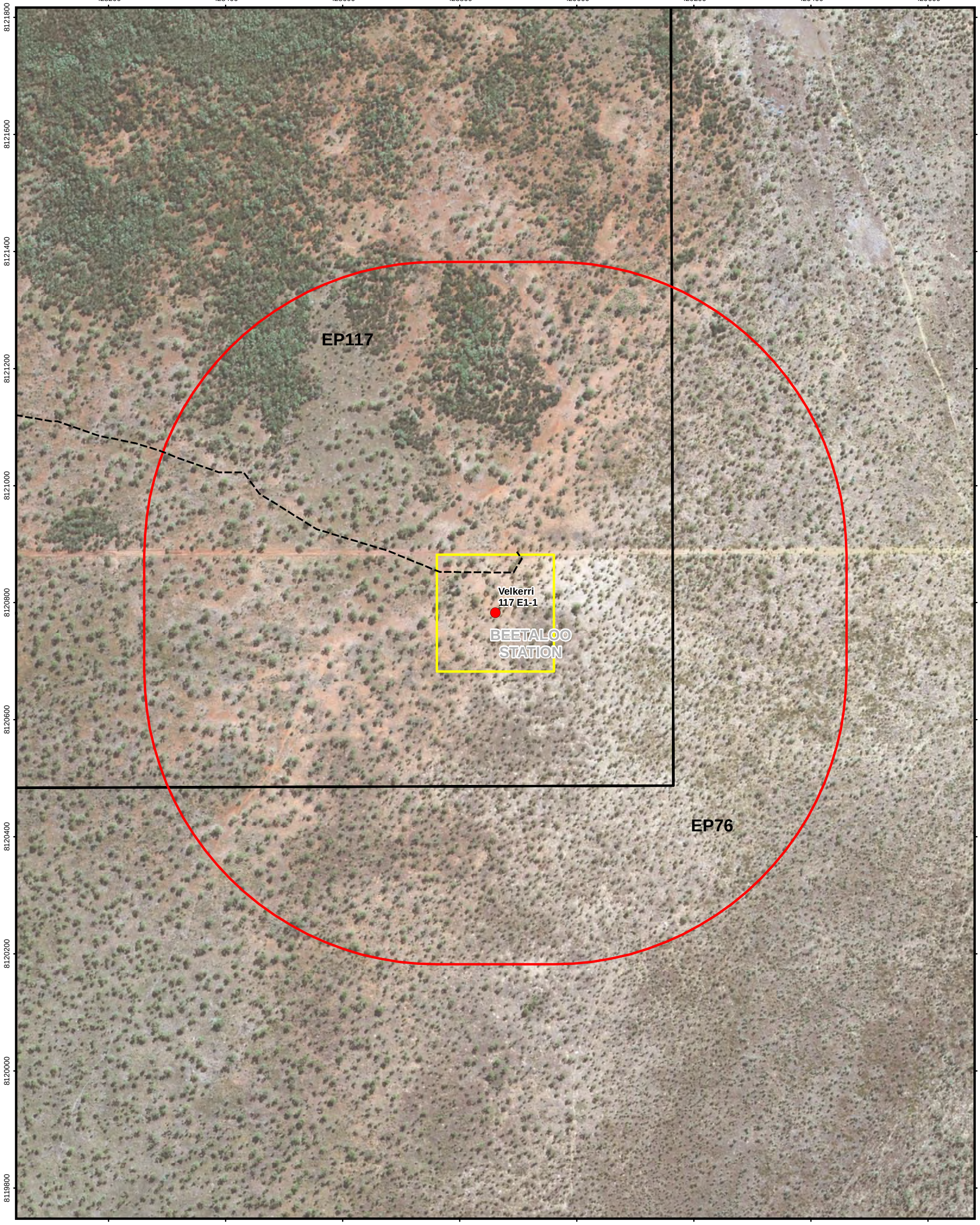

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Projection: GDA94 MGA Zone 53

0 50 100 200

Meters

1:6,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Velkerri 117 E1-1

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
3A

A3 size

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EP117

Velkerri
117 E1-1

BEETALOO
STATION

EP76

AECOM
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N

Projection: GDA94 MGA Zone 53

0 50 100 200
Meters

1:6,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

Vegetation Community

- Acacia low open forest/Eriachne (mixed) low open tussock grassland
- 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 2014.
Places, Vegetation - Aust Gov 2014
Highways, Roads, Drainage - StreetPro 2014

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Velkerri 117 E1-1
Vegetation Community

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
3B

A3 size

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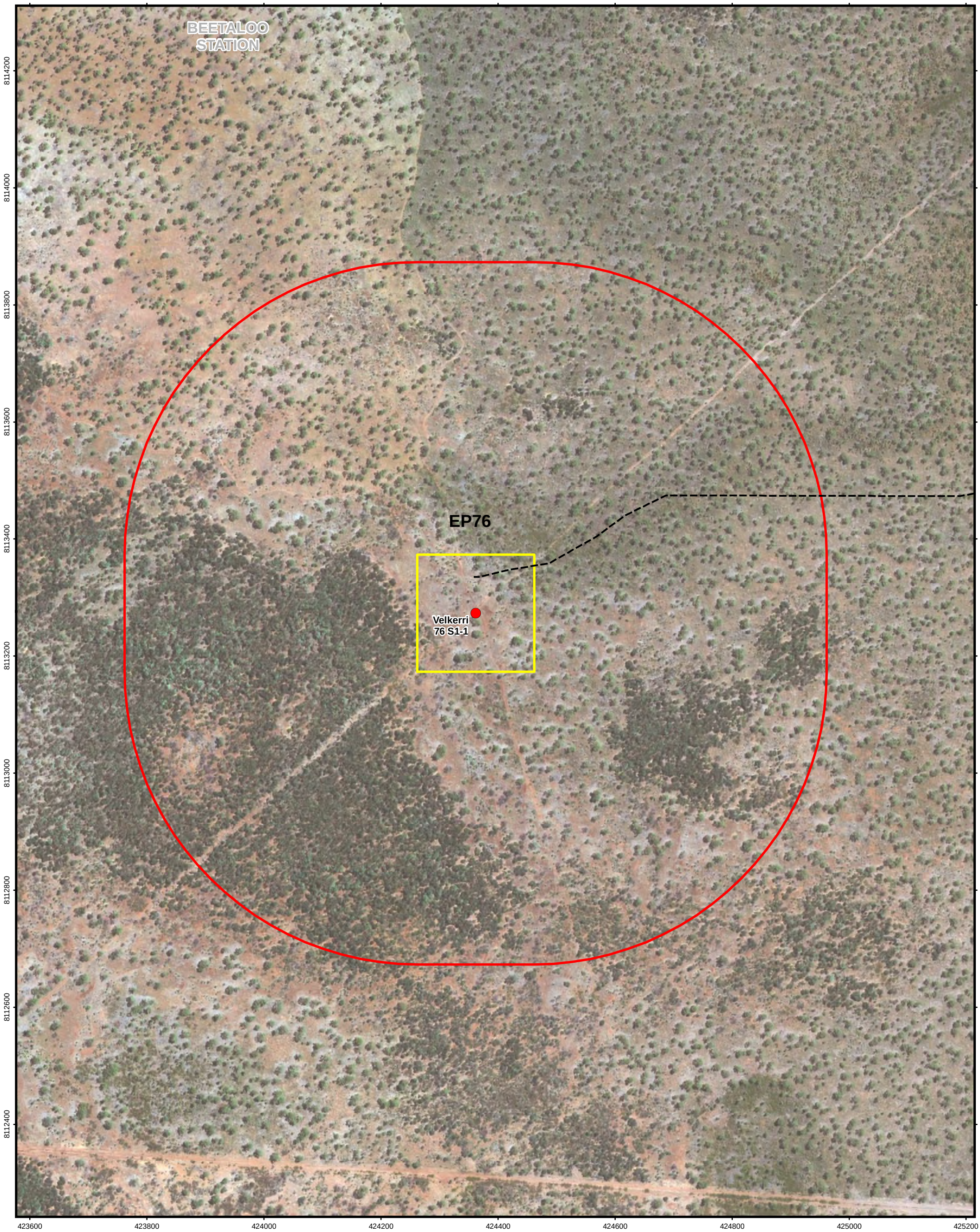

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N

Projection: GDA94 MGA Zone 53

0 50 100 200

Meters

1:6,000 (when printed at A3)

- Proposed Well
- Permit
- Proposed
- 4 Ha
- 500m

LOCATION

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Velkerri 117 E1-1

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure 4A

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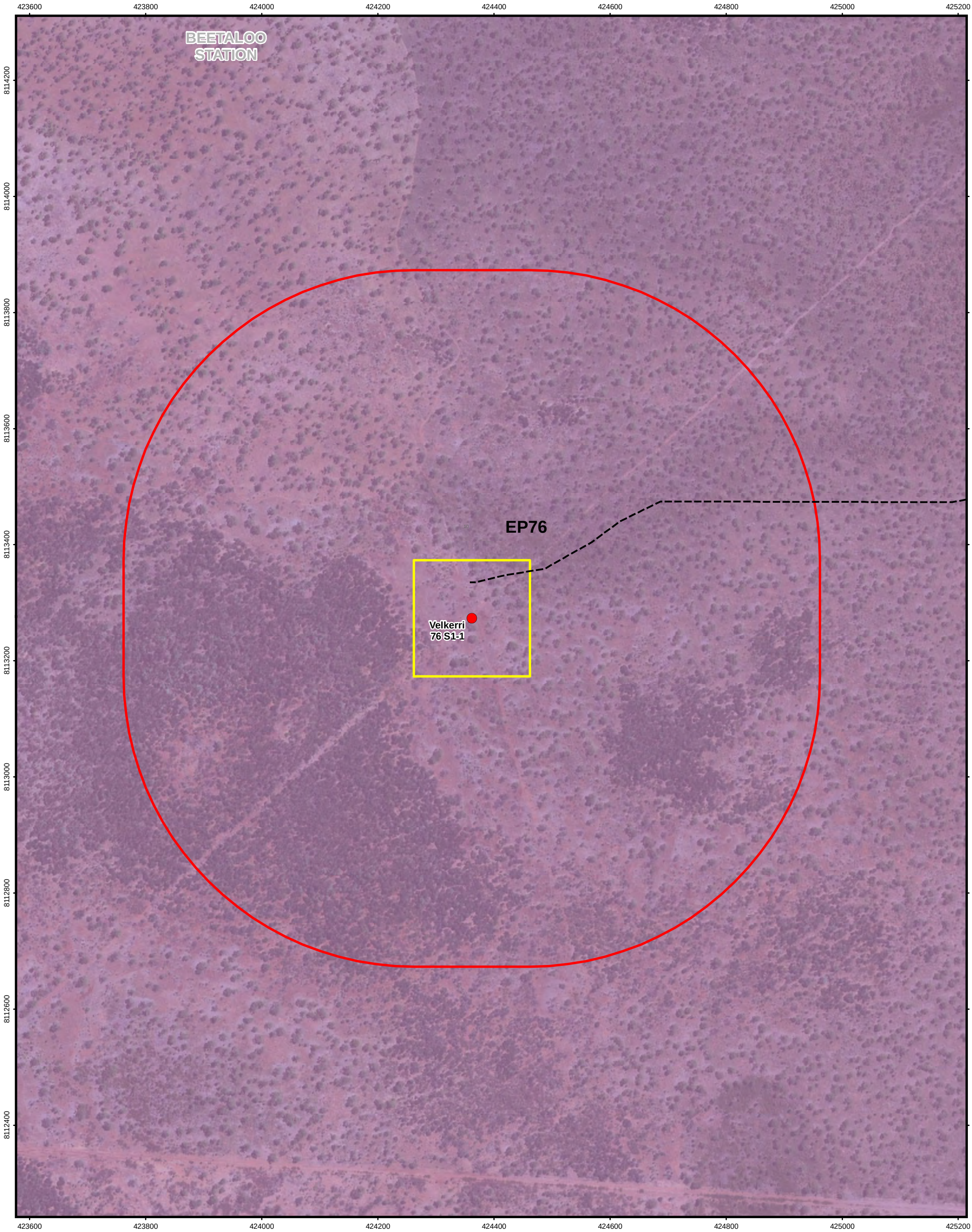

AECOM
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N

Projection: GDA94 MGA Zone 53

0 50 100 200

Meters

1:6,000 (when printed at A3)

- Proposed Well 2018
- Cadastre
- Permit
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

Vegetation

- Eucalyptus low woodland/Eucalyptus (mixed) low open woodland/Iseilema (mixed) tussock grassland

LOCATION

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Velkerri 117 E1-1
Vegetation Community

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure 4B

Filename: P:\604x\60480548\4. Tech Work Area\4.99 GIS\02_MXDs\August2018_Scouting\G60480548_Map_Velkerri76S1-1_20180822_v1_A3.mxd

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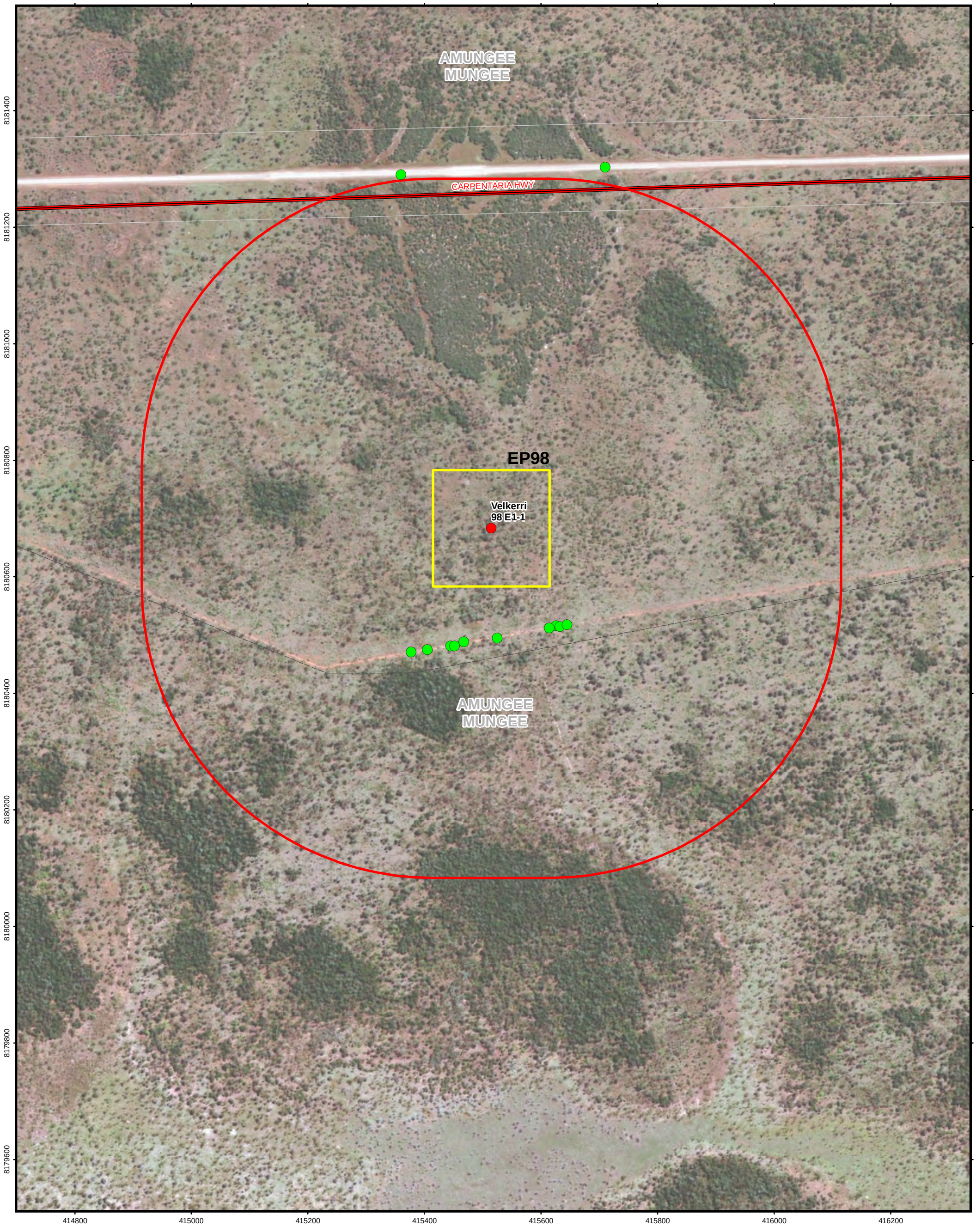

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Projection: GDA94 MGA Zone 53

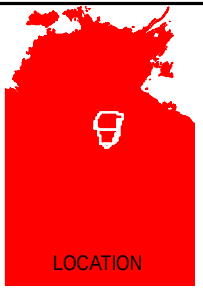
0 50 100 200

Meters

1:6,000 (when printed at A3)

LEGEND

- Weeds - Hyptis
- Proposed Well 2018
- Highway
- Tracks
- Cadastre
- Permit Areas
- 4 Ha Boundary
- 500m Buffer



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Places, Vegetation - Aust Gov 2014
Highways, Roads, Drainage - StreetPro 2014

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Velkerri 98 E1-1

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
5A

Filename: P:\604x\60480548\4. Tech Work Area\4.99 GIS\02_MXDs\August2018_Scouting\G60480548_Map_Velkerri98E1-1_20180822_v1_A3.mxd

A3 size

AMUNGEE
MUNGEE

CARPENTARIA HWY

EP98

Velkerri
98 E1-1

AMUNGEE
MUNGEE

414800 415000 415200 415400 415600 415800 416000 416200

8181400 8181200 8181000 8180800 8180600 8180400 8180200 8180000 8179800 8179600

AECOM
www.aecom.com

N

Projection: GDA94 MGA Zone 53

0 50 100 200
Meters

1:6,000 (when printed at A3)

LEGEND

- Weeds - Hyptis
- Proposed Well 2018
- Highway
- Tracks
- Cadastre
- Permit Areas
- 4 Ha Boundary
- 500m Buffer

Vegetation Community

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

LOCATION

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Velkerri 98 E1-1
Vegetation Community

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
5B

A3 size

Filename: P:\604x\60480548\4. Tech Work Area\4.99 GIS\02_MXDs\August2018_Scouting\G60480548_Map_Velkerri98E1-1_20180822_v1_A3.mxd

AMUNGEE
MUNGEE

EP76

Velkerri
76 S2-1

434800 435000 435200 435400 435600 435800 436000 436200

8137200 8137000 8136800 8136600 8136400 8136200 8136000 8135800 8135600 8135400

AECOM
www.aecom.com

N

Projection: GDA94 MGA Zone 53

0 50 100 200
Meters

1:6,000 (when printed at A3)

LEGEND
- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

LOCATION

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Velkerri 76 S2-1

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
6A

A3 size

Filename: P:\604x\60480548\4. Tech Work Area\4.99 GIS\02_MXDs\August2018_Scouting\G60480548_Map_Velkerri76S2-1_20180822_v1_A3.mxd

AMUNGEE
MUNGEE

EP76

Velkerri
76 S2-1

434800 435000 435200 435400 435600 435800 436000 436200

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AECOM
www.aecom.com

N

Projection: GDA94 MGA Zone 53

0 50 100 200
Meters

1:6,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

Vegetation Community

- Acacia low woodland/Eragrostis (mixed) low open tussock grassland
- Eucalyptus low woodland/Eucalyptus (mixed) low open woodland/Iseilema (mixed) tussock grassland

LOCATION

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Velkerri 76 S2-1
Vegetation Community

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
6B

A3 size

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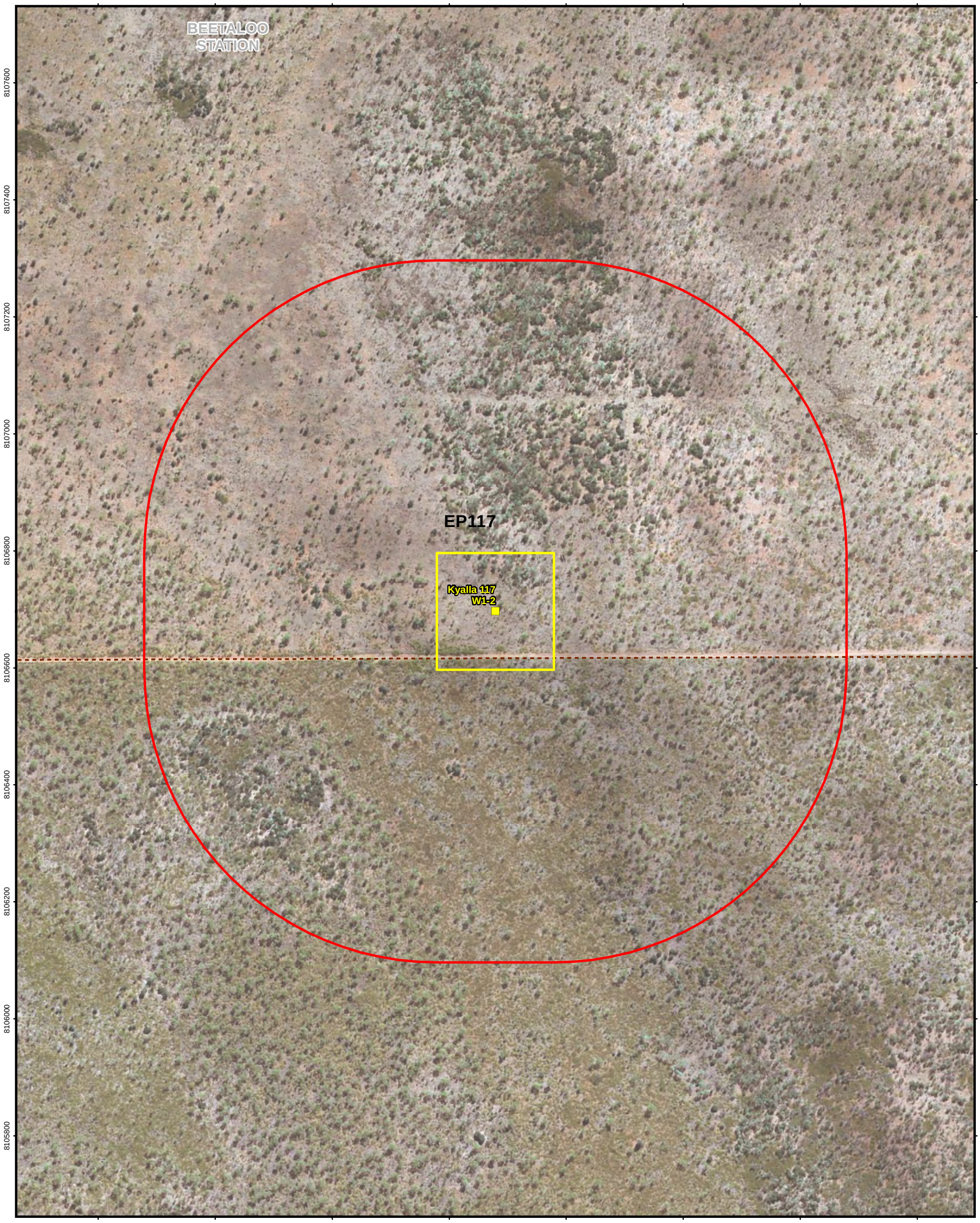

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N

Projection: GDA94 MGA Zone 53

0 50 100 200
Meters

1:6,000 (when printed at A3)

LEGEND

- Existing Well 2016
- Access Routes
- Cadastre
- Permit Areas
- 4 Ha Boundary
- 500m Buffer

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Kyalla 117 W1-2

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
7A

A3 size

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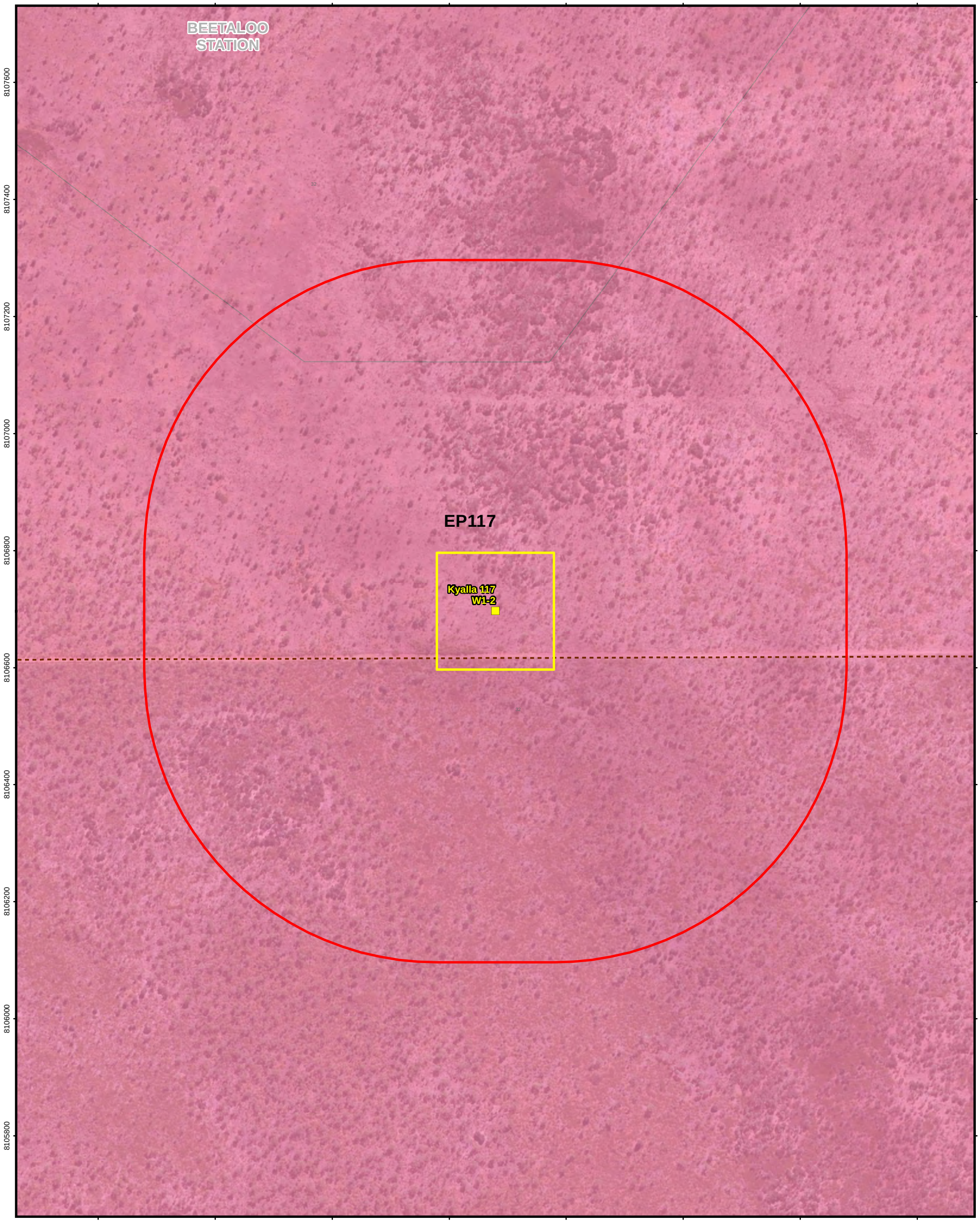

AECOM
www.aecom.com

N

Projection: GDA94 MGA Zone 53

0 50 100 200
Meters

1:6,000 (when printed at A3)

LEGEND

- Existing Well 2016
- Access Routes
- Cadastre
- Permit Areas
- 4 Ha Boundary
- 500m Buffer

Vegetation Community
- Unknown

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Kyalla 117 W1-2
Vegetation Community

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
7B

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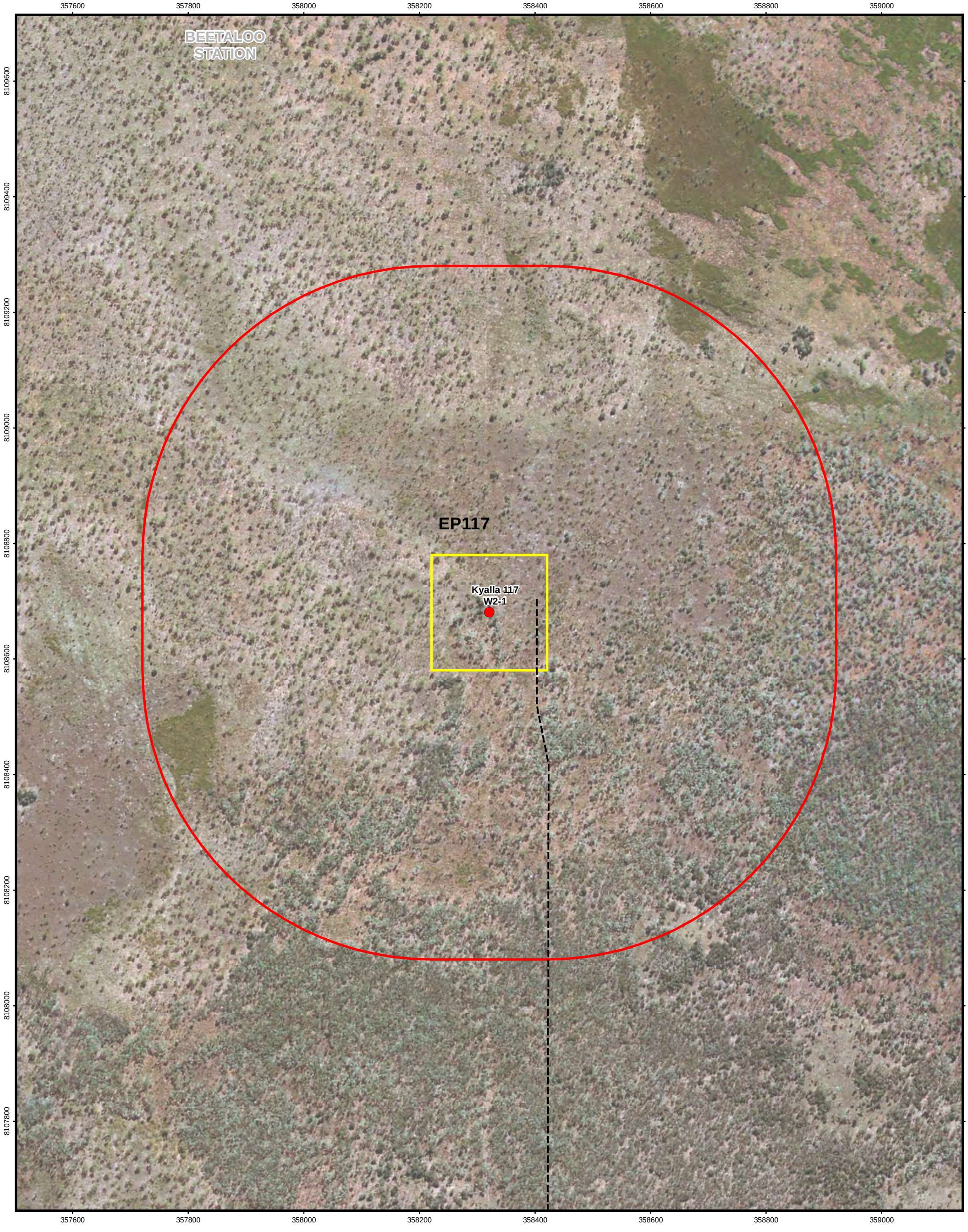

AECOM
www.aecom.com

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Projection: GDA94 MGA Zone 53

0 50 100 200

Meters

1:6,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

LOCATION

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

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Kyalla 117 W2-1

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

Figure
8A

Filename: P:\604x\60480548\4. Tech Work Area\4.99 GIS\02_MXDs\August2018_Scouting\G60480548_Map_Kyalla117W2-1_20180822_v1_A3.mxd

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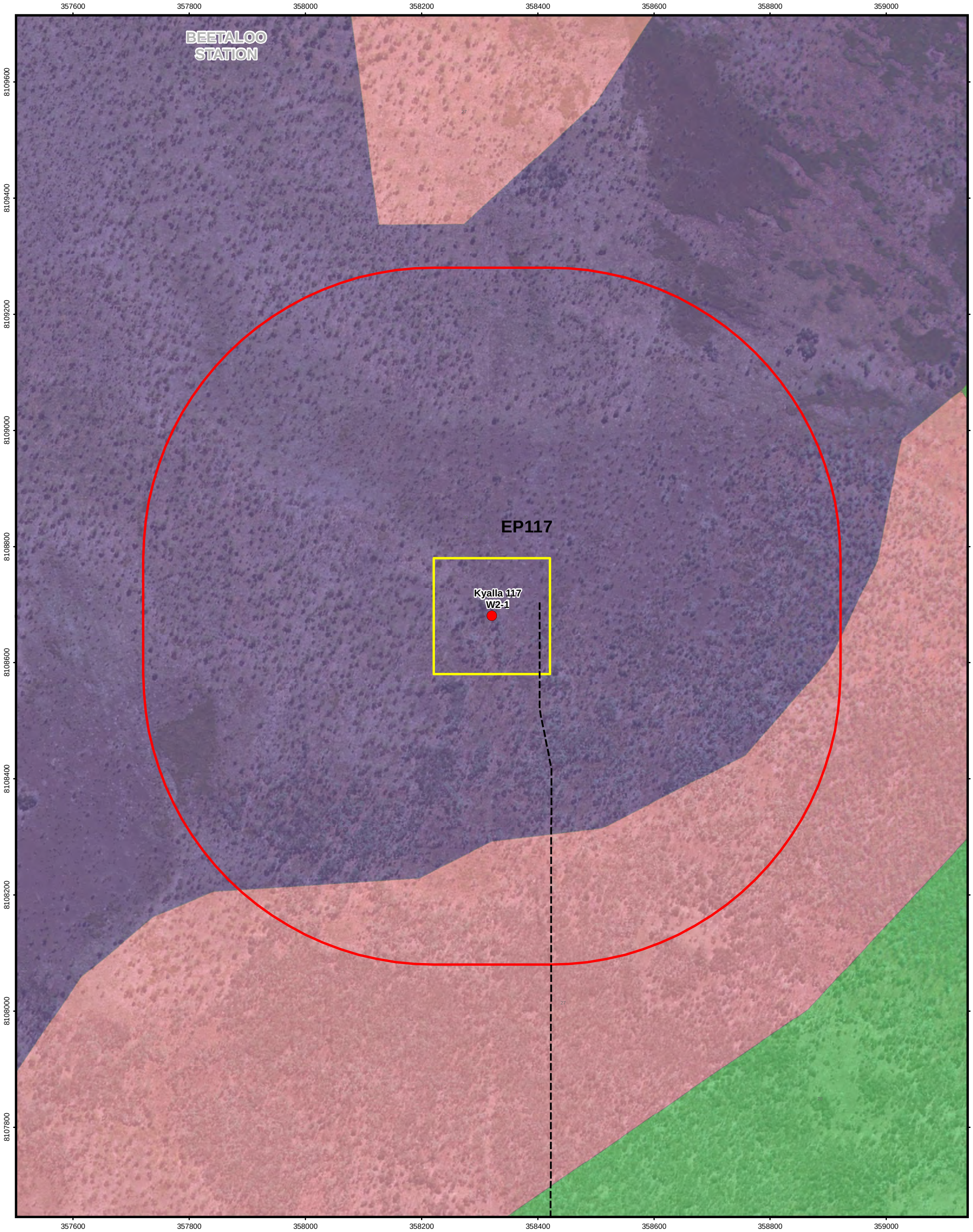

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www.aecom.com

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Projection: GDA94 MGA Zone 53

0 50 100 200

Meters

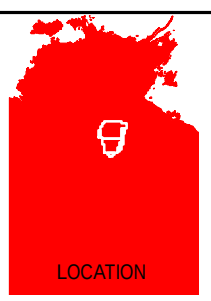
1:6,000 (when printed at A3)

LEGEND

- Proposed Well 2018
- Cadastre
- Permit Areas
- Proposed Tracks
- 4 Ha Boundary
- 500m Buffer

Vegetation Community

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



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Places, Vegetation - Aust Gov 2014
Highways, Roads, Drainage - StreetPro 2014

ORIGIN ENERGY RESOURCES LIMITED
2018 SCOUTING PLAN

Kyalla 117 W2-1
Vegetation Community

PROJECT ID	60480548
CREATED BY	justin.dwyer
LAST MODIFIED	03-Oct-2018
VERSION	1

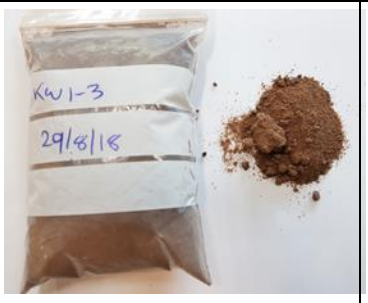
Figure
8B

Filename: P:\604x\60480548\4. Tech Work Area\4.99 GIS\02_MXDs\August2018_Scouting\G60480548_Map_Kyalla117W2-1_20180822_v1_A3.mxd

A3 size

Appendix B

Soil Test Results

Soil Id	Photo	Soil pH	Soil Colour	Dispersion Test Observations
KN2-1		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.
VS1-1		5.31	5YR 5/8	**Initial Observation** • light crumbling of sample when submerged in water. **Final Observation** • Non-dispersive, maintained shape and boundary of crumb clearly defined.
KW2-1		5.64	2.5YR 5/2	**Initial Observation** • Partially crumbed sample when submerged in water **Final Observation** • Non-dispersive, maintained shape and boundary of crumb clearly defined
KW1-3		5.71	7.5YR 4/6	**Initial Observation** • Partially crumbed sample when submerged in water **Final Observation** • Non-dispersive, maintained shape and boundary of crumb clearly defined
VE1-1		6.15	7.5YR 3/4	**Initial Observation** • Light crumbling of sample when submerged in water. **Final Observation** • Non-dispersive, maintained shape and boundary of crumb clearly defined.

Soil Id	Photo	Soil pH	Soil Colour	Dispersion Test Observations
V98 E1-1		5.64	10YR 3/6	**Initial Observation** • Light crumbling of sample when submerged in water. **Final Observation** • Non-dispersive, maintained shape and boundary of crumb clearly defined.
VS2-1		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 C

Flora Species Record,
August 2018

Appendix C Flora Species Record, August 2018

Table 20 Flora Species Recorded, August 2018 Field Survey

Family	Genus	Species
Amaranthaceae	*Gomphrena*	*canescens*
	Ptilotus	*clementii*
Asteraceae	*Pterocaulon*	*sphacelatum*
Caesalpiniaceae	*Bauhinia*	*cunninghamii*
	Erythrophleum	*chlorostachys*
Combretaceae	*Terminalia*	*canescens*
		arostrata
	Macropteranthes	*kekwickii*
Euphorbiaceae	*Petalostigma*	*pubescens*
Fabaceae	*Acacia*	*ancistrocarpa*
		holosericea
		lysiphloia
		shirleyi
		sp.
Lamiaceae	*Hyptis*	*suaveolens**
Myrtaceae	*Calytrix*	*exstipulata*
	Corymbia	*dichromophloia*
		drysdalensis
		ferruginea
Poaceae	*Aristida*	*holathera*
	Chrysopogon	*fallax*
	Enneapogon	*lindleyanus*
	Eragrostis	*spartinoides*
	Heteropogon	*contortus*
	Sarga	*plumosum*
	Schizachyrium	*fragile*
	Themeda	*triandra*
	Triodia	*bitextura*
		sp.

Family	Genus	Species
Proteaceae	*Grevillea*	*pteridifolia*
		striata
		wickhamii
	Hakea	*arborescens*
Rhamnaceae	*Alphitonia*	*pomaderroides*
Tiliaceae	*Grewia*	*retusifolia*

Appendix D

DotEE Protected Matters Search Report

Australian Government
Department of the Environment and Energy

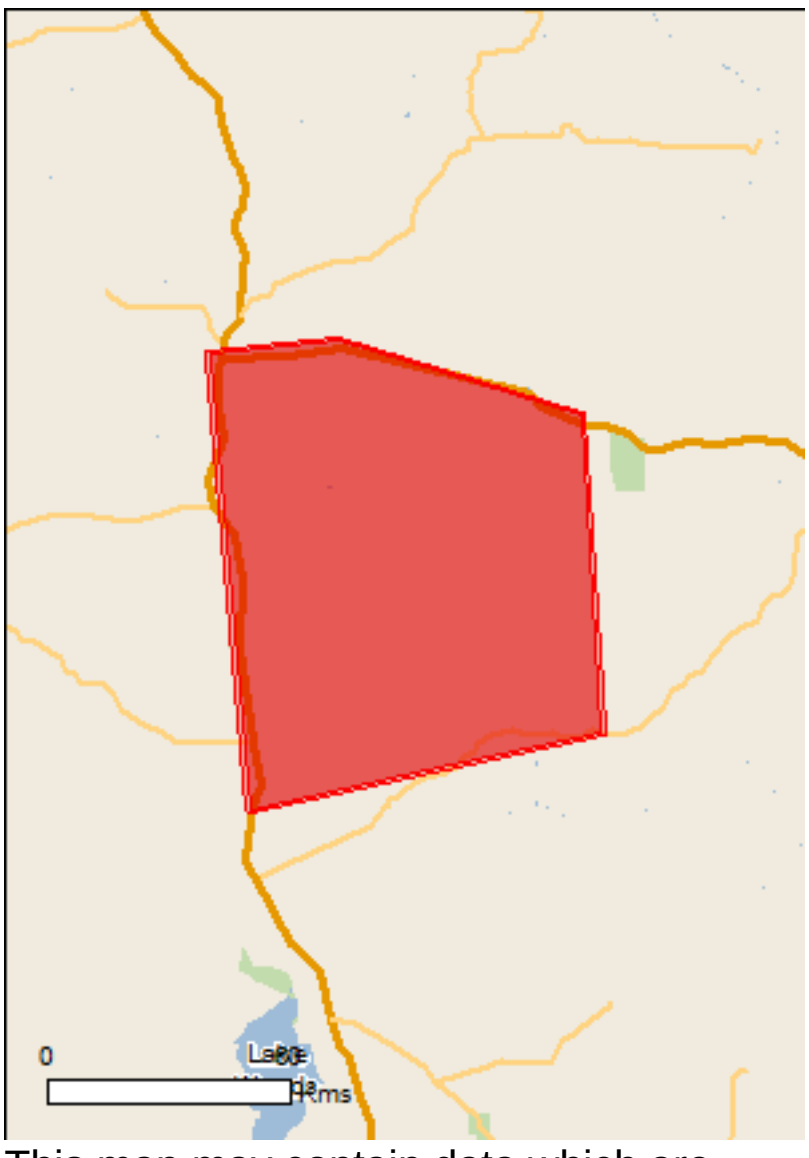
EPBC Act Protected Matters Report

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.

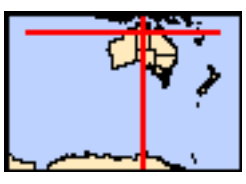
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

Report created: 27/08/18 10:22:23



Coordinates
Buffer: 1.0Km



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.

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Appendix E

NRM Infonet Report

Territory Natural Resource Management

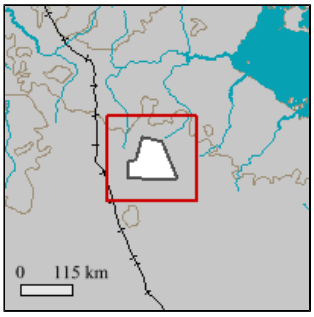
Northern Territory Government

CHARLES DARWIN UNIVERSITY

2018 Beetaloo

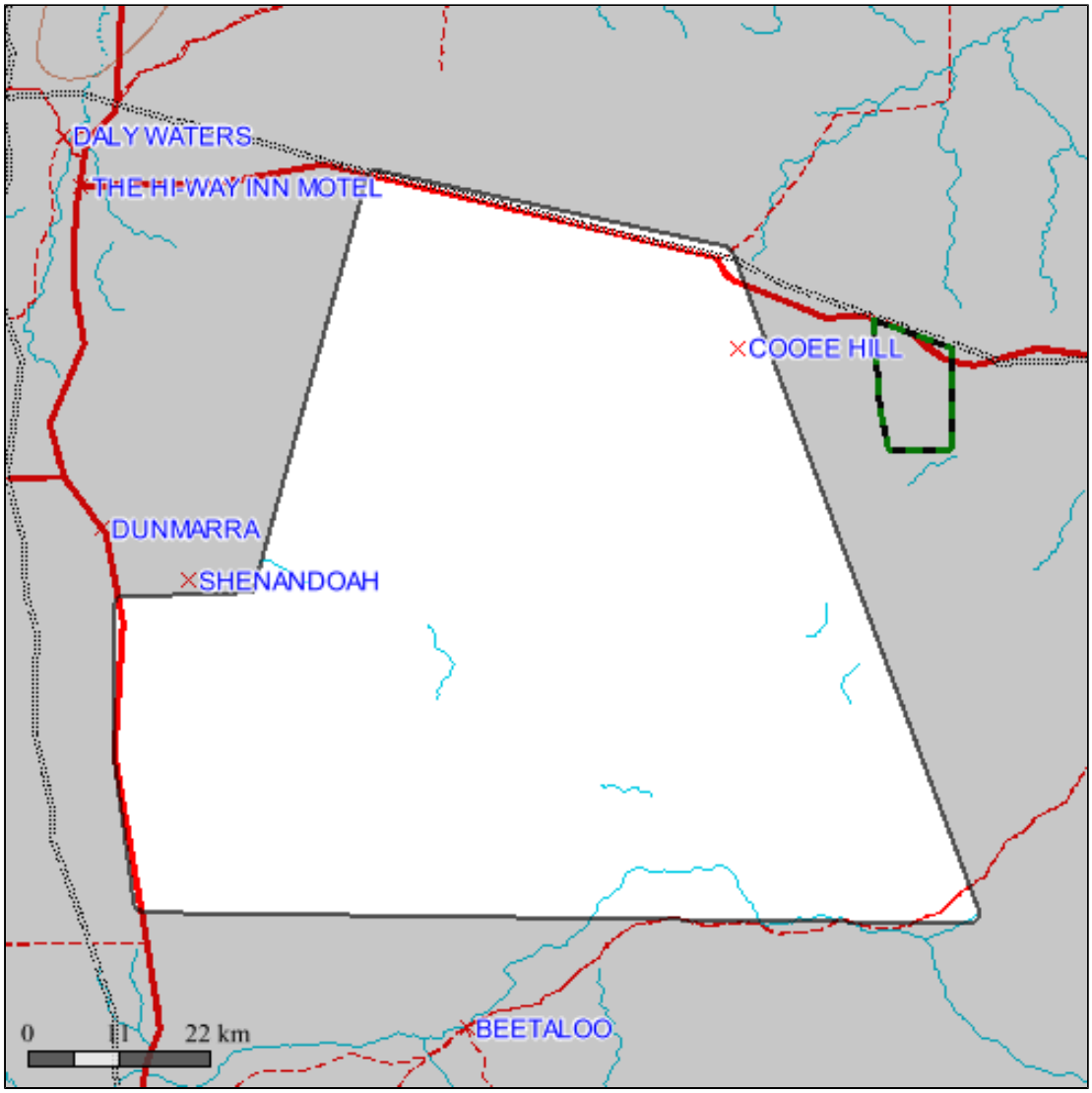
NT NRM Report

2018 Beetaloo



2018 Beetaloo encompasses an area of 6122.17 sq km extending from 16 deg 17.0 min to 17 deg 6.0 min S and 133 deg 25.0 min to 134 deg 21.0 min E.
2018 Beetaloo is located in the Sturt Plateau, bioregion(s)

Location of 2018 Beetaloo

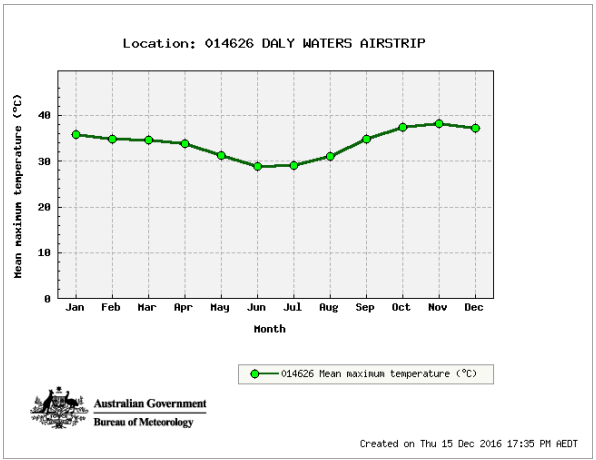


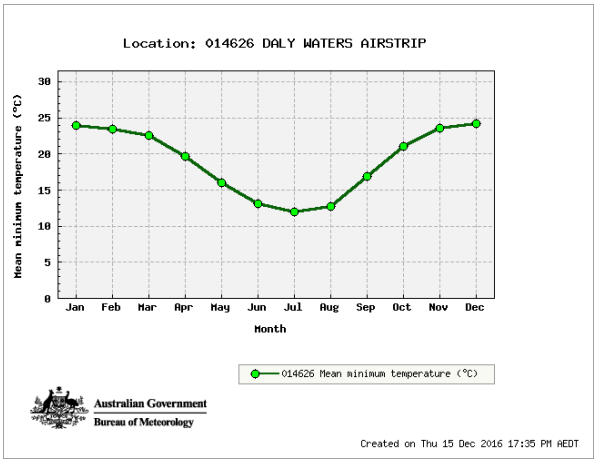
2018 Beetaloo Climate

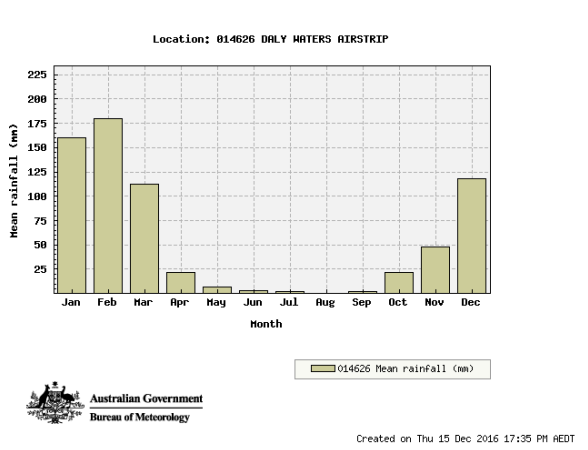
The closest long-term weather station is DALY WATERS AWS (16 deg 15.0 min S, 133.3782E) 72 km NW of the center of selected area

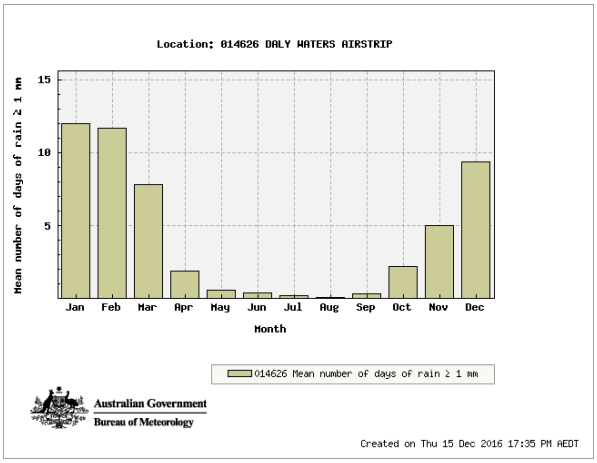
Statistics	Annual Values	Years of record
Mean max temp (deg C)	33.9	47
Mean min temp (deg C)	19.1	47
Average rainfall (mm)	676.7	45
Average days of rain	51.6	47

Climate summaries from Bureau of Meteorology (www.bom.gov.au)



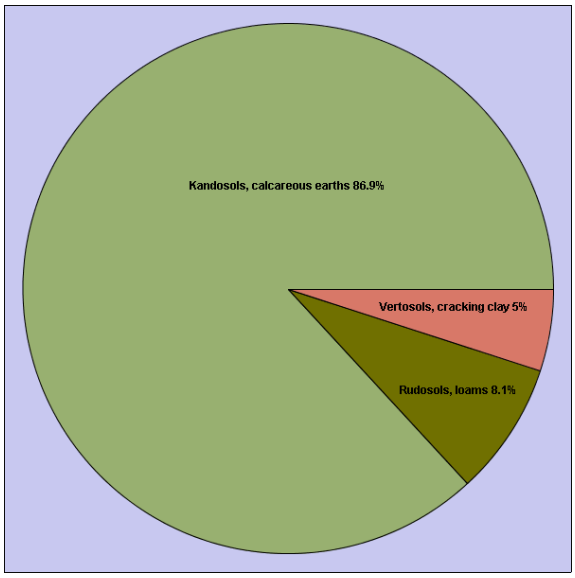






2018 Beetaloo Soils

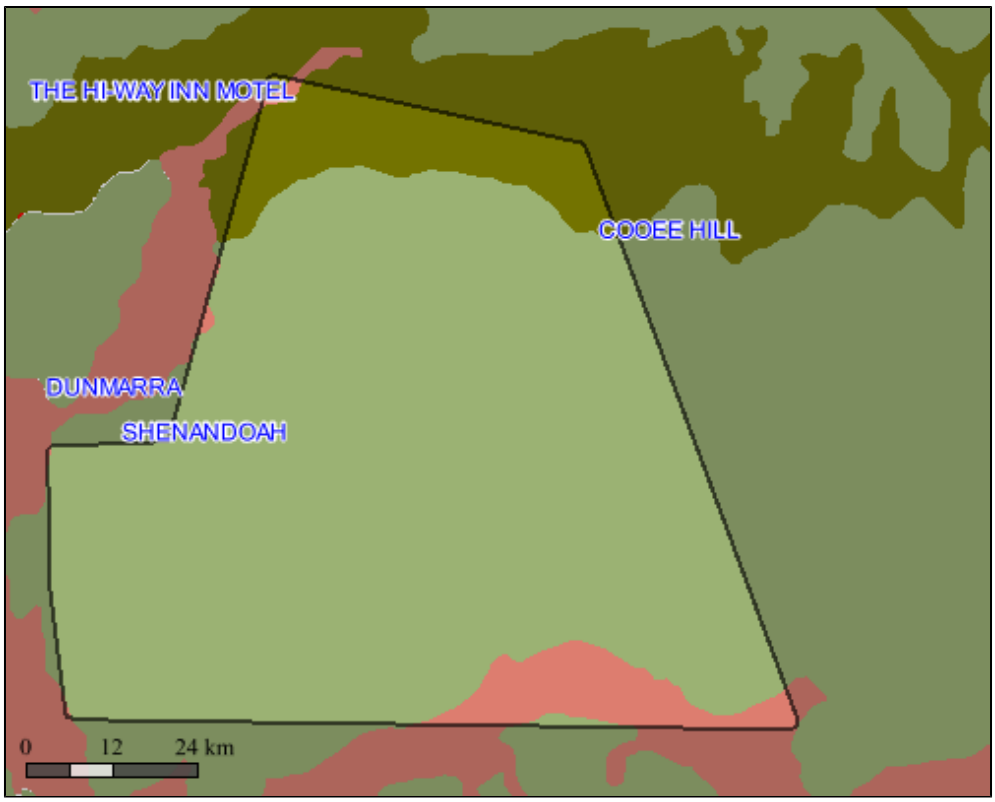
Soil Types



Area of soil types (Northcote Factual Key)

Category	Area sq km	Area%
Kandosols, calcareous earths	5317.28	86.85
Rudosols, loams	498.06	8.14
Vertosols, cracking clay	306.84	5.01

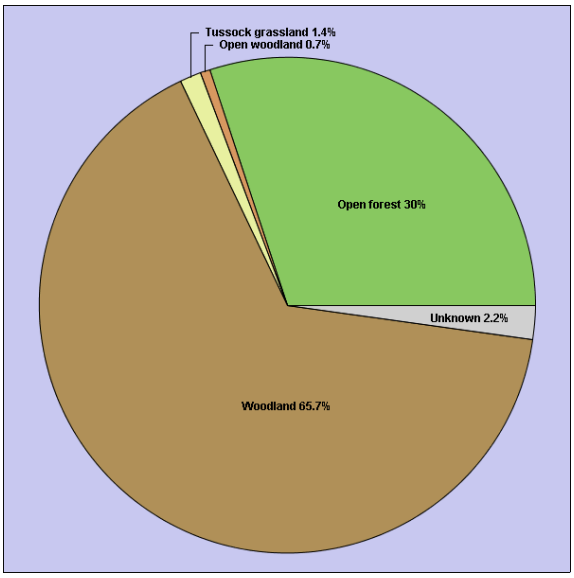
Soil Types



Soils 1:2M Layer is a copy of the NT portion (1:2,000,000 scale dataset) of the CSIRO Atlas of Australian Soils - K.H. Northcote et al. Data scale: 1:2,000,000 ANZLIC Identifier: 2DBCB771205D06B6E040CD9B0F274EFE
More details: Go to www.lrm.nt.gov.au/nrmapsnt/ and enter the ANZLIC identifier in the Spatial Data Search

2018 Beetaloo Vegetation

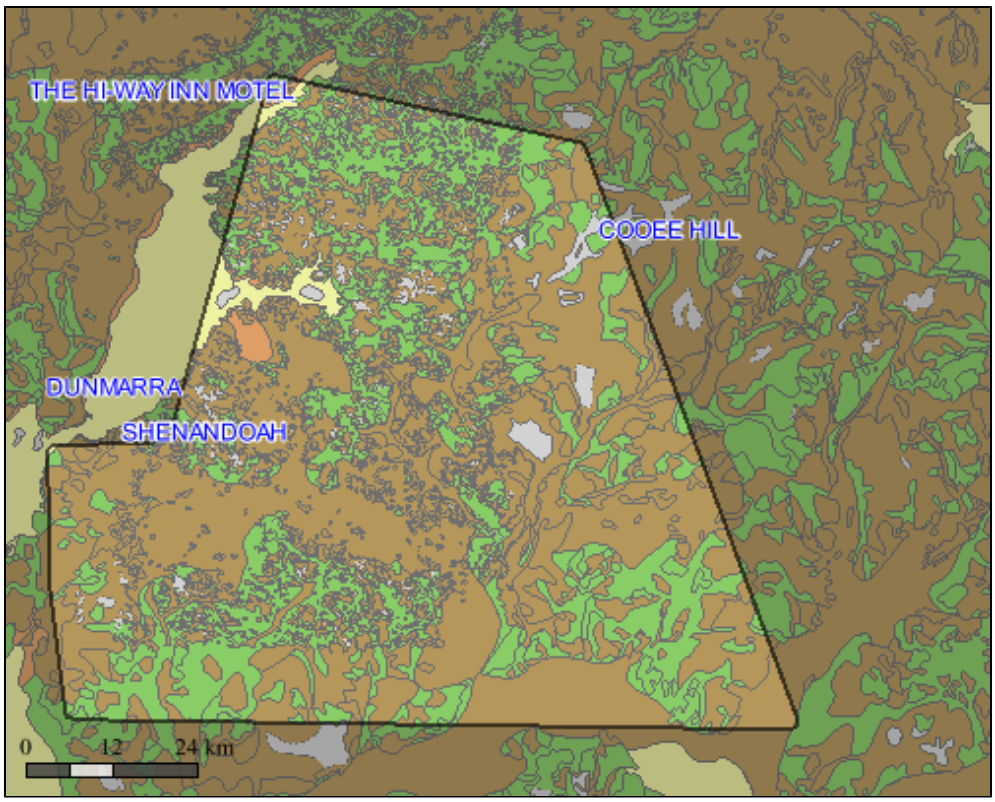
Vegetation Communities



Area of vegetation communities

Category	Area sq km	Area%
Woodland	4024.33	65.73
Open forest	1838.79	30.04
Unknown	134.56	2.20
Tussock grassland	83.22	1.36
Open woodland	41.27	.67

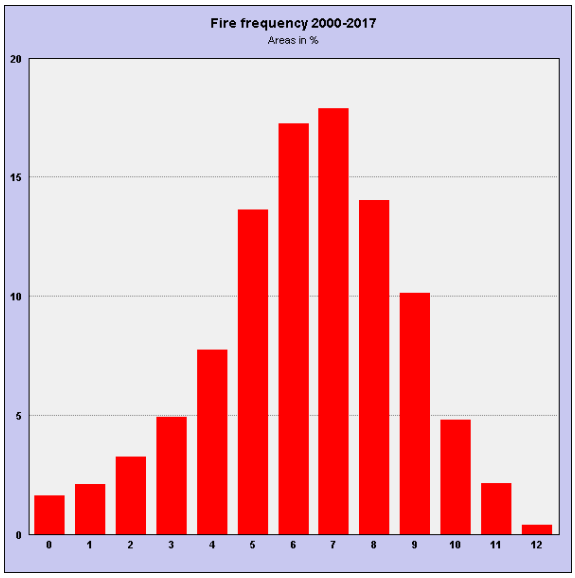
Vegetation Communities



The NVIS 2005 Layer is compiled from a number of vegetation and land unit survey maps that were recoded and re-attributed for the National Vegetation Information System (NVIS)
Data scale variable depending on location. ANZLIC Identifier:2DBCB771207006B6E040CD9B0F274EFE
More details:Go to www.lrm.nt.gov.au/nrmapsnt/ and enter the ANZLIC identifier in the Spatial Data Search

2018 Beetaloo Fire History

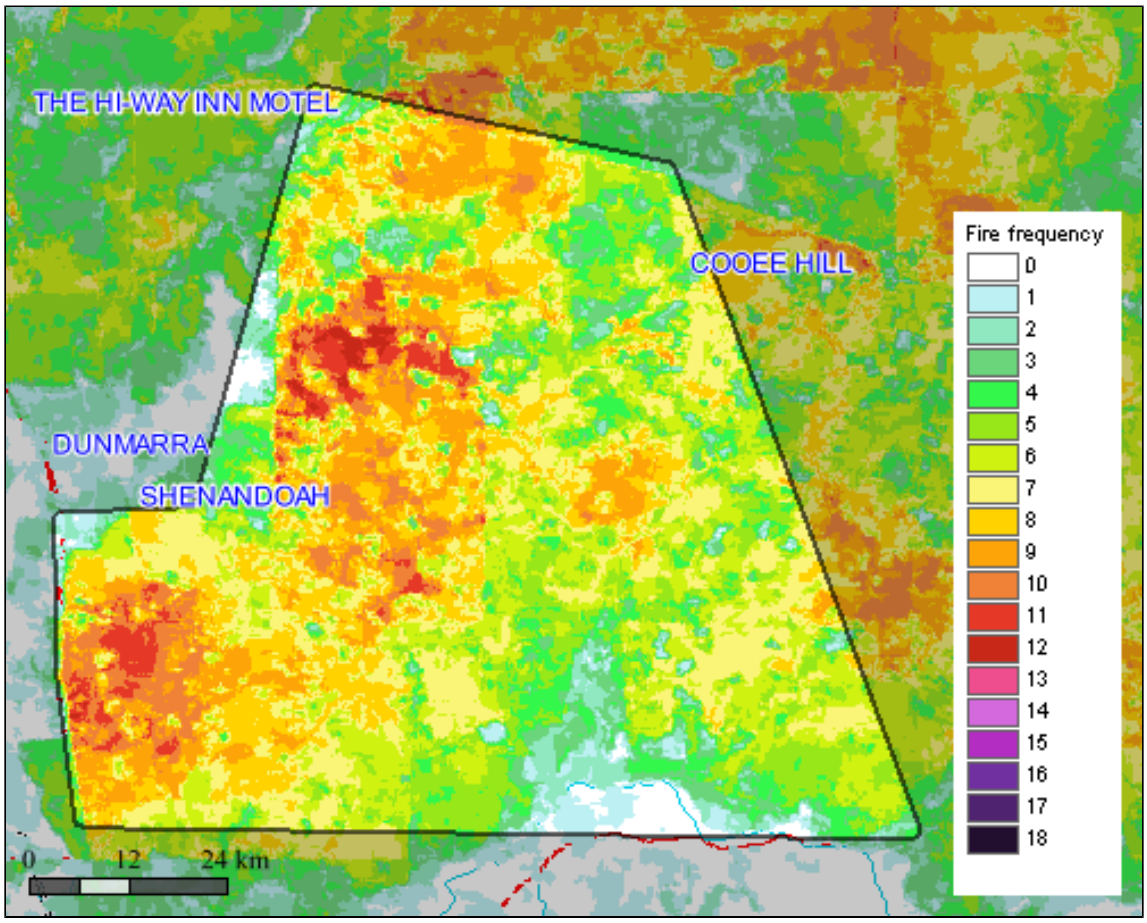
Fire frequency 2000-2017



area burnt for each fire frequency category 2000-2017

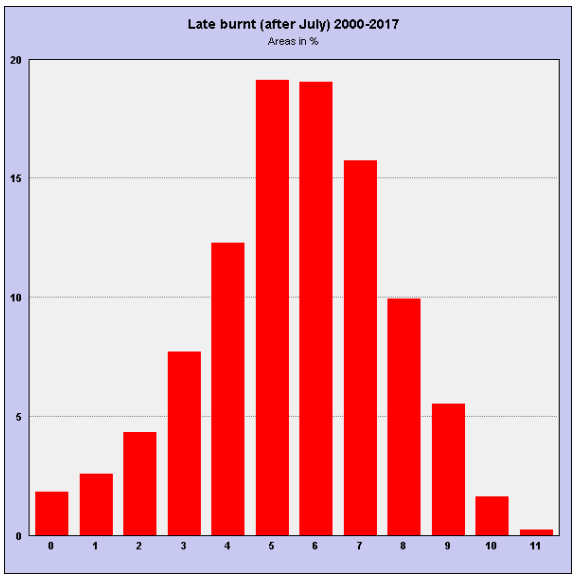
Category	Area sq km	Area%
0	98.88	1.62
1	127.88	2.09
2	199.79	3.26
3	301.95	4.93
4	475.66	7.77
5	834.52	13.63
6	1056.53	17.26
7	1095.74	17.90
8	859.76	14.04
9	621.05	10.14
10	293.33	4.79
11	132.41	2.16
12	24.67	.40

Fire frequency 2000-2017



The fire frequency(250m) Layer is derived from satellite imagery sourced from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Terra satellite
Spatial Resolution: 250m x 250m pixels (at Nadir).

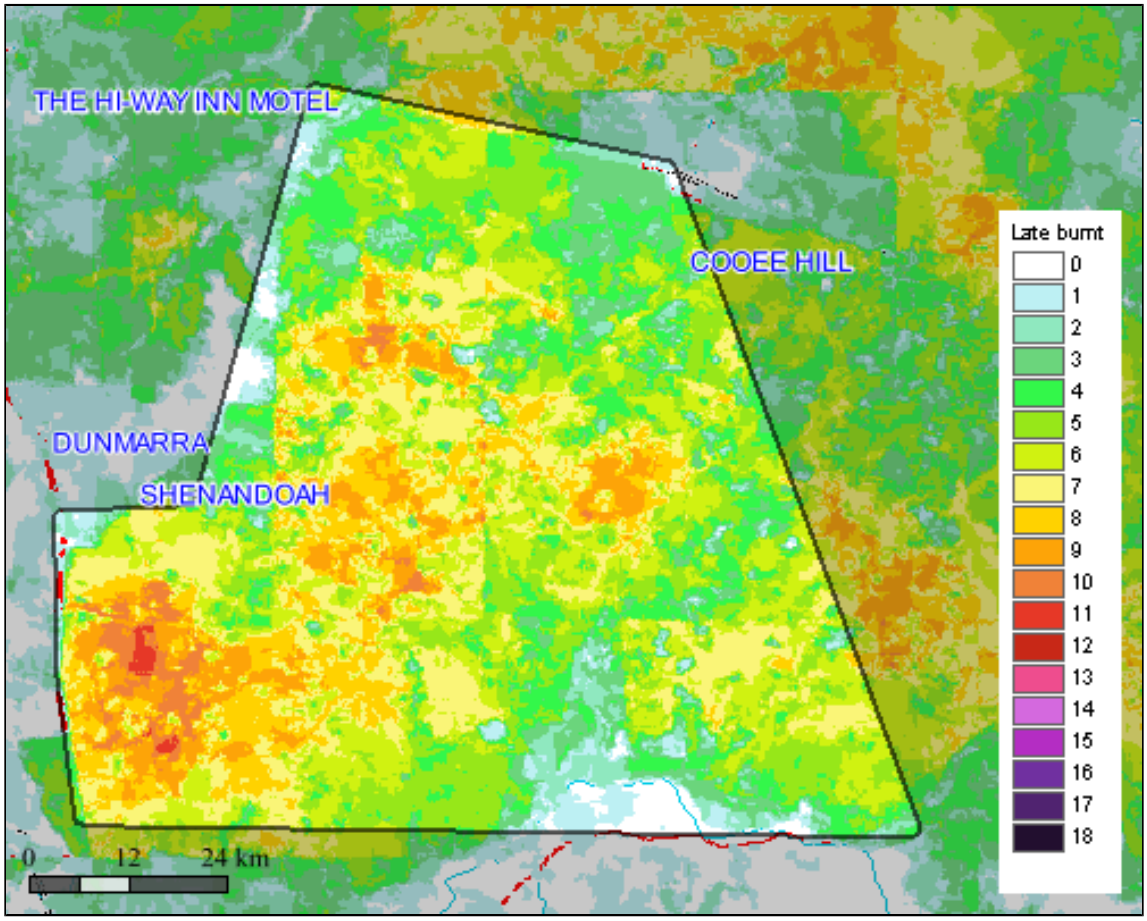
Late fire frequency(after July 31) 2000-2017



area burnt in each late fire frequency category 2000-2017

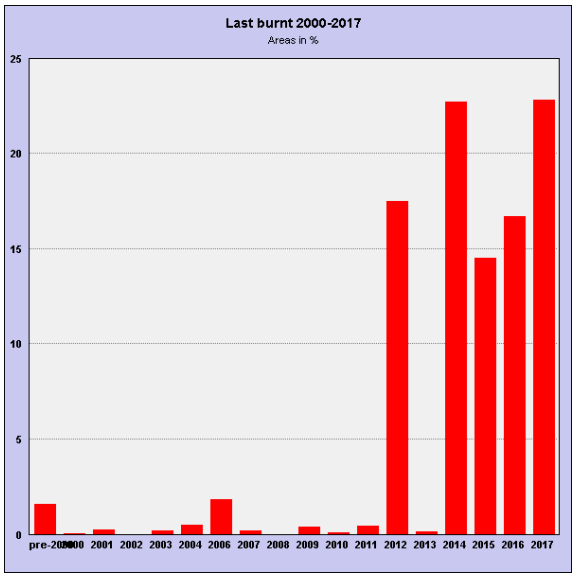
Category	Area sq km	Area%
0	111.20	1.82
1	157.75	2.58
2	264.12	4.31
3	471.33	7.70
4	753.03	12.30
5	1171.25	19.13
6	1166.29	19.05
7	964.58	15.76
8	609.31	9.95
9	337.98	5.52
10	100.56	1.64
11	14.76	.24

Late fire frequency 2000-2017



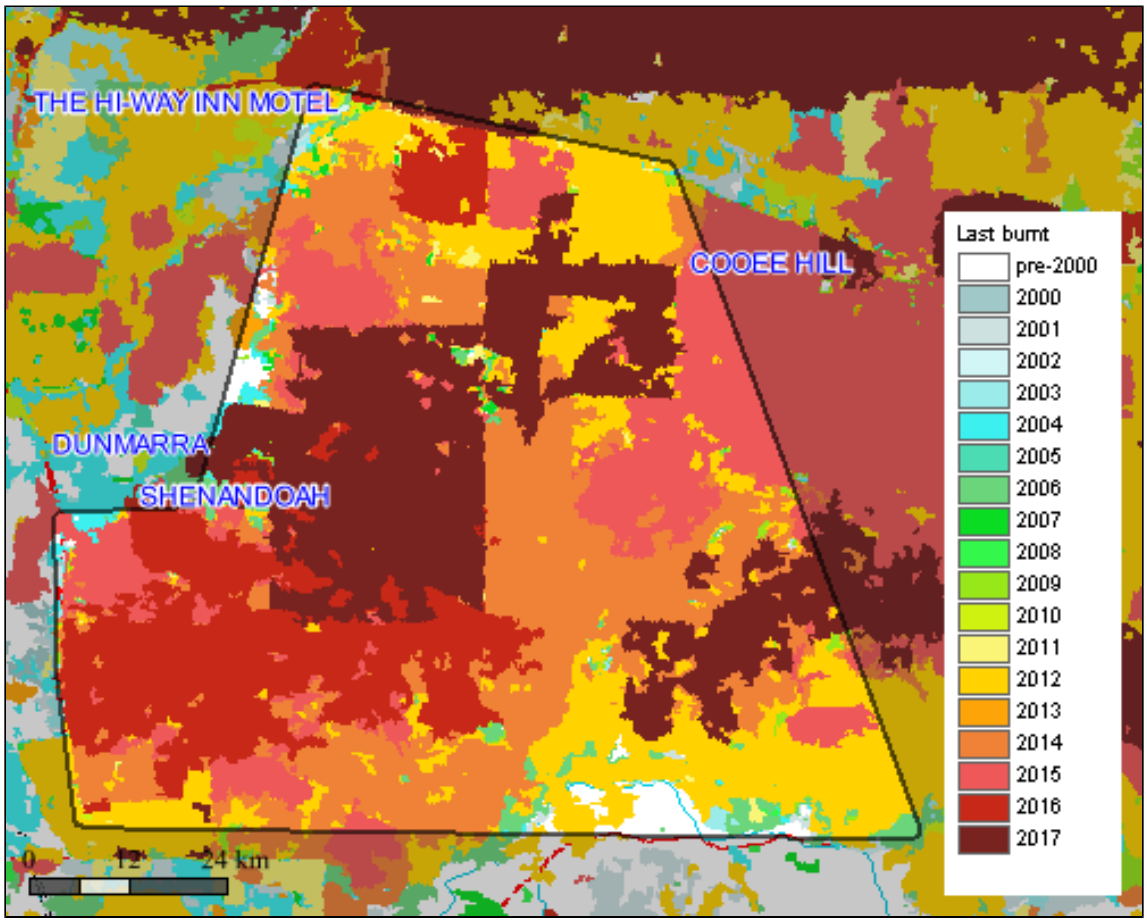
The fire frequency(250m) Layer is derived from satellite imagery sourced from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Terra satellite
Spatial Resolution: 250m x 250m pixels (at Nadir).

Year last burnt 2000-2017 and area of each year category



Category	Area sq km	Area%
pre-2000	98.88	1.62
2000	3.13	.05
2001	16.73	.27
2002	1.34	.02
2003	11.96	.20
2004	30.17	.49
2006	111.18	1.82
2007	13.04	.21
2008	1.12	.02
2009	23.07	.38
2010	5.27	.09
2011	26.02	.42
2012	1070.75	17.49
2013	9.06	.15
2014	1391.95	22.74
2015	889.28	14.53
2016	1023.34	16.72
2017	1395.87	22.80

Year last burnt 2000-2017



The fire frequency(250m) Layer is derived from satellite imagery sourced from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Terra satellite
Spatial Resolution: 250m x 250m pixels (at Nadir).

2018 Beetaloo Threatened Species

Threatened species recorded in 2018 Beetaloo (Records Updated: Sept 2013)

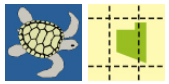
Group	Common Name	Scientific Name	NT Status	National Status	ID	#Observations (Latest)	#Specimens (Latest)	#Surveys (Latest)
Mammals	Pale Field-rat	*Rattus tunneyi*	VU	.	.	0 (Unknown)	1 (1999)	0 (Unknown)

EX = Extinct
EW = Extinct in the Wild
ER = Extinct in the NT
EN = Endangered
EN/VU = One Endangered subspecies/One Vulnerable subspecies
VU=Vulnerable
VU/- = One or more subspecies vulnerable EN/- = One or more subspecies endangered

Survey = this category refers to data collected using systematic survey methodology
Specimen = this category refers to museum or other records where a specimen has been collected and lodged
Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to www.landmanager.org.au/view/index.aspx?id=####
where #### is the ID number from the tables above for the species of interest.

2018 Beetaloo Threatened Species Grid



Threatened species recorded in the grid cell(s) in which 2018 Beetaloo occurs (Records Updated: Sept 2013)

Group	Family Name	Scientific Name	Common Name	NT Status	National Status	#Observations	Latest Observation Date	#Specimens	Latest Specimen Date	#Surveys	Latest Survey Record
Reptiles	Varanidae	*Varanus mertensi*	Mertens` Water Monitor	VU		3	1993	0	Unknown	1	1993
Reptiles	Elapidae	*Acanthophis hawkei*	Plains Death Adder	VU	VU	0	Unknown	1	1968	0	Unknown
Birds	Columbidae	*Geophaps smithii*	Partridge Pigeon	VU	VU	0	Unknown	1	1898	0	Unknown
Birds	Falconidae	*Falco hypoleucos*	Grey Falcon	VU		6	2008	0	Unknown	0	Unknown
Birds	Rostratulidae	*Rostratula australis*	Australian Painted Snipe	VU	EN	4	1991	0	Unknown	1	1993
Birds	Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper	VU	CE	0	Unknown	0	Unknown	2	1993
Birds	Psittacidae	*Polytelis alexandrae*	Princess Parrot	VU	VU	2	1977	4	1891	0	Unknown
Birds	Meliphagidae	*Grantiella picta*	Painted Honeyeater	VU	VU	2	2001	0	Unknown	0	Unknown
Birds	Estrildidae	*Erythrura gouldiae*	Gouldian Finch	VU	EN	3	2006	0	Unknown	0	Unknown
Mammals	Dasyuridae	*Dasyurus hallucatus*	Northern Quoll	CR	EN	1	Unknown	1	Unknown	0	Unknown
Mammals	Dasyuridae	*Pseudantechinus mimulus*	Carpentarian Antechinus		VU	0	Unknown	1	1987	0	Unknown
Mammals	Peramelidae	*Isoodon auratus*	Golden Bandicoot	EN	VU	1	1969	0	Unknown	0	Unknown
Mammals	Thylacomyidae	*Macrotis lagotis*	Greater Bilby	VU	VU	12	2011	0	Unknown	0	Unknown
Mammals	Phalangeridae	*Trichosurus vulpecula vulpecula*	Common Brushtail Possum (southern)	EN		2	1969	0	Unknown	0	Unknown
Mammals	Muridae	*Rattus tunneyi*	Pale Field-rat	VU		0	Unknown	1	1999	0	Unknown

EX = Extinct
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VU/- = One or more subspecies vulnerable EN/- = One or more subspecies endangered

Survey = this category refers to data collected using systematic survey methodology
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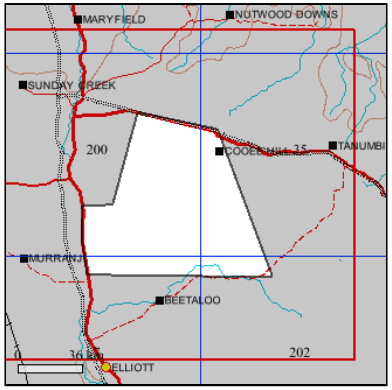
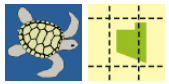
More species info: Go to www.landmanager.org.au/view/index.aspx?id=####
where #### is the ID number from the tables above for the species of interest.

Species listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap 2018 Beetaloo



2018 Beetaloo Native Species



Native species that have been recorded in the grid cell(s) in which 2018 Beetaloo occurs

Group	Family Name	Scientific Name	Common Name	NT Status	National Status	#Observations	#Latest Observation Date	#Specimens	#Latest Speciman Date	#Surveys	#Latest Survey Record
Fern Allies	Isoetaceae	*Isoetes muelleri*	Quillwort			0	Unknown	1	1975	0	Unknown
Ferns	Lygodiaceae	*Lygodium microphyllum*	Climbing Maidenhair Fern			0	Unknown	2	1977	0	Unknown
Ferns	Marsileaceae	*Marsilea angustifolia*	Narrow-leaf Nardoo			0	Unknown	6	1994	0	Unknown
Ferns	Marsileaceae	*Marsilea crenata*	Nadoo			0	Unknown	1	1975	0	Unknown
Ferns	Marsileaceae	*Marsilea drummondii*	Common Nardoo			0	Unknown	1	2010	0	Unknown
Ferns	Marsileaceae	*Marsilea hirsuta*	Short-fruit Nardoo			0	Unknown	1	1963	0	Unknown
Ferns	Lindsaeaceae	*Lindsaea brachypoda*	Wedgefern			0	Unknown	2	1977	0	Unknown
Ferns	Lindsaeaceae	*Lindsaea ensifolia*	Common Wedgefern			0	Unknown	2	1977	0	Unknown
Ferns	Pteridaceae	*Cheilanthes brownii*	Northern Rock-fern			0	Unknown	3	1977	0	Unknown
Ferns	Pteridaceae	*Cheilanthes nitida*	Fern			0	Unknown	0	Unknown	0	Unknown
Ferns	Pteridaceae	*Cheilanthes nudiuscula*	Fern			0	Unknown	11	1989	0	Unknown
Ferns	Pteridaceae	*Cheilanthes pumilio*	Fern			0	Unknown	2	1967	0	Unknown
Ferns	Pteridaceae	*Cheilanthes sieberi subsp. sieberi*	Mulga Fern			0	Unknown	0	Unknown	0	Unknown
Ferns	Pteridaceae	*Cheilanthes tenuifolia*	Rock Fern			0	Unknown	2	2001	0	Unknown
Flowering Plants	Lauraceae	*Cassytha capillaris*	Snotty Gobble			0	Unknown	3	1978	0	Unknown
Flowering Plants	Lauraceae	*Cassytha filiformis*	Hairy Dodder-laurel			0	Unknown	4	1987	0	Unknown
Flowering Plants	Hernandiaceae	*Gyrocarpus americanus*	Stinkwood			0	Unknown	10	1994	0	Unknown
Flowering Plants	Alismataceae	*Caldesia oligococca var. oligococca*	Caldesia			0	Unknown	2	1994	0	Unknown
Flowering Plants	Hydrocharitaceae	*Najas marina*	Prickly Water Nymph			0	Unknown	2	1999	0	Unknown
Flowering Plants	Hydrocharitaceae	*Najas marina subsp. latior*	Prickly Water Nymph			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Hydrocharitaceae	*Ottelia alismoides*	Swamp Lily			0	Unknown	1	1998	0	Unknown
Flowering Plants	Hydrocharitaceae	*Vallisneria annua*	Eel Grass			0	Unknown	3	1975	0	Unknown
Flowering Plants	Hydrocharitaceae	*Vallisneria rubra*	Eel Grass			0	Unknown	2	1994	0	Unknown
Flowering Plants	Potamogetonaceae	*Potamogeton tepperi*	Floating Pondweed			0	Unknown	1	1996	0	Unknown
Flowering Plants	Potamogetonaceae	*Stuckenia pectinata*	Fennel Pondweed			0	Unknown	1	1999	0	Unknown
Flowering Plants	Colchicaceae	*Iphigenia indica*	Iphigenia			0	Unknown	2	1999	0	Unknown
Flowering Plants	Hemerocallidaceae	*Caesia chlorantha*	Grass-Lily			0	Unknown	3	2001	0	Unknown
Flowering Plants	Amaryllidaceae	*Crinum angustifolium*	Crinium Lily			0	Unknown	2	1988	0	Unknown
Flowering Plants	Amaryllidaceae	*Crinum flaccidum*	Darling Lily			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Eriocaulaceae	*Eriocaulon carpentariae*	Hatpins	DD		0	Unknown	4	1994	0	Unknown
Flowering Plants	Eriocaulaceae	*Eriocaulon cinereum*	Hatpins			0	Unknown	9	2010	0	Unknown
Flowering Plants	Eriocaulaceae	*Eriocaulon pygmaeum*	Hatpins			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cyperaceae	*Bulbostylis barbata*	Short-leaved Rush			0	Unknown	8	1994	0	Unknown
Flowering Plants	Cyperaceae	*Bulbostylis turbinata*	Rush			0	Unknown	2	2006	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus astartodes*	Sedge			0	Unknown	4	1983	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus betchei*	Sedge			0	Unknown	3	1983	0	Unknown

Group	Family Name	Scientific Name	Common Name	NT Status	National Status	#Observations	#Latest Observation Date	#Specimens	#Latest Speciman Date	#Surveys	#Latest Survey Record
Flowering Plants	Cyperaceae	*Cyperus betchei subsp. commiscens*	Sedge			0	Unknown	2	1977	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus bifax*	Downs Nutgrass			0	Unknown	2	2011	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus bulbosus*	Yalka			0	Unknown	2	1991	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus carinatus*	Sedge			0	Unknown	6	2010	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus castaneus*	Sedge			0	Unknown	2	1977	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus concinnus*	Trim Sedge			0	Unknown	6	2001	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus crispulus*	Sedge			0	Unknown	4	1987	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus cristulatus*	Sedge			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus cunninghamii subsp. uniflorus*	Sedge			0	Unknown	2	1983	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus dactylotes*	Sedge			0	Unknown	4	1988	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus difformis*	Dirty Dora			0	Unknown	2	1969	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus eleusinoides*	Sedge			0	Unknown	2	1986	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus exaltatus*	Giant Sedge			0	Unknown	2	1986	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus fucosus*	Sedge	DD		0	Unknown	2	1947	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus haspan subsp. haspan*	Small Umbrella Rush	DD		0	Unknown	1	1991	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus holoschoenus*	Umbrella Rush			0	Unknown	8	1986	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus iria*	Rice Flat Sedge			0	Unknown	2	1983	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus javanicus*	Saw Rush			0	Unknown	2	1977	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus macrostachyos*	Tick Grass			0	Unknown	6	1995	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus microcephalus*	Sedge			0	Unknown	4	1977	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus microcephalus subsp. chersophilus*	Sedge			0	Unknown	1	1975	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus oxycarpus*	Sedge	DD		0	Unknown	2	1977	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus polystachyos*	Bunchy Sedge			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus pulchellus*	White Button Sedge			0	Unknown	3	1991	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus pygmaeus*	Dwarf Sedge			0	Unknown	3	1999	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus sexflorus*	Sedge			0	Unknown	2	1983	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus squarrosus*	Bearded Flatsedge			0	Unknown	3	1991	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus tenuispica*	Pink-root Sedge			0	Unknown	6	1983	0	Unknown
Flowering Plants	Cyperaceae	*Cyperus victoriensis*	Yelka			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cyperaceae	*Eleocharis atropurpurea*	Spike-Rush			0	Unknown	5	2003	0	Unknown
Flowering Plants	Cyperaceae	*Eleocharis brassii*	Spike-Rush			0	Unknown	1	1994	0	Unknown
Flowering Plants	Cyperaceae	*Eleocharis dulcis*	Chinese Water Chestnut			0	Unknown	1	1996	0	Unknown
Flowering Plants	Cyperaceae	*Eleocharis pallens*	Pale Spike-Rush			0	Unknown	2	1994	0	Unknown
Flowering Plants	Cyperaceae	*Eleocharis triquetra*	Spike-Rush			0	Unknown	5	2001	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis acuminata*	Fringe-Rush			0	Unknown	1	1947	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis aestivalis*	Summer Fringe-Rush			0	Unknown	1	1965	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis ammobia*	Fringe-Rush			0	Unknown	3	2011	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis bisumbellata*	Fringe-Rush	DD		0	Unknown	2	1988	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis caespitosa*	Fringe-Rush			0	Unknown	6	2011	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis cardiocarpa*	Fringe-Rush			0	Unknown	2	1977	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis corynocarya*	Fringe-Rush	DD		0	Unknown	2	2001	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis costiglumis*	Fringe-Rush			0	Unknown	2	1983	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis densa*	Angle Head			0	Unknown	0	Unknown	0	Unknown

Group	Family Name	Scientific Name	Common Name	NT Status	National Status	#Observations	#Latest Observation Date	#Specimens	#Latest Speciman Date	#Surveys	#Latest Survey Record
Flowering Plants	Cyperaceae	*Fimbristylis depauperata*	Fringe-Rush			0	Unknown	5	2010	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis dichotoma*	Eight Day Grass			0	Unknown	5	1993	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis ferruginea*	Fringe-Rush			0	Unknown	2	1987	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis furva*	Fringe-Rush			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis laxiglumis*	Fringe-Rush			0	Unknown	6	1994	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis leucocolea*	Fringe-Rush			0	Unknown	2	1999	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis littoralis*	Fringe-Rush			0	Unknown	6	1988	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis littoralis var. littoralis*	Fringe-Rush			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis microcarya*	Fringe-Rush			0	Unknown	8	2009	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis neilsonii*	Fringe-Rush			0	Unknown	8	2011	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis nuda*	Fringe-Rush			0	Unknown	1	1974	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis nutans*	Long-head Fringe-Rush			0	Unknown	1	2009	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis oxystachya*	Iukarrara			0	Unknown	4	1996	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis phaeoleuca*	Water Grass			0	Unknown	9	2011	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis rupestris*	Fringe-Rush			0	Unknown	2	1977	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis schultzii*	Fringe-Rush			0	Unknown	4	2011	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis sp. Connells Lagoon*	Fringe-Rush			0	Unknown	1	2011	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis sphaerocephala*	Fringe-Rush			0	Unknown	4	1977	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis squarrulosa*	Fringe-Rush			0	Unknown	2	1975	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis tetragona*	Fringe-Rush			0	Unknown	1	1975	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis trigastrocarya*	Fringe-Rush			0	Unknown	2	1977	0	Unknown
Flowering Plants	Cyperaceae	*Fimbristylis tristachya*	Fringe-Rush			0	Unknown	2	1977	0	Unknown
Flowering Plants	Cyperaceae	*Fuirena ciliaris*	Small Club Rush			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cyperaceae	*Fuirena incrassata*	Umbrella-Sedge			0	Unknown	2	2001	0	Unknown
Flowering Plants	Cyperaceae	*Isolepis humillima*	Club-Rush			0	Unknown	2	1986	0	Unknown
Flowering Plants	Cyperaceae	*Lipocarpha microcephala*	Button Rush			0	Unknown	1	1971	0	Unknown
Flowering Plants	Cyperaceae	*Rhynchospora brownii*	Star Sedge			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cyperaceae	*Rhynchospora exserta*	Star Sedge			0	Unknown	2	1976	0	Unknown
Flowering Plants	Cyperaceae	*Rhynchospora longisetis*	Tick Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cyperaceae	*Rhynchospora subtenuifolia*	Star Sedge			0	Unknown	2	1987	0	Unknown
Flowering Plants	Cyperaceae	*Rhynchospora wightiana*	Star Sedge			0	Unknown	4	1991	0	Unknown
Flowering Plants	Cyperaceae	*Schoenoplectus dissachanthus*	Inland Club-Rush			0	Unknown	4	2003	0	Unknown
Flowering Plants	Cyperaceae	*Schoenoplectus laevis*	Club-Rush			0	Unknown	5	1991	0	Unknown
Flowering Plants	Cyperaceae	*Schoenoplectus lateriflorus*	Club-Rush			0	Unknown	2	2001	0	Unknown
Flowering Plants	Cyperaceae	*Scleria brownii*	Sedge			0	Unknown	6	2004	0	Unknown
Flowering Plants	Cyperaceae	*Scleria novae-hollandiae*	Sedge			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cyperaceae	*Scleria rugosa*	Mildrop Sedge			0	Unknown	3	1987	0	Unknown
Flowering Plants	Cyperaceae	*Scleria sphacelata*	Razor Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Flagellariaceae	*Flagellaria indica*	Supplejack			0	Unknown	2	1972	0	Unknown
Flowering Plants	Centrolepidaceae	*Centrolepis banksii*	Centrolepis			0	Unknown	2	2001	0	Unknown
Flowering Plants	Poaceae	*Acrachne racemosa*	Goose Grass	DD		0	Unknown	4	1991	0	Unknown
Flowering Plants	Poaceae	*Alloteropsis semialata*	Cockatoo Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Aristida calycina*	Dark Wiregrass			0	Unknown	4	2001	0	Unknown

Group	Family Name	Scientific Name	Common Name	NT Status	National Status	#Observations	#Latest Observation Date	#Specimens	#Latest Speciman Date	#Surveys	#Latest Survey Record
Flowering Plants	Poaceae	*Aristida calycina var. calycina*	Dark Wiregrass			0	Unknown	3	2011	0	Unknown
Flowering Plants	Poaceae	*Aristida contorta*	Bunched Kerosene Grass			0	Unknown	1	1993	0	Unknown
Flowering Plants	Poaceae	*Aristida exserta*	Wire Grass			0	Unknown	3	1977	0	Unknown
Flowering Plants	Poaceae	*Aristida holathera*	Erect Kerosene Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Aristida holathera var. holathera*	Erect Kerosene Grass			0	Unknown	6	1993	0	Unknown
Flowering Plants	Poaceae	*Aristida holathera var. latifolia*	Erect Kerosene Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Aristida hygrometrica*	Northern Kerosene Grass			0	Unknown	11	1994	0	Unknown
Flowering Plants	Poaceae	*Aristida inaequiglumis*	Unequal Threeawn			0	Unknown	13	2008	0	Unknown
Flowering Plants	Poaceae	*Aristida ingrata*	Wire Grass			0	Unknown	3	1977	0	Unknown
Flowering Plants	Poaceae	*Aristida latifolia*	Feathertop Wiregrass			0	Unknown	13	2006	0	Unknown
Flowering Plants	Poaceae	*Aristida perniciosa*	Noxious Wiregrass	DD		0	Unknown	2	1977	0	Unknown
Flowering Plants	Poaceae	*Aristida pruinosa*	Gulf Feathertop Wiregrass			0	Unknown	5	1996	0	Unknown
Flowering Plants	Poaceae	*Aristida queenslandica var. queenslandica*	Wire Grass			0	Unknown	1	1987	0	Unknown
Flowering Plants	Poaceae	*Arundinella setosa*	Reed Grass			0	Unknown	1	1971	0	Unknown
Flowering Plants	Poaceae	*Astrebla elymoides*	Hoop Mitchell Grass			0	Unknown	3	2006	0	Unknown
Flowering Plants	Poaceae	*Astrebla lappacea*	Curly Mitchell Grass	DD		0	Unknown	2	1971	0	Unknown
Flowering Plants	Poaceae	*Astrebla pectinata*	Barley Mitchell Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Astrebla squarrosa*	Bull Mitchell Grass			0	Unknown	5	2010	0	Unknown
Flowering Plants	Poaceae	*Bothriochloa bladhii*	Forest Bluegrass			0	Unknown	4	1986	0	Unknown
Flowering Plants	Poaceae	*Bothriochloa bladhii subsp. bladhii*	Forest Bluegrass			0	Unknown	2	1972	0	Unknown
Flowering Plants	Poaceae	*Bothriochloa ewartiana*	Desert Bluegrass			0	Unknown	3	1999	0	Unknown
Flowering Plants	Poaceae	*Brachyachne convergens*	Spider Grass			0	Unknown	9	1999	0	Unknown
Flowering Plants	Poaceae	*Brachyachne tenella*	Slender Native Couch			0	Unknown	6	1994	0	Unknown
Flowering Plants	Poaceae	*Cenchrus basedowii*	Asbestos Grass	DD		0	Unknown	6	2010	0	Unknown
Flowering Plants	Poaceae	*Chionachne cyathopoda*	River Grass			0	Unknown	2	1971	0	Unknown
Flowering Plants	Poaceae	*Chionachne hubbardiana*	Hairy Ribbon Grass			0	Unknown	3	2006	0	Unknown
Flowering Plants	Poaceae	*Chloris lobata*	Lobed Chloris			0	Unknown	4	1995	0	Unknown
Flowering Plants	Poaceae	*Chloris pectinata*	Comb Chloris			0	Unknown	2	2010	0	Unknown
Flowering Plants	Poaceae	*Chloris pumilio*	Little Chloris	DD		0	Unknown	1	1975	0	Unknown
Flowering Plants	Poaceae	*Chrysopogon fallax*	Golden-beard Grass			0	Unknown	10	1994	0	Unknown
Flowering Plants	Poaceae	*Chrysopogon pallidus*	Ribbon Grass			0	Unknown	6	2011	0	Unknown
Flowering Plants	Poaceae	*Cymbopogon bombycinus*	Silky Oilgrass			0	Unknown	16	1994	0	Unknown
Flowering Plants	Poaceae	*Cymbopogon procerus*	Scentgrass			0	Unknown	2	1971	0	Unknown
Flowering Plants	Poaceae	*Cymbopogon refractus*	Barbed-Wire Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Dactyloctenium radulans*	Button Grass			0	Unknown	6	1973	0	Unknown
Flowering Plants	Poaceae	*Dichanthium fecundum*	Curly Bluegrass			0	Unknown	9	1988	0	Unknown
Flowering Plants	Poaceae	*Dichanthium sericeum*	Queensland Bluegrass			0	Unknown	5	1989	0	Unknown
Flowering Plants	Poaceae	*Dichanthium sericeum subsp. humilius*	Dwarf Bluegrass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Dichanthium sericeum subsp. polystachyum*	Tassel Bluegrass			0	Unknown	9	2002	0	Unknown

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Flowering Plants	Poaceae	*Dichanthium sericeum subsp. sericeum*	Silky Bluegrass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Digitaria benthamiana*	Finger Grass	DD		0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Digitaria breviglumis*	Finger Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Digitaria brownii*	Cotton Panic Grass			0	Unknown	12	2001	0	Unknown
Flowering Plants	Poaceae	*Digitaria cowiei*	Finger Grass			0	Unknown	3	1991	0	Unknown
Flowering Plants	Poaceae	*Digitaria ctenantha*	Comb Finger Grass			0	Unknown	6	2011	0	Unknown
Flowering Plants	Poaceae	*Digitaria divaricatissima var. divaricatissima*	Finger Panic Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Digitaria gibbosa*	Finger Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Digitaria longiflora*	Finger Grass			0	Unknown	2	1977	0	Unknown
Flowering Plants	Poaceae	*Digitaria nematostachya*	Finger Grass			0	Unknown	5	2001	0	Unknown
Flowering Plants	Poaceae	*Digitaria papposa*	Finger Grass			0	Unknown	2	1977	0	Unknown
Flowering Plants	Poaceae	*Echinochloa elliptica*	Elliptic Cokspur Grass			0	Unknown	1	1982	0	Unknown
Flowering Plants	Poaceae	*Echinochloa turneriana*	Northern Channel Millet			0	Unknown	4	2010	0	Unknown
Flowering Plants	Poaceae	*Ectrosia agrostoides*	Haresfoot Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Ectrosia leporina*	Haresfoot Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Ectrosia scabrida*	Haresfoot Grass			0	Unknown	9	1989	0	Unknown
Flowering Plants	Poaceae	*Elytrophorus spicatus*	Spike-grass			0	Unknown	7	2003	0	Unknown
Flowering Plants	Poaceae	*Enneapogon avenaceus*	Common Bottle-washers			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Enneapogon clelandii*	Cleland`s Nine-awn			0	Unknown	1	1999	0	Unknown
Flowering Plants	Poaceae	*Enneapogon cylindricus*	Jointed Bottle-washers			0	Unknown	1	1993	0	Unknown
Flowering Plants	Poaceae	*Enneapogon decipiens*	Nine-awn Grass			0	Unknown	7	1993	0	Unknown
Flowering Plants	Poaceae	*Enneapogon lindleyanus*	Wiry Nine-awn			0	Unknown	9	2010	0	Unknown
Flowering Plants	Poaceae	*Enneapogon oblongus*	Rock Nine-awn			0	Unknown	3	1989	0	Unknown
Flowering Plants	Poaceae	*Enneapogon pallidus*	Conetop Nine-awn			0	Unknown	7	1994	0	Unknown
Flowering Plants	Poaceae	*Enneapogon polyphyllus*	Leafy Nine-awn			0	Unknown	14	1993	0	Unknown
Flowering Plants	Poaceae	*Enneapogon purpurascens*	Purple Nineawn			0	Unknown	8	1994	0	Unknown
Flowering Plants	Poaceae	*Enteropogon minutus*	Windmill Grass	DD		0	Unknown	2	1987	0	Unknown
Flowering Plants	Poaceae	*Eragrostis confertiflora*	Spike Lovegrass			0	Unknown	5	2011	0	Unknown
Flowering Plants	Poaceae	*Eragrostis cumingii*	Cuming`s Lovegrass			0	Unknown	16	2001	0	Unknown
Flowering Plants	Poaceae	*Eragrostis cylindriflora*	Lovegrass			0	Unknown	1	2011	0	Unknown
Flowering Plants	Poaceae	*Eragrostis eriopoda*	Woollybutt Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Eragrostis eriopoda subsp. sandy fireweed*	Woollybutt Grass			0	Unknown	8	1994	0	Unknown
Flowering Plants	Poaceae	*Eragrostis exigua*	Lovegrass			0	Unknown	7	1995	0	Unknown
Flowering Plants	Poaceae	*Eragrostis falcata*	Sickle Lovegrass			0	Unknown	2	1973	0	Unknown
Flowering Plants	Poaceae	*Eragrostis fallax*	Lovegrass			0	Unknown	7	2010	0	Unknown
Flowering Plants	Poaceae	*Eragrostis pubescens*	Giant Fairy Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Eragrostis schultzii*	Lovegrass			0	Unknown	2	1977	0	Unknown
Flowering Plants	Poaceae	*Eragrostis setifolia*	Neverfail Grass			0	Unknown	1	1969	0	Unknown
Flowering Plants	Poaceae	*Eragrostis tenellula*	Delicate Lovegrass			0	Unknown	11	1992	0	Unknown
Flowering Plants	Poaceae	*Eriachne aristidea*	Three-awn Wanderrie			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Eriachne armitii*	Long-awn Wanderrie			0	Unknown	3	1991	0	Unknown
Flowering Plants	Poaceae	*Eriachne basalis*	Wanderrie Grass	DD		0	Unknown	2	1975	0	Unknown
Flowering Plants	Poaceae	*Eriachne ciliata*	Slender Wanderrie			0	Unknown	7	1994	0	Unknown
Flowering Plants	Poaceae	*Eriachne festucacea*	Plains Wanderrie Grass			0	Unknown	1	1988	0	Unknown

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Flowering Plants	Poaceae	*Eriachne glauca*	Pan Wanderrie			0	Unknown	5	2001	0	Unknown
Flowering Plants	Poaceae	*Eriachne glauca var. glauca*	Wanderrie Grass			0	Unknown	2	1987	0	Unknown
Flowering Plants	Poaceae	*Eriachne melicacea*	Fire Grass			0	Unknown	4	1993	0	Unknown
Flowering Plants	Poaceae	*Eriachne mucronata*	Mountain Wanderrie			0	Unknown	1	1993	0	Unknown
Flowering Plants	Poaceae	*Eriachne nervosa*	Plains Wanderrie			0	Unknown	3	1977	0	Unknown
Flowering Plants	Poaceae	*Eriachne nodosa*	Wanderrie Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Eriachne obtusa*	Northern Wanderrie			0	Unknown	15	1993	0	Unknown
Flowering Plants	Poaceae	*Eriachne obtusa var. tall broad inflorescence*	Sandhill Wanderrie			0	Unknown	1	2004	0	Unknown
Flowering Plants	Poaceae	*Eriachne schultziana*	Salt-and-Pepper Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Eriochloa crebra*	Tall Cupgrass			0	Unknown	1	2010	0	Unknown
Flowering Plants	Poaceae	*Eriochloa pseudoacrotricha*	Early Spring Grass			0	Unknown	4	1995	0	Unknown
Flowering Plants	Poaceae	*Eulalia aurea*	Silky Browntop			0	Unknown	19	1999	0	Unknown
Flowering Plants	Poaceae	*Germainia truncatiglumis*	Germainia			0	Unknown	1	1994	0	Unknown
Flowering Plants	Poaceae	*Heterachne gulliveri*	Heterachne			0	Unknown	2	1987	0	Unknown
Flowering Plants	Poaceae	*Heteropogon contortus*	Black Speargrass			0	Unknown	3	1994	0	Unknown
Flowering Plants	Poaceae	*Imperata cylindrica*	Blady Grass			0	Unknown	1	1976	0	Unknown
Flowering Plants	Poaceae	*Iseilema calvum*	Flinders Grass	DD		0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Iseilema fragile*	Flinders Grass			0	Unknown	4	2011	0	Unknown
Flowering Plants	Poaceae	*Iseilema macratherum*	Bull Flinders Grass			0	Unknown	8	1991	0	Unknown
Flowering Plants	Poaceae	*Iseilema membranaceum*	Small Flinders Grass			0	Unknown	7	1995	0	Unknown
Flowering Plants	Poaceae	*Iseilema vaginiflorum*	Red Flinders Grass			0	Unknown	12	2010	0	Unknown
Flowering Plants	Poaceae	*Iseilema windersii*	Scented Flinders Grass			0	Unknown	3	2001	0	Unknown
Flowering Plants	Poaceae	*Leptochloa digitata*	Umbrella Canegrass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Leptochloa neesii*	Swamp Grass			0	Unknown	8	2001	0	Unknown
Flowering Plants	Poaceae	*Lepturus xerophilus*	Lepturus	DD		0	Unknown	2	2001	0	Unknown
Flowering Plants	Poaceae	*Mnesithea formosa*	Red Grass			0	Unknown	10	2004	0	Unknown
Flowering Plants	Poaceae	*Mnesithea rottboellioides*	Northern Canegrass			0	Unknown	2	1977	0	Unknown
Flowering Plants	Poaceae	*Oryza australiensis*	Australian Wild Rice			0	Unknown	11	2002	0	Unknown
Flowering Plants	Poaceae	*Oxychloris scariosa*	Winged Chloris			0	Unknown	1	1955	0	Unknown
Flowering Plants	Poaceae	*Panicum decompositum*	Australian Millet			0	Unknown	5	1988	0	Unknown
Flowering Plants	Poaceae	*Panicum decompositum var. decompositum*	Australian Millet			0	Unknown	1	2010	0	Unknown
Flowering Plants	Poaceae	*Panicum effusum*	Hairy Panic			0	Unknown	5	1994	0	Unknown
Flowering Plants	Poaceae	*Panicum laevinode*	Pepper Grass			0	Unknown	9	2010	0	Unknown
Flowering Plants	Poaceae	*Panicum latzii*	Panic	DD		0	Unknown	1	1988	0	Unknown
Flowering Plants	Poaceae	*Panicum mindanaense*	Native Panic			0	Unknown	4	1999	0	Unknown
Flowering Plants	Poaceae	*Panicum trachyrhachis*	Whistle Grass			0	Unknown	2	1991	0	Unknown
Flowering Plants	Poaceae	*Panicum trichoides*	Jungle Grass			0	Unknown	5	2001	0	Unknown
Flowering Plants	Poaceae	*Paraneurachne muelleri*	Spinifex Couch			0	Unknown	5	2011	0	Unknown
Flowering Plants	Poaceae	*Paspalidium constrictum*	Knotty-butt Paspalidium			0	Unknown	2	1987	0	Unknown
Flowering Plants	Poaceae	*Paspalidium distans*	Shot Grass			0	Unknown	2	1999	0	Unknown
Flowering Plants	Poaceae	*Paspalidium gracile*	Slender Panic	DD		0	Unknown	7	2001	0	Unknown
Flowering Plants	Poaceae	*Paspalidium rarum*	Bunch Paspalidium			0	Unknown	11	1993	0	Unknown
Flowering Plants	Poaceae	*Paspalidium retiglume*	Paspalidium			0	Unknown	3	2011	0	Unknown
Flowering Plants	Poaceae	*Perotis rara*	Comet Grass			0	Unknown	6	1991	0	Unknown

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Flowering Plants	Poaceae	*Pseudopogonatherum contortum*	Black Top			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Pseudoraphis spinescens*	Spiny Mudgrass			0	Unknown	10	2002	0	Unknown
Flowering Plants	Poaceae	*Schizachyrium crinizonatum*	Schizachyrium			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Schizachyrium fragile*	Fire Grass			0	Unknown	9	1994	0	Unknown
Flowering Plants	Poaceae	*Schizachyrium pseudeulalia*	Short-leaved Silk Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Sehima nervosum*	White Grass			0	Unknown	8	2006	0	Unknown
Flowering Plants	Poaceae	*Setaria apiculata*	Pigeon Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Setaria surgens*	Brown`s Pigeon Grass			0	Unknown	11	2011	0	Unknown
Flowering Plants	Poaceae	*Sorghum interjectum*	Sorghum			0	Unknown	2	1999	0	Unknown
Flowering Plants	Poaceae	*Sorghum intrans*	Annual Sorghum			0	Unknown	1	1981	0	Unknown
Flowering Plants	Poaceae	*Sorghum matarankense*	Sorghum			0	Unknown	13	2002	0	Unknown
Flowering Plants	Poaceae	*Sorghum plumosum*	Plume Sorghum			0	Unknown	7	1993	0	Unknown
Flowering Plants	Poaceae	*Sorghum plumosum var. plumosum*	Plume Sorghum			0	Unknown	4	2002	0	Unknown
Flowering Plants	Poaceae	*Sorghum stipoideum*	Annual Native Sorghum			0	Unknown	2	1975	0	Unknown
Flowering Plants	Poaceae	*Sorghum timorense*	Downs Sorghum			0	Unknown	15	2006	0	Unknown
Flowering Plants	Poaceae	*Spathia neurosa*	Spathe Grass			0	Unknown	2	2006	0	Unknown
Flowering Plants	Poaceae	*Sporobolus actinocladus*	Katoora			0	Unknown	1	1955	0	Unknown
Flowering Plants	Poaceae	*Sporobolus australasicus*	Australian Dropseed			0	Unknown	13	2010	0	Unknown
Flowering Plants	Poaceae	*Sporobolus mitchellii*	Rat`s Tail Couch			0	Unknown	2	1971	0	Unknown
Flowering Plants	Poaceae	*Sporobolus pulchellus*	Sporobolus			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Sporobolus virginicus*	Sand Couch			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Thaumastochloa pubescens*	Thaumastochloa			0	Unknown	2	1977	0	Unknown
Flowering Plants	Poaceae	*Themeda arguens*	Annual Kangaroo Grass			0	Unknown	2	1988	0	Unknown
Flowering Plants	Poaceae	*Themeda avenacea*	Oat Kangaroo Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Themeda triandra*	Kangaroo Grass			0	Unknown	7	1999	0	Unknown
Flowering Plants	Poaceae	*Tragus australianus*	Small Burr-grass			0	Unknown	2	1969	0	Unknown
Flowering Plants	Poaceae	*Triodia basedowii*	Lobed Spinifex			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Triodia bitextura*	Curly Spinifex			0	Unknown	15	1994	0	Unknown
Flowering Plants	Poaceae	*Triodia inutilis*	Spinifex			0	Unknown	5	1994	0	Unknown
Flowering Plants	Poaceae	*Triodia latzii*	Spinifex			0	Unknown	4	1988	0	Unknown
Flowering Plants	Poaceae	*Triodia microstachya*	Spinifex			0	Unknown	2	1977	0	Unknown
Flowering Plants	Poaceae	*Triodia pungens*	Soft Spinifex			0	Unknown	10	2004	0	Unknown
Flowering Plants	Poaceae	*Triodia stenostachya*	Spinifex			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Tripogon loliiformis*	Five-minute Grass			0	Unknown	2	1988	0	Unknown
Flowering Plants	Poaceae	*Urochloa gilesii var. gilesii*	Hairy-edged Armgrass			0	Unknown	1	1989	0	Unknown
Flowering Plants	Poaceae	*Urochloa gilesii var. nothochthona*	Hairy-edged Armgrass			0	Unknown	2	1973	0	Unknown
Flowering Plants	Poaceae	*Urochloa holosericea*	Silkytop Armgrass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Urochloa holosericea subsp. velutina*	Silkytop Armgrass			0	Unknown	3	1991	0	Unknown
Flowering Plants	Poaceae	*Urochloa piligera*	Hairy Armgrass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Urochloa praetervisa*	Large Armgrass			0	Unknown	3	2001	0	Unknown
Flowering Plants	Poaceae	*Urochloa pubigera*	Armgrass Millet			0	Unknown	6	1992	0	Unknown
Flowering Plants	Poaceae	*Urochloa subquadripara*	Green Summer Grass			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Poaceae	*Whiteochloa airoides*	Creeping Panic			0	Unknown	4	1988	0	Unknown

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Flowering Plants	Poaceae	*Whiteochloa capillipes*	Whiteochloa			0	Unknown	7	1994	0	Unknown
Flowering Plants	Poaceae	*Whiteochloa cymbiformis*	Whiteochloa			0	Unknown	2	1971	0	Unknown
Flowering Plants	Poaceae	*Yakirra australiensis*	Desert Flinders Grass			0	Unknown	2	1971	0	Unknown
Flowering Plants	Poaceae	*Yakirra australiensis var. australiensis*	Desert Flinders Grass			0	Unknown	2	1994	0	Unknown
Flowering Plants	Poaceae	*Yakirra australiensis var. intermedia*	Desert Flinders Grass			0	Unknown	3	1975	0	Unknown
Flowering Plants	Poaceae	*Yakirra majuscula*	Yakirra			0	Unknown	7	1996	0	Unknown
Flowering Plants	Poaceae	*Yakirra muelleri*	Yakirra	DD		0	Unknown	2	1971	0	Unknown
Flowering Plants	Poaceae	*Yakirra nulla*	Yakirra			0	Unknown	1	1991	0	Unknown
Flowering Plants	Poaceae	*Yakirra pauciflora*	Yakirra			0	Unknown	4	1991	0	Unknown
Flowering Plants	Commelinaceae	*Commelina agrostophylla*	Commelina			0	Unknown	2	1979	0	Unknown
Flowering Plants	Commelinaceae	*Commelina ciliata*	Scurvy Weed			0	Unknown	1	1959	0	Unknown
Flowering Plants	Commelinaceae	*Commelina ensifolia*	Wandering Jew			0	Unknown	11	2010	0	Unknown
Flowering Plants	Commelinaceae	*Cyanotis axillaris*	Commelina			0	Unknown	4	1994	0	Unknown
Flowering Plants	Commelinaceae	*Murdannia graminea*	Pink Swamp Lily			0	Unknown	12	1994	0	Unknown
Flowering Plants	Commelinaceae	*Murdannia vaginata*	Day Flower			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Pontederiaceae	*Monochoria cyanea*	Monochoria			0	Unknown	3	1994	0	Unknown
Flowering Plants	Haemodoraceae	*Haemodorum coccineum*	Scarlet-flowered Bloodroot			0	Unknown	2	1988	0	Unknown
Flowering Plants	Menispermaceae	*Tinospora smilacina*	Snake Vine			0	Unknown	5	1991	0	Unknown
Flowering Plants	Proteaceae	*Grevillea decurrens*	Clothes-peg Tree			0	Unknown	1	1971	0	Unknown
Flowering Plants	Proteaceae	*Grevillea dryandri*	Dryander`s Grevillea			0	Unknown	17	1993	0	Unknown
Flowering Plants	Proteaceae	*Grevillea dryandri subsp. dryandri*	Dryander`s Grevillea			0	Unknown	1	1987	0	Unknown
Flowering Plants	Proteaceae	*Grevillea heliosperma*	Rock Grevillea			0	Unknown	2	1971	0	Unknown
Flowering Plants	Proteaceae	*Grevillea mimosoides*	Grevillea			0	Unknown	1	1996	0	Unknown
Flowering Plants	Proteaceae	*Grevillea parallela*	Silver Grevillea			0	Unknown	9	1996	0	Unknown
Flowering Plants	Proteaceae	*Grevillea prasina*	Grevillea			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Proteaceae	*Grevillea pteridifolia*	Fern-leaved Grevillea			0	Unknown	3	1988	0	Unknown
Flowering Plants	Proteaceae	*Grevillea refracta*	Silver-leaved Grevillea			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Proteaceae	*Grevillea refracta subsp. refracta*	Silver-leaved Grevillea			0	Unknown	10	1993	0	Unknown
Flowering Plants	Proteaceae	*Grevillea striata*	Western Beefwood			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Proteaceae	*Grevillea wickhamii subsp. aprica*	Holly Grevillea			0	Unknown	12	1993	0	Unknown
Flowering Plants	Proteaceae	*Hakea arborescens*	Yellow Hakea			0	Unknown	14	2001	0	Unknown
Flowering Plants	Proteaceae	*Hakea chordophylla*	Northern Corkwood			0	Unknown	2	1988	0	Unknown
Flowering Plants	Proteaceae	*Hakea lorea*	Long-leaf Corkwood			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Proteaceae	*Hakea lorea subsp. borealis*	Northern Long-leaf Corkwood			0	Unknown	5	1996	0	Unknown
Flowering Plants	Proteaceae	*Hakea lorea subsp. lorea*	Southern Long-leaf Corkwood			0	Unknown	1	1968	0	Unknown
Flowering Plants	Proteaceae	*Hakea macrocarpa*	Flat-leaved Hakea			0	Unknown	3	1988	0	Unknown
Flowering Plants	Proteaceae	*Persoonia falcata*	Milky Plum			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Proteaceae	*Stenocarpus acacioides*	Stenocarpus			0	Unknown	2	1986	0	Unknown
Flowering Plants	Dilleniaceae	*Hibbertia lepidota*	Scaly Guinea Flower			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Dilleniaceae	*Hibbertia tomentosa*	Guinea Flower			0	Unknown	0	Unknown	0	Unknown

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Flowering Plants	Droseraceae	*Drosera indica*	Narrow-leaved Sundew			0	Unknown	2	2001	0	Unknown
Flowering Plants	Polygonaceae	*Muehlenbeckia florulenta*	Tangled Lignum			0	Unknown	5	1982	0	Unknown
Flowering Plants	Polygonaceae	*Persicaria attenuata*	Smartweed			0	Unknown	1	1977	0	Unknown
Flowering Plants	Polygonaceae	*Persicaria attenuata subsp. attenuata*	Smartweed			0	Unknown	1	1977	0	Unknown
Flowering Plants	Caryophyllaceae	*Polycarpaea breviflora*	Polycarpaea			0	Unknown	4	1993	0	Unknown
Flowering Plants	Caryophyllaceae	*Polycarpaea corymbosa*	Polycarpaea			0	Unknown	5	1993	0	Unknown
Flowering Plants	Caryophyllaceae	*Polycarpaea involucrata*	Polycarpaea			0	Unknown	3	1987	0	Unknown
Flowering Plants	Caryophyllaceae	*Polycarpaea spirostylis*	Copper Plant			0	Unknown	2	1971	0	Unknown
Flowering Plants	Amaranthaceae	*Achyranthes aspera*	Prickly Chaff Flower			0	Unknown	5	1986	0	Unknown
Flowering Plants	Amaranthaceae	*Alternanthera angustifolia*	Narrow-leaf Joyweed			0	Unknown	1	1993	0	Unknown
Flowering Plants	Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed			0	Unknown	7	2010	0	Unknown
Flowering Plants	Amaranthaceae	*Alternanthera denticulata var. denticulata*	Lesser Joyweed			0	Unknown	6	2010	0	Unknown
Flowering Plants	Amaranthaceae	*Alternanthera nana*	Hairy Joyweed			0	Unknown	12	2010	0	Unknown
Flowering Plants	Amaranthaceae	*Alternanthera nodiflora*	Common Joyweed			0	Unknown	8	1996	0	Unknown
Flowering Plants	Amaranthaceae	*Amaranthus cochleitepalus*	Amaranth			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Amaranthaceae	*Amaranthus interruptus*	Native Amaranth			0	Unknown	5	1991	0	Unknown
Flowering Plants	Amaranthaceae	*Amaranthus pallidiflorus*	Pale-flowered Amaranth			0	Unknown	2	1977	0	Unknown
Flowering Plants	Amaranthaceae	*Chenopodium auricomum*	Northern Bluebush			0	Unknown	3	2011	0	Unknown
Flowering Plants	Amaranthaceae	*Dysphania kalpari*	Kalpari			0	Unknown	2	1995	0	Unknown
Flowering Plants	Amaranthaceae	*Enchylaena tomentosa*	Ruby Saltbush			0	Unknown	1	1993	0	Unknown
Flowering Plants	Amaranthaceae	*Gomphrena affinis subsp. affinis*	Gomphrena			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Amaranthaceae	*Gomphrena breviflora*	Gomphrena			0	Unknown	7	2011	0	Unknown
Flowering Plants	Amaranthaceae	*Gomphrena canescens*	Batchelor`s Buttons			0	Unknown	5	1999	0	Unknown
Flowering Plants	Amaranthaceae	*Gomphrena canescens subsp. canescens*	Batchelor`s Buttons			0	Unknown	16	2006	0	Unknown
Flowering Plants	Amaranthaceae	*Gomphrena flaccida*	Gomphrena Weed			0	Unknown	6	1995	0	Unknown
Flowering Plants	Amaranthaceae	*Gomphrena lanata*	Gomphrena			0	Unknown	11	2010	0	Unknown
Flowering Plants	Amaranthaceae	*Gomphrena leptophylla*	Gomphrena			0	Unknown	2	2010	0	Unknown
Flowering Plants	Amaranthaceae	*Maireana villosa*	Silky Bluebush			0	Unknown	2	1989	0	Unknown
Flowering Plants	Amaranthaceae	*Ptilotus calostachyus*	Weeping Mulla Mulla			0	Unknown	5	1989	0	Unknown
Flowering Plants	Amaranthaceae	*Ptilotus conicus*	Red Everlasting			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Amaranthaceae	*Ptilotus exaltatus*	Pink Mulla Mulla			0	Unknown	7	2008	0	Unknown
Flowering Plants	Amaranthaceae	*Ptilotus exaltatus var. exaltatus*	Pink Mulla Mulla			0	Unknown	1	2005	0	Unknown
Flowering Plants	Amaranthaceae	*Ptilotus fusiformis*	Skeleton plant			0	Unknown	24	1994	0	Unknown
Flowering Plants	Amaranthaceae	*Ptilotus macrocephalus*	Large Green Pussy-tail			0	Unknown	1	1948	0	Unknown
Flowering Plants	Amaranthaceae	*Ptilotus polystachyus*	Long Pussy-tails			0	Unknown	12	2008	0	Unknown
Flowering Plants	Amaranthaceae	*Ptilotus schwartzii*	Mulla Mulla			0	Unknown	4	2006	0	Unknown
Flowering Plants	Amaranthaceae	*Ptilotus spicatus*	Mulla Mulla			0	Unknown	8	2011	0	Unknown
Flowering Plants	Amaranthaceae	*Rhagodia eremaea*	Tall Saltbush			0	Unknown	3	1992	0	Unknown
Flowering Plants	Amaranthaceae	*Salsola australis*	Rolypoly			0	Unknown	6	2006	0	Unknown
Flowering Plants	Amaranthaceae	*Sclerolaena eriacantha*	Silky Copperburr			0	Unknown	1	1972	0	Unknown
Flowering Plants	Molluginaceae	*Glinus lotoides*	Hairy Carpet-weed			0	Unknown	5	1979	0	Unknown
Flowering Plants	Molluginaceae	*Glinus oppositifolius*	Slender Carpet-weed			0	Unknown	2	1977	0	Unknown

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Flowering Plants	Molluginaceae	*Mollugo molluginis*	Carpet Weed			0	Unknown	4	1991	0	Unknown
Flowering Plants	Portulacaceae	*Calandrinia quadrivalvis*	Parakeelya			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Portulacaceae	*Calandrinia uniflora*	Parakeelya			0	Unknown	2	1988	0	Unknown
Flowering Plants	Portulacaceae	*Portulaca australis*	Pigweed			0	Unknown	1	1987	0	Unknown
Flowering Plants	Portulacaceae	*Portulaca bicolor*	Heart Plant			0	Unknown	2	1982	0	Unknown
Flowering Plants	Portulacaceae	*Portulaca digyna*	Pigweed			0	Unknown	2	2001	0	Unknown
Flowering Plants	Portulacaceae	*Portulaca filifolia*	Slender Pigweed			0	Unknown	8	2003	0	Unknown
Flowering Plants	Portulacaceae	*Portulaca oleracea*	Munyeroo			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Portulacaceae	*Portulaca oleracea var. Undoolya*	Munyeroo			0	Unknown	2	2006	0	Unknown
Flowering Plants	Portulacaceae	*Portulaca oligosperma*	Pigweed			0	Unknown	2	1980	0	Unknown
Flowering Plants	Portulacaceae	*Portulaca sp. clay soil*	Pigweed			0	Unknown	2	1973	0	Unknown
Flowering Plants	Portulacaceae	*Portulaca sp. Elliott*	Pigweed			0	Unknown	3	1986	0	Unknown
Flowering Plants	Portulacaceae	*Portulaca sp. finely echinate*	Pigweed	DD		0	Unknown	4	2006	0	Unknown
Flowering Plants	Aizoaceae	*Sesuvium portulacastrum*	Sea Purslane			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Aizoaceae	*Trianthema pilosa*	Purslane			0	Unknown	12	2011	0	Unknown
Flowering Plants	Aizoaceae	*Trianthema triquetra*	Red Spinach			0	Unknown	1	Unknown	0	Unknown
Flowering Plants	Aizoaceae	*Trianthema turgidifolia*	Purslane			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Nyctaginaceae	*Boerhavia coccinea*	Scarlet Tar Vine			0	Unknown	13	2010	0	Unknown
Flowering Plants	Nyctaginaceae	*Boerhavia dominii*	Tar Vine			0	Unknown	4	1986	0	Unknown
Flowering Plants	Nyctaginaceae	*Boerhavia paludosa*	Black-soil Tar Vine			0	Unknown	1	1989	0	Unknown
Flowering Plants	Opiliaceae	*Opilia amentacea*	Opilia			0	Unknown	6	1996	0	Unknown
Flowering Plants	Santalaceae	*Santalum lanceolatum*	Plumbush			0	Unknown	11	1992	0	Unknown
Flowering Plants	Loranthaceae	*Amyema bifurcata*	Twin-fork Mistletoe			0	Unknown	2	1992	0	Unknown
Flowering Plants	Loranthaceae	*Amyema maidenii subsp. maidenii*	Pale-leaf Mistletoe			0	Unknown	4	1989	0	Unknown
Flowering Plants	Loranthaceae	*Amyema miquelii*	Box Mistletoe			0	Unknown	2	1947	0	Unknown
Flowering Plants	Loranthaceae	*Amyema sanguinea*	Blood Mistletoe			0	Unknown	2	1986	0	Unknown
Flowering Plants	Loranthaceae	*Amyema sanguinea var. sanguinea*	Blood Mistletoe			0	Unknown	3	2007	0	Unknown
Flowering Plants	Loranthaceae	*Amyema villiflora*	Mistletoe			0	Unknown	3	1987	0	Unknown
Flowering Plants	Loranthaceae	*Amyema villiflora subsp. villiflora*	Mistletoe			0	Unknown	1	1979	0	Unknown
Flowering Plants	Loranthaceae	*Dendrophthoe glabrescens*	Orange-Flowered Mistletoe			0	Unknown	4	1979	0	Unknown
Flowering Plants	Loranthaceae	*Dendrophthoe odontocalyx*	Hairy Mistletoe			0	Unknown	1	1999	0	Unknown
Flowering Plants	Loranthaceae	*Diplatia grandibractea*	Royal Mistletoe			0	Unknown	4	2010	0	Unknown
Flowering Plants	Loranthaceae	*Lysiana exocarpi*	Harlequin Mistletoe			0	Unknown	1	1987	0	Unknown
Flowering Plants	Loranthaceae	*Lysiana exocarpi subsp. exocarpi*	Harlequin Mistletoe			0	Unknown	1	1978	0	Unknown
Flowering Plants	Loranthaceae	*Lysiana spathulata*	Flat-leaved Mistletoe			0	Unknown	6	2010	0	Unknown
Flowering Plants	Loranthaceae	*Lysiana spathulata subsp. parvifolia*	Flat-leaved Mistletoe			0	Unknown	1	1979	0	Unknown
Flowering Plants	Loranthaceae	*Lysiana spathulata subsp. spathulata*	Flat-leaved Mistletoe			0	Unknown	3	1993	0	Unknown
Flowering Plants	Loranthaceae	*Lysiana subfalcata*	Northern Mistletoe			0	Unknown	3	1987	0	Unknown
Flowering Plants	Haloragaceae	*Haloragis glauca*	Grey Raspwort			0	Unknown	1	2010	0	Unknown
Flowering Plants	Haloragaceae	*Haloragis glauca f. glauca*	Raspwort			0	Unknown	2	2011	0	Unknown

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Flowering Plants	Haloragaceae	*Myriophyllum filiforme*	Water Milfoil			0	Unknown	2	1991	0	Unknown
Flowering Plants	Haloragaceae	*Myriophyllum verrucosum*	Red Water-milfoil			0	Unknown	2	1975	0	Unknown
Flowering Plants	Vitaceae	*Cayratia trifolia*	Native Grape			0	Unknown	5	1999	0	Unknown
Flowering Plants	Vitaceae	*Cissus reniformis*	Large-leaved Jungle Vine			0	Unknown	2	1987	0	Unknown
Flowering Plants	Combretaceae	*Macropteranthes kekwickii*	Bullwaddy			0	Unknown	46	2011	0	Unknown
Flowering Plants	Combretaceae	*Terminalia arostrata*	Nutwood			0	Unknown	1	1982	0	Unknown
Flowering Plants	Combretaceae	*Terminalia bursarina*	Bendee			0	Unknown	8	1987	0	Unknown
Flowering Plants	Combretaceae	*Terminalia canescens*	Winged Nut Tree			0	Unknown	33	2011	0	Unknown
Flowering Plants	Combretaceae	*Terminalia grandiflora*	Nut Tree			0	Unknown	1	1956	0	Unknown
Flowering Plants	Combretaceae	*Terminalia platyphylla*	Red Plum			0	Unknown	5	1987	0	Unknown
Flowering Plants	Combretaceae	*Terminalia platyptera*	Wing-seed Terminalia			0	Unknown	1	1988	0	Unknown
Flowering Plants	Combretaceae	*Terminalia pterocarya*	Wing-fruited Terminalia			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Combretaceae	*Terminalia volucris*	Rosewood			0	Unknown	21	2007	0	Unknown
Flowering Plants	Lythraceae	*Ammannia multiflora*	Jerry-Jerry			0	Unknown	9	2010	0	Unknown
Flowering Plants	Lythraceae	*Nesaea arnhemica*	Neasea			0	Unknown	1	1994	0	Unknown
Flowering Plants	Lythraceae	*Nesaea muelleri*	Neasea			0	Unknown	6	2001	0	Unknown
Flowering Plants	Lythraceae	*Nesaea repens*	Neasea	DD		0	Unknown	2	2006	0	Unknown
Flowering Plants	Lythraceae	*Rotala diandra*	Rotala			0	Unknown	5	2001	0	Unknown
Flowering Plants	Lythraceae	*Rotala mexicana*	Rotala			0	Unknown	4	1994	0	Unknown
Flowering Plants	Lythraceae	*Rotala occultiflora*	Rotala			0	Unknown	1	2001	0	Unknown
Flowering Plants	Onagraceae	*Ludwigia octovalvis*	Willow Primrose			0	Unknown	3	1988	0	Unknown
Flowering Plants	Onagraceae	*Ludwigia perennis*	Ludwigia			0	Unknown	5	1991	0	Unknown
Flowering Plants	Myrtaceae	*Calytrix exstipulata*	Turkey Bush			0	Unknown	27	1988	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia aspera*	Rough-leaved Range Gum			0	Unknown	2	1980	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia bella*	Ghost Gum			0	Unknown	1	1992	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia confertiflora*	Roughleaf Cabbage Gum			0	Unknown	7	2007	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia dichromophloia*	Variable-barked Bloodwood			0	Unknown	6	1999	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia drysdalensis*	Bloodwood			0	Unknown	21	1994	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia ferruginea*	Rusty Bloodwood			0	Unknown	15	2007	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia ferruginea subsp. ferruginea*	Rusty Bloodwood			0	Unknown	3	2002	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia ferruginea subsp. stypophylla*	Rusty Bloodwood			0	Unknown	2	1970	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia flavescens*	Cabbage Gum			0	Unknown	8	2007	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia foelscheana*	Broad-leaved Bloodwood			0	Unknown	1	1970	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia grandifolia*	Large-leaved Cabbage Gum			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia grandifolia subsp. grandifolia*	Large-leaved Cabbage Gum			0	Unknown	2	1988	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia latifolia*	Round-leaved Bloodwood			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia opaca*	Bloodwood			0	Unknown	2	2004	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia polycarpa*	Long-fruited Bloodwood			0	Unknown	18	1994	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia ptychocarpa*	Swamp Bloodwood			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia ptychocarpa subsp. ptychocarpa*	Swamp Bloodwood			0	Unknown	2	1986	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia setosa*	Rough-leaved Bloodwood			0	Unknown	2	2010	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia setosa subsp. setosa*	Rough-leaved Bloodwood			0	Unknown	11	2007	0	Unknown

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Flowering Plants	Myrtaceae	*Corymbia terminalis*	Northern Bloodwood			0	Unknown	5	1994	0	Unknown
Flowering Plants	Myrtaceae	*Corymbia umbonata*	Rusty Bloodwood			0	Unknown	2	1970	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus barklyensis*	Barkly Coolabah			0	Unknown	2	2003	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus bigalerita*	Northern Salmon Gum			0	Unknown	2	1996	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus brevifolia*	Snappy Gum			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus camaldulensis*	River Red Gum			0	Unknown	1	2000	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus camaldulensis subsp. obtusa*	Northern River Red Gum			0	Unknown	14	2002	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus chlorophylla*	Green-leaf Box			0	Unknown	24	2001	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus chlorophylla subsp. chlorophylla*	Greenleaf Box			0	Unknown	1	2007	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus coolabah subsp. arida*	Coolabah			0	Unknown	1	1989	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus cyanoclada*	Box			0	Unknown	18	2006	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus distans*	Katherine Box			0	Unknown	2	1987	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus helenae*	Box	DD		0	Unknown	3	1964	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus leucophloia*	Snappy Gum			0	Unknown	7	1996	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus leucophloia subsp. euroa*	Snappy Gum			0	Unknown	2	1988	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus microtheca*	Western Coolibah			0	Unknown	7	1993	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus miniata*	Darwin Woollybutt			0	Unknown	2	1971	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus normantonensis*	Normanton Box			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus patellaris*	Weeping Box			0	Unknown	2	2007	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus pruinosa*	Silver-leaf Box			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus pruinosa subsp. pruinosa*	Silver-leaf Box			0	Unknown	8	1988	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus pruinosa subsp. tenuata*	Silver-leaf Box			0	Unknown	5	1993	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus tectifica*	McArthur River Box			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus tetrodonta*	Darwin Stringybark			0	Unknown	2	1988	0	Unknown
Flowering Plants	Myrtaceae	*Eucalyptus umbrawarrensis*	Umbrawarra Gum			0	Unknown	1	1983	0	Unknown
Flowering Plants	Myrtaceae	*Lithomyrtus hypoleuca*	Lithomyrtus			0	Unknown	2	1977	0	Unknown
Flowering Plants	Myrtaceae	*Lophostemon grandiflorus*	Northern Swamp Box			0	Unknown	7	1992	0	Unknown
Flowering Plants	Myrtaceae	*Melaleuca acacioides*	Coastal Paperbark			0	Unknown	2	1988	0	Unknown
Flowering Plants	Myrtaceae	*Melaleuca argentea*	Silver-leaved Paperbark			0	Unknown	2	1988	0	Unknown
Flowering Plants	Myrtaceae	*Melaleuca citrolens*	Lemon-scented Paperbark			0	Unknown	9	1988	0	Unknown
Flowering Plants	Myrtaceae	*Melaleuca lasiandra*	Sandhill Teatree			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Myrtaceae	*Melaleuca leucadendra*	Weeping Paperbark			0	Unknown	2	1988	0	Unknown
Flowering Plants	Myrtaceae	*Melaleuca nervosa*	Yellow-barked Paperbark			0	Unknown	9	2001	0	Unknown
Flowering Plants	Myrtaceae	*Melaleuca viridiflora*	Broad-leaved Paperbark			0	Unknown	6	1988	0	Unknown
Flowering Plants	Zygophyllaceae	*Tribulopis angustifolia*	Tribulopis			0	Unknown	3	1993	0	Unknown
Flowering Plants	Zygophyllaceae	*Tribulopis pentandra*	Tribulopis			0	Unknown	9	1994	0	Unknown
Flowering Plants	Zygophyllaceae	*Tribulus eichlerianus*	Eichler`s Caltrop			0	Unknown	1	1992	0	Unknown
Flowering Plants	Celastraceae	*Denhamia cunninghamii*	Yellowberry Bush			0	Unknown	14	1999	0	Unknown
Flowering Plants	Celastraceae	*Denhamia obscura*	Orange Root			0	Unknown	2	1988	0	Unknown
Flowering Plants	Celastraceae	*Stackhousia clementii*	Limestone Candles			0	Unknown	1	1975	0	Unknown
Flowering Plants	Celastraceae	*Stackhousia intermedia*	Wiry Stackhousia			0	Unknown	2	1977	0	Unknown

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Flowering Plants	Celastraceae	*Stackhousia sp. Mt Liebig*	Candles			0	Unknown	1	1989	0	Unknown
Flowering Plants	Violaceae	*Hybanthus aurantiacus*	Orange Spade Flower			0	Unknown	3	1993	0	Unknown
Flowering Plants	Violaceae	*Hybanthus enneaspermus*	Blue Spade Flower			0	Unknown	12	1993	0	Unknown
Flowering Plants	Violaceae	*Hybanthus enneaspermus subsp. enneaspermus*	Blue Spade Flower			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Euphorbiaceae	*Acalypha lanceolata*	Acalypha	DD		0	Unknown	1	1990	0	Unknown
Flowering Plants	Euphorbiaceae	*Croton arnhemicus*	Native Croton			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Euphorbiaceae	*Euphorbia australis*	Hairy Caustic Weed			0	Unknown	1	2009	0	Unknown
Flowering Plants	Euphorbiaceae	*Euphorbia biconvexa*	Euphorbia			0	Unknown	18	1989	0	Unknown
Flowering Plants	Euphorbiaceae	*Euphorbia bifida*	Euphorbia			0	Unknown	5	1993	0	Unknown
Flowering Plants	Euphorbiaceae	*Euphorbia coghlanii*	Euphorbia			0	Unknown	10	1989	0	Unknown
Flowering Plants	Euphorbiaceae	*Euphorbia drummondii*	Caustic Weed			0	Unknown	9	2010	0	Unknown
Flowering Plants	Euphorbiaceae	*Euphorbia mitchelliana*	Native Gypsophila			0	Unknown	8	1993	0	Unknown
Flowering Plants	Euphorbiaceae	*Euphorbia petala*	Euphorbia			0	Unknown	1	1991	0	Unknown
Flowering Plants	Euphorbiaceae	*Euphorbia schizolepis*	Euphorbia			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Euphorbiaceae	*Euphorbia schultzii var. comans*	Euphorbia			0	Unknown	15	1989	0	Unknown
Flowering Plants	Euphorbiaceae	*Euphorbia schultzii var. schultzii*	Euphorbia			0	Unknown	7	1993	0	Unknown
Flowering Plants	Euphorbiaceae	*Euphorbia stevenii*	Bottletree Caustic			0	Unknown	2	1987	0	Unknown
Flowering Plants	Euphorbiaceae	*Excoecaria parvifolia*	Gutta-percha			0	Unknown	3	1991	0	Unknown
Flowering Plants	Euphorbiaceae	*Microstachys chamaelea*	Striped Seed Plant			0	Unknown	5	1994	0	Unknown
Flowering Plants	Phyllanthaceae	*Antidesma ghesaembilla*	Black Currant Bush			0	Unknown	2	1986	0	Unknown
Flowering Plants	Phyllanthaceae	*Antidesma parvifolium*	Currant Bush			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Phyllanthaceae	*Breynia cernua*	Breynia			0	Unknown	7	1989	0	Unknown
Flowering Plants	Phyllanthaceae	*Bridelia tomentosa*	Pop-gun Seed			0	Unknown	1	1989	0	Unknown
Flowering Plants	Phyllanthaceae	*Flueggea virosa*	White Currant			0	Unknown	14	1993	0	Unknown
Flowering Plants	Phyllanthaceae	*Flueggea virosa subsp. melanthesoides*	White Currant			0	Unknown	2	1971	0	Unknown
Flowering Plants	Phyllanthaceae	*Margaritaria dubium-traceyi*	Tracey's Puzzle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Phyllanthaceae	*Notoleptopus decaisnei*	Leptopus			0	Unknown	2	1973	0	Unknown
Flowering Plants	Phyllanthaceae	*Phyllanthus carpentariae*	Phyllanthus			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Phyllanthaceae	*Phyllanthus exilis*	Phyllanthus			0	Unknown	24	2007	0	Unknown
Flowering Plants	Phyllanthaceae	*Phyllanthus fuernrohrii*	Sand Spurge			0	Unknown	2	1988	0	Unknown
Flowering Plants	Phyllanthaceae	*Phyllanthus hebecarpus*	Phyllanthus			0	Unknown	7	1993	0	Unknown
Flowering Plants	Phyllanthaceae	*Phyllanthus indigoferoides*	Phyllanthus			0	Unknown	1	1971	0	Unknown
Flowering Plants	Phyllanthaceae	*Phyllanthus maderaspatensis*	Phyllanthus			0	Unknown	11	2010	0	Unknown
Flowering Plants	Phyllanthaceae	*Phyllanthus minutiflorus*	Phyllanthus			0	Unknown	2	1989	0	Unknown
Flowering Plants	Phyllanthaceae	*Phyllanthus sp. broad tuberculate seeds*	Phyllanthus			0	Unknown	1	2002	0	Unknown
Flowering Plants	Phyllanthaceae	*Phyllanthus sp. narrow tuberculate seeds*	Phyllanthus	DD		0	Unknown	3	2010	0	Unknown
Flowering Plants	Phyllanthaceae	*Phyllanthus urinaria*	Phyllanthus			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Phyllanthaceae	*Phyllanthus virgatus*	Seed-under-leaf			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Phyllanthaceae	*Poranthera microphylla*	Small Poranthera			0	Unknown	4	1977	0	Unknown
Flowering Plants	Phyllanthaceae	*Sauropus hubbardii*	Sauropus			0	Unknown	7	2006	0	Unknown

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Flowering Plants	Phyllanthaceae	*Sauropus rhytidospermus*	Sauropus			0	Unknown	1	2010	0	Unknown
Flowering Plants	Phyllanthaceae	*Sauropus rigidulus*	Sauropus			0	Unknown	2	1986	0	Unknown
Flowering Plants	Phyllanthaceae	*Sauropus sp.*	Sauropus			0	Unknown	8	2006	0	Unknown
Flowering Plants	Picrodendraceae	*Petalostigma banksii*	Quinine Bush			0	Unknown	5	1987	0	Unknown
Flowering Plants	Picrodendraceae	*Petalostigma pubescens*	Quinine Tree			0	Unknown	18	1994	0	Unknown
Flowering Plants	Erythroxylaceae	*Erythroxylum ellipticum*	Kerosene Wood			0	Unknown	4	1992	0	Unknown
Flowering Plants	Elatinaceae	*Bergia barklyana*	Barkly Water-fire			0	Unknown	5	1994	0	Unknown
Flowering Plants	Elatinaceae	*Bergia diacheiron*	Water-fire			0	Unknown	2	1994	0	Unknown
Flowering Plants	Elatinaceae	*Bergia henshallii*	Water-fire			0	Unknown	2	1987	0	Unknown
Flowering Plants	Elatinaceae	*Bergia pedicellaris*	Water-fire			0	Unknown	5	2001	0	Unknown
Flowering Plants	Elatinaceae	*Bergia trimera*	Small Water-Fire			0	Unknown	3	2001	0	Unknown
Flowering Plants	Fabaceae	*Abrus precatorius*	Crab`s Eye			0	Unknown	4	1988	0	Unknown
Flowering Plants	Fabaceae	*Abrus precatorius subsp. precatorius*	Crab`s Eye			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia acradenia*	Wattle			0	Unknown	1	1999	0	Unknown
Flowering Plants	Fabaceae	*Acacia adoxa var. adoxa*	Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia alleniana*	Needle-leaved Wattle			0	Unknown	3	1986	0	Unknown
Flowering Plants	Fabaceae	*Acacia ancistrocarpa*	Fitzroy Wattle			0	Unknown	3	1969	0	Unknown
Flowering Plants	Fabaceae	*Acacia argyraea*	Wattle			0	Unknown	6	2010	0	Unknown
Flowering Plants	Fabaceae	*Acacia calligera*	Wattle			0	Unknown	50	1999	0	Unknown
Flowering Plants	Fabaceae	*Acacia chippendalei*	Chippendales Wattle			0	Unknown	2	1969	0	Unknown
Flowering Plants	Fabaceae	*Acacia colei var. colei*	Kalkardi			0	Unknown	17	1999	0	Unknown
Flowering Plants	Fabaceae	*Acacia conspersa*	Wattle			0	Unknown	2	1971	0	Unknown
Flowering Plants	Fabaceae	*Acacia cowleana*	Halls Creek Wattle			0	Unknown	5	1996	0	Unknown
Flowering Plants	Fabaceae	*Acacia cuthbertsonii*	Silver Witchetty			0	Unknown	1	1956	0	Unknown
Flowering Plants	Fabaceae	*Acacia difficilis*	River Wattle			0	Unknown	12	2007	0	Unknown
Flowering Plants	Fabaceae	*Acacia dimidiata*	Swamp Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia drepanocarpa*	Wattle			0	Unknown	1	1991	0	Unknown
Flowering Plants	Fabaceae	*Acacia drepanocarpa subsp. latifolia*	Wattle			0	Unknown	7	1993	0	Unknown
Flowering Plants	Fabaceae	*Acacia elachantha*	Wattle			0	Unknown	1	1994	0	Unknown
Flowering Plants	Fabaceae	*Acacia galioides*	Wattle			0	Unknown	65	1999	0	Unknown
Flowering Plants	Fabaceae	*Acacia gonoclada*	Wattle			0	Unknown	16	1999	0	Unknown
Flowering Plants	Fabaceae	*Acacia hammondii*	Wattle			0	Unknown	14	1991	0	Unknown
Flowering Plants	Fabaceae	*Acacia hemignosta*	Club-leaf Wattle			0	Unknown	4	1994	0	Unknown
Flowering Plants	Fabaceae	*Acacia hemsleyi*	Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia hilliana*	Flying-saucer Bush			0	Unknown	1	1965	0	Unknown
Flowering Plants	Fabaceae	*Acacia holosericea*	Candelabra Wattle			0	Unknown	8	1996	0	Unknown
Flowering Plants	Fabaceae	*Acacia humifusa*	Cape York Wattle			0	Unknown	2	1977	0	Unknown
Flowering Plants	Fabaceae	*Acacia lamprocarpa*	Hickory Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia latescens*	Ball Wattle			0	Unknown	4	1977	0	Unknown
Flowering Plants	Fabaceae	*Acacia limbata*	Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia longipedunculata*	Wattle	DD		0	Unknown	1	1982	0	Unknown
Flowering Plants	Fabaceae	*Acacia lycopodiifolia*	Cypress Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia lysiphloia*	Turpentine Bush			0	Unknown	19	1999	0	Unknown
Flowering Plants	Fabaceae	*Acacia megalantha*	Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia melleodora*	Waxy Wattle			0	Unknown	1	2004	0	Unknown

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Flowering Plants	Fabaceae	*Acacia monticola*	Hill Turpentine			0	Unknown	11	1993	0	Unknown
Flowering Plants	Fabaceae	*Acacia neurocarpa*	Wattle			0	Unknown	1	1996	0	Unknown
Flowering Plants	Fabaceae	*Acacia oncinocarpa*	Wattle			0	Unknown	1	1987	0	Unknown
Flowering Plants	Fabaceae	*Acacia orthocarpa*	Needle-leaf Wattle			0	Unknown	7	1994	0	Unknown
Flowering Plants	Fabaceae	*Acacia perryi*	Wattle			0	Unknown	1	2010	0	Unknown
Flowering Plants	Fabaceae	*Acacia platycarpa*	Ghost Wattle			0	Unknown	5	2008	0	Unknown
Flowering Plants	Fabaceae	*Acacia plectocarpa*	Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia plectocarpa subsp. tanumbirinensis*	Wattle			0	Unknown	4	1988	0	Unknown
Flowering Plants	Fabaceae	*Acacia pruinocarpa*	Black Gidgee			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia retivenea subsp. retivenea*	Wattle			0	Unknown	12	2005	0	Unknown
Flowering Plants	Fabaceae	*Acacia sericophylla*	Dogwood			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia shirleyi*	Lancewood			0	Unknown	28	2002	0	Unknown
Flowering Plants	Fabaceae	*Acacia stenophylla*	River Cooba			0	Unknown	7	1992	0	Unknown
Flowering Plants	Fabaceae	*Acacia stipuligera*	Scrub Wattle			0	Unknown	10	2003	0	Unknown
Flowering Plants	Fabaceae	*Acacia sublanata*	Spiny Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia subternata*	Wattle			0	Unknown	6	1986	0	Unknown
Flowering Plants	Fabaceae	*Acacia tenuissima*	Broom Wattle			0	Unknown	2	2010	0	Unknown
Flowering Plants	Fabaceae	*Acacia thomsonii*	Wattle			0	Unknown	11	2011	0	Unknown
Flowering Plants	Fabaceae	*Acacia torulosa*	Torulosa Wattle			0	Unknown	8	2003	0	Unknown
Flowering Plants	Fabaceae	*Acacia tumida*	Pindan Wattle			0	Unknown	2	1975	0	Unknown
Flowering Plants	Fabaceae	*Acacia tumida var. kulparn*	Pindan Wattle			0	Unknown	5	1975	0	Unknown
Flowering Plants	Fabaceae	*Acacia tumida var. tumida*	Pindan Wattle			0	Unknown	1	1956	0	Unknown
Flowering Plants	Fabaceae	*Acacia umbellata*	Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia victoriae*	Victoria Wattle			0	Unknown	16	1992	0	Unknown
Flowering Plants	Fabaceae	*Acacia wickhamii*	Wickham`s Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Acacia wickhamii subsp. wickhamii*	Wattle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Aeschynomene indica*	Budda Pea			0	Unknown	4	1995	0	Unknown
Flowering Plants	Fabaceae	*Albizia lebbeck*	Indian Siris			0	Unknown	2	2006	0	Unknown
Flowering Plants	Fabaceae	*Alysicarpus muelleri*	Rough Chain-pea			0	Unknown	3	2001	0	Unknown
Flowering Plants	Fabaceae	*Bauhinia cunninghamii*	Butterfly Tree			0	Unknown	19	1993	0	Unknown
Flowering Plants	Fabaceae	*Bossiaea bossiaeoides*	Holly-leaved Pea-flower			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Cajanus cinereus*	Pigeon-pea			0	Unknown	2	2002	0	Unknown
Flowering Plants	Fabaceae	*Cajanus marmoratus*	Pigeon-pea			0	Unknown	3	2002	0	Unknown
Flowering Plants	Fabaceae	*Cajanus pubescens*	Pigeon-pea			0	Unknown	8	1986	0	Unknown
Flowering Plants	Fabaceae	*Chamaecrista absus var. absus*	Hairy Cassia			0	Unknown	14	1995	0	Unknown
Flowering Plants	Fabaceae	*Chamaecrista deserti*	Cassia	DD		0	Unknown	1	1968	0	Unknown
Flowering Plants	Fabaceae	*Chamaecrista mimosoides*	Five-leafed Cassia			0	Unknown	2	1986	0	Unknown
Flowering Plants	Fabaceae	*Chamaecrista nomame*	Cassia			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Chamaecrista nomame var. nomame*	Cassia			0	Unknown	2	1991	0	Unknown
Flowering Plants	Fabaceae	*Chamaecrista symonii*	Dwarf Cassia			0	Unknown	13	2010	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria aridicola subsp. densifolia*	Rattlepod			0	Unknown	11	2004	0	Unknown

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Flowering Plants	Fabaceae	*Crotalaria brevis*	Rattlepod			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria crispata*	Kimberley Horse Poison			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria dissitiflora*	Grey Rattlepod			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria dissitiflora subsp. dissitiflora*	Grey Rattlepod	DD		0	Unknown	1	2011	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria dissitiflora subsp. rugosa*	Grey Rattlepod			0	Unknown	5	1969	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria medicaginea*	Trefoil Rattlepod			0	Unknown	2	1994	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria medicaginea var. neglecta*	Trefoil Rattlepod			0	Unknown	8	2006	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria montana*	Rattlepod			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria montana var. angustifolia*	Rattlepod			0	Unknown	3	1988	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria novae-hollandiae*	New Holland Rattlepod			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria novae-hollandiae subsp. novae-hollandiae*	New Holland Rattlepod	DD		0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Crotalaria ramosissima*	Rattlepod			0	Unknown	3	1993	0	Unknown
Flowering Plants	Fabaceae	*Cullen australasicum*	Tall Verbine			0	Unknown	1	2012	0	Unknown
Flowering Plants	Fabaceae	*Cullen balsamicum*	Verbine			0	Unknown	4	2011	0	Unknown
Flowering Plants	Fabaceae	*Cullen cinereum*	Annual Verbine			0	Unknown	5	1987	0	Unknown
Flowering Plants	Fabaceae	*Cullen leucanthum*	White Verbine			0	Unknown	1	1975	0	Unknown
Flowering Plants	Fabaceae	*Cullen plumosum*	Scurf-pea			0	Unknown	12	2009	0	Unknown
Flowering Plants	Fabaceae	*Cullen pustulatum*	Scurf-pea			0	Unknown	7	1994	0	Unknown
Flowering Plants	Fabaceae	*Desmodium brachypodum*	Large Tick-trefoil			0	Unknown	6	1989	0	Unknown
Flowering Plants	Fabaceae	*Desmodium campylocaulon*	Creeping Tick-trefoil			0	Unknown	8	2011	0	Unknown
Flowering Plants	Fabaceae	*Desmodium filiforme*	Tick-trefoil			0	Unknown	2	1993	0	Unknown
Flowering Plants	Fabaceae	*Desmodium muelleri*	Tick-trefoil			0	Unknown	16	2011	0	Unknown
Flowering Plants	Fabaceae	*Dichrostachys spicata*	Single Thorn Prickly Bush			0	Unknown	8	1992	0	Unknown
Flowering Plants	Fabaceae	*Erythrina vespertilio subsp. vespertilio*	Bat Wing Coral Tree			0	Unknown	3	1996	0	Unknown
Flowering Plants	Fabaceae	*Erythrophleum chlorostachys*	Northern Ironwood			0	Unknown	6	1993	0	Unknown
Flowering Plants	Fabaceae	*Flemingia pauciflora*	Flemingia			0	Unknown	9	1996	0	Unknown
Flowering Plants	Fabaceae	*Galactia muelleri*	Mueller's Pea			0	Unknown	2	1988	0	Unknown
Flowering Plants	Fabaceae	*Galactia tenuiflora*	Poison Pea			0	Unknown	13	2001	0	Unknown
Flowering Plants	Fabaceae	*Gastrolobium grandiflorum*	Heartleaf			0	Unknown	1	1956	0	Unknown
Flowering Plants	Fabaceae	*Glycine canescens*	Silky Glycine			0	Unknown	1	1999	0	Unknown
Flowering Plants	Fabaceae	*Glycine falcata*	Glycine Pea			0	Unknown	5	2011	0	Unknown
Flowering Plants	Fabaceae	*Glycine pullenii*	Glycine Pea			0	Unknown	1	2004	0	Unknown
Flowering Plants	Fabaceae	*Glycine tomentella*	Rusty Glycine			0	Unknown	11	2012	0	Unknown
Flowering Plants	Fabaceae	*Indigastrum parviflorum*	Small-flower Indigo			0	Unknown	1	1969	0	Unknown
Flowering Plants	Fabaceae	*Indigofera colutea*	Sticky Indigo			0	Unknown	6	1993	0	Unknown
Flowering Plants	Fabaceae	*Indigofera ewartiana*	Indigo			0	Unknown	3	2011	0	Unknown
Flowering Plants	Fabaceae	*Indigofera haplophylla*	Indigo			0	Unknown	7	1993	0	Unknown
Flowering Plants	Fabaceae	*Indigofera linifolia*	Native Indigo			0	Unknown	9	1993	0	Unknown
Flowering Plants	Fabaceae	*Indigofera linnaei*	Birdsville Indigo			0	Unknown	8	2011	0	Unknown
Flowering Plants	Fabaceae	*Indigofera trita*	Indigo			0	Unknown	13	1999	0	Unknown

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Flowering Plants	Fabaceae	*Jacksonia dilatata*	Cladode Pea			0	Unknown	4	1977	0	Unknown
Flowering Plants	Fabaceae	*Jacksonia odontoclada*	Jacksonia			0	Unknown	8	2010	0	Unknown
Flowering Plants	Fabaceae	*Mirbelia viminalis*	Yellow Broom			0	Unknown	6	1988	0	Unknown
Flowering Plants	Fabaceae	*Neptunia dimorphantha*	Sensitive Plant			0	Unknown	5	1992	0	Unknown
Flowering Plants	Fabaceae	*Neptunia gracilis*	Native Sensitive Plant			0	Unknown	1	1999	0	Unknown
Flowering Plants	Fabaceae	*Neptunia gracilis f. glandulosa*	Sensitive Plant			0	Unknown	3	1979	0	Unknown
Flowering Plants	Fabaceae	*Neptunia monosperma*	One-seeded Sensitive Plant			0	Unknown	6	1999	0	Unknown
Flowering Plants	Fabaceae	*Petalostylis cassioides*	Butterfly Bush			0	Unknown	10	1992	0	Unknown
Flowering Plants	Fabaceae	*Rhynchosia australis*	Native Rock Trefoil			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Rhynchosia minima*	Native Pea			0	Unknown	9	1988	0	Unknown
Flowering Plants	Fabaceae	*Senna costata*	Cassia			0	Unknown	5	1991	0	Unknown
Flowering Plants	Fabaceae	*Senna glutinosa*	Cassia			0	Unknown	1	2005	0	Unknown
Flowering Plants	Fabaceae	*Senna oligoclada*	Cassia			0	Unknown	5	1993	0	Unknown
Flowering Plants	Fabaceae	*Senna venusta*	Graceful Cassia			0	Unknown	6	1993	0	Unknown
Flowering Plants	Fabaceae	*Sesbania brachycarpa*	Sesbania			0	Unknown	5	2010	0	Unknown
Flowering Plants	Fabaceae	*Sesbania cannabina*	Yellow Pea-bush			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Sesbania cannabina var. cannabina*	Yellow Pea-bush			0	Unknown	1	2001	0	Unknown
Flowering Plants	Fabaceae	*Sesbania chippendalei*	Yellow Pea-bush			0	Unknown	1	2009	0	Unknown
Flowering Plants	Fabaceae	*Sesbania muelleri*	Peabush			0	Unknown	15	2012	0	Unknown
Flowering Plants	Fabaceae	*Templetonia hookeri*	Templetonia			0	Unknown	5	1994	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia brachyodon*	Red Pea-bush			0	Unknown	12	2011	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia brachyodon var. longifolia*	Red Pea-bush			0	Unknown	5	2010	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia conspicua*	Tephrosia			0	Unknown	2	1971	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia delestangii*	Tephrosia			0	Unknown	3	2011	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia lasiochlaena*	Tephrosia			0	Unknown	9	2010	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia leptoclada*	Tephrosia			0	Unknown	14	2010	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia macrocarpa*	Tephrosia			0	Unknown	3	1995	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia oblongata*	Tephrosia			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia remotiflora*	Tephrosia			0	Unknown	5	1991	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia rosea*	Flinder`s River Poison			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia simplicifolia*	Tephrosia			0	Unknown	5	1999	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia sp. Barrow Creek*	Tephrosia			0	Unknown	7	1993	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia sp. OT Station*	Tephrosia			0	Unknown	12	2010	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia sp. Willowra*	Tephrosia			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia stuartii*	Tephrosia			0	Unknown	8	2010	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia subpectinata*	Tephrosia			0	Unknown	2	2010	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia supina*	Tephrosia			0	Unknown	10	2010	0	Unknown
Flowering Plants	Fabaceae	*Tephrosia virens*	Tephrosia			0	Unknown	4	1993	0	Unknown
Flowering Plants	Fabaceae	*Uraria lagopodioides*	Purple Clover-weed			0	Unknown	10	1993	0	Unknown
Flowering Plants	Fabaceae	*Vachellia ditricha*	Wattle			0	Unknown	6	1986	0	Unknown
Flowering Plants	Fabaceae	*Vachellia farnesiana*	Sweet Acacia			0	Unknown	0	Unknown	13	1990
Flowering Plants	Fabaceae	*Vachellia valida*	Wattle			0	Unknown	3	1996	0	Unknown
Flowering Plants	Fabaceae	*Vigna lanceolata*	Maloga Bean			0	Unknown	4	1994	0	Unknown

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Flowering Plants	Fabaceae	*Vigna lanceolata var. filiformis*	Maloga Bean			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Fabaceae	*Vigna lanceolata var. lanceolata*	Maloga Bean			0	Unknown	1	1969	0	Unknown
Flowering Plants	Fabaceae	*Vigna lanceolata var. latifolia*	Maloga Bean			0	Unknown	2	1969	0	Unknown
Flowering Plants	Fabaceae	*Zornia albiflora*	Zornia			0	Unknown	5	1993	0	Unknown
Flowering Plants	Fabaceae	*Zornia chaetophora*	Zornia			0	Unknown	1	1969	0	Unknown
Flowering Plants	Fabaceae	*Zornia muriculata*	Zornia			0	Unknown	9	1991	0	Unknown
Flowering Plants	Fabaceae	*Zornia muriculata subsp. angustata*	Zornia			0	Unknown	3	1972	0	Unknown
Flowering Plants	Fabaceae	*Zornia prostrata*	Zornia			0	Unknown	4	1986	0	Unknown
Flowering Plants	Polygalaceae	*Polygala barbata*	Milkwort			0	Unknown	7	1999	0	Unknown
Flowering Plants	Polygalaceae	*Polygala bifoliata*	Milkwort			0	Unknown	1	1971	0	Unknown
Flowering Plants	Polygalaceae	*Polygala crassitesta*	Milkwort			0	Unknown	1	1999	0	Unknown
Flowering Plants	Polygalaceae	*Polygala dependens*	Milkwort			0	Unknown	3	2011	0	Unknown
Flowering Plants	Polygalaceae	*Polygala eriocephala*	Milkwort			0	Unknown	5	2010	0	Unknown
Flowering Plants	Polygalaceae	*Polygala integra*	Milkwort			0	Unknown	1	1976	0	Unknown
Flowering Plants	Polygalaceae	*Polygala longifolia*	Milkwort			0	Unknown	3	1995	0	Unknown
Flowering Plants	Polygalaceae	*Polygala orbicularis*	Milkwort			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Polygalaceae	*Polygala pterocarpa*	Milkwort			0	Unknown	6	2007	0	Unknown
Flowering Plants	Polygalaceae	*Polygala stenoclada*	Milkwort			0	Unknown	1	1999	0	Unknown
Flowering Plants	Polygalaceae	*Polygala tepperi*	Milkwort			0	Unknown	3	2011	0	Unknown
Flowering Plants	Rhamnaceae	*Alphitonia excelsa*	Red Ash			0	Unknown	12	1994	0	Unknown
Flowering Plants	Rhamnaceae	*Ventilago viminalis*	Supplejack			0	Unknown	7	1999	0	Unknown
Flowering Plants	Rhamnaceae	*Ziziphus quadrilocularis*	Ziziphus			0	Unknown	1	1950	0	Unknown
Flowering Plants	Cannabaceae	*Trema tomentosa*	Peach-leaved Poison-bush			0	Unknown	2	1977	0	Unknown
Flowering Plants	Moraceae	*Fatoua villosa*	Arzerarzer			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Moraceae	*Ficus aculeata*	Sandpaper Fig			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Moraceae	*Ficus cerasicarpa*	Fig			0	Unknown	6	1987	0	Unknown
Flowering Plants	Moraceae	*Ficus subpuberula*	Fig			0	Unknown	4	1977	0	Unknown
Flowering Plants	Moraceae	*Ficus virens var. virens*	Banyan			0	Unknown	2	1977	0	Unknown
Flowering Plants	Cucurbitaceae	*Cucumis althaeoides*	Melon			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cucurbitaceae	*Cucumis argenteus*	Melon			0	Unknown	4	2008	0	Unknown
Flowering Plants	Cucurbitaceae	*Cucumis sp.*	Head-ache Vine			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Cucurbitaceae	*Cucumis melo*	Ulcardo Melon			0	Unknown	0	Unknown	18	2009
Flowering Plants	Cucurbitaceae	*Cucumis picrocarpus*	Melon			0	Unknown	4	1999	0	Unknown
Flowering Plants	Casuarinaceae	*Casuarina cunninghamiana subsp. miodon*	River Oak			0	Unknown	2	1988	0	Unknown
Flowering Plants	Capparaceae	*Capparis lasiantha*	Split-arse-jack			0	Unknown	9	2010	0	Unknown
Flowering Plants	Capparaceae	*Capparis loranthifolia var. loranthifolia*	Narrow-leaf Bumble			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Capparaceae	*Capparis sepiaria*	Native Caper			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Capparaceae	*Capparis spinosa var. nummularia*	Caper Bush			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Capparaceae	*Capparis umbonata*	Northern Wild Orange			0	Unknown	15	1992	0	Unknown
Flowering Plants	Cleomaceae	*Cleome oxalidea*	Spiderflower			0	Unknown	1	2004	0	Unknown
Flowering Plants	Cleomaceae	*Cleome tetrandra*	Spiderflower			0	Unknown	4	1989	0	Unknown

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Flowering Plants	Cleomaceae	*Cleome tetrandra var. tetrandra*	Spiderflower			0	Unknown	2	1996	0	Unknown
Flowering Plants	Cleomaceae	*Cleome viscosa*	Tickweed			0	Unknown	16	2004	0	Unknown
Flowering Plants	Bixaceae	*Cochlospermum fraseri*	Kapok Bush			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Bixaceae	*Cochlospermum gregorii*	Cotton Tree			0	Unknown	6	1992	0	Unknown
Flowering Plants	Malvaceae	*Abelmoschus ficulneus*	Native Rosella			0	Unknown	4	2001	0	Unknown
Flowering Plants	Malvaceae	*Abutilon fraseri*	Dwarf Lantern-bush			0	Unknown	1	2011	0	Unknown
Flowering Plants	Malvaceae	*Abutilon fraseri subsp. fraseri*	Dwarf Lantern-bush			0	Unknown	3	1999	0	Unknown
Flowering Plants	Malvaceae	*Abutilon hannii*	Mallow			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Malvaceae	*Abutilon hannii subsp. prostrate*	Lantern Bush			0	Unknown	13	1999	0	Unknown
Flowering Plants	Malvaceae	*Abutilon indicum var. australiense*	Indian Lantern-flower			0	Unknown	2	2010	0	Unknown
Flowering Plants	Malvaceae	*Abutilon leucopetalum*	Desert Lantern-bush			0	Unknown	8	2004	0	Unknown
Flowering Plants	Malvaceae	*Abutilon otocarpum*	Desert Chinese Lantern			0	Unknown	13	1993	0	Unknown
Flowering Plants	Malvaceae	*Abutilon sp. Mataranka*	Mallow			0	Unknown	1	1996	0	Unknown
Flowering Plants	Malvaceae	*Brachychiton collinus*	Kurrajong			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Malvaceae	*Brachychiton diversifolius subsp. diversifolius*	Northern Kurrajong			0	Unknown	5	1996	0	Unknown
Flowering Plants	Malvaceae	*Brachychiton megaphyllus*	Red-flowered Kurrajong			0	Unknown	1	2002	0	Unknown
Flowering Plants	Malvaceae	*Brachychiton paradoxus*	Red-flowering Kurrajong			0	Unknown	5	2002	0	Unknown
Flowering Plants	Malvaceae	*Brachychiton x hirtellus*	Kurrajong			0	Unknown	2	2002	0	Unknown
Flowering Plants	Malvaceae	*Corchorus aestuans*	Grubweed			0	Unknown	3	1994	0	Unknown
Flowering Plants	Malvaceae	*Corchorus capsularis*	Grubweed			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Malvaceae	*Corchorus fascicularis*	Grubweed			0	Unknown	4	2003	0	Unknown
Flowering Plants	Malvaceae	*Corchorus pascuorum*	Grubweed	DD		0	Unknown	1	1971	0	Unknown
Flowering Plants	Malvaceae	*Corchorus sidoides*	Flannel Weed			0	Unknown	8	1996	0	Unknown
Flowering Plants	Malvaceae	*Corchorus sidoides subsp. sidoides*	Flannel Weed			0	Unknown	18	1992	0	Unknown
Flowering Plants	Malvaceae	*Corchorus sidoides subsp. vermicularis*	Flannel Weed			0	Unknown	2	1992	0	Unknown
Flowering Plants	Malvaceae	*Corchorus tridens*	Grubweed			0	Unknown	4	2001	0	Unknown
Flowering Plants	Malvaceae	*Gossypium australe*	Native Cotton			0	Unknown	11	2005	0	Unknown
Flowering Plants	Malvaceae	*Grewia breviflora*	Coffee Fruit			0	Unknown	1	1989	0	Unknown
Flowering Plants	Malvaceae	*Grewia mesomischa*	Grewia			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Malvaceae	*Grewia retusifolia*	Emu Berries			0	Unknown	15	1993	0	Unknown
Flowering Plants	Malvaceae	*Helicteres integrifolia*	Helicteres			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Malvaceae	*Helicteres isora*	Spiral Bush			0	Unknown	2	1972	0	Unknown
Flowering Plants	Malvaceae	*Herissantia crispa*	Indian Mallow			0	Unknown	14	1993	0	Unknown
Flowering Plants	Malvaceae	*Hibiscus leptocladus*	Variable-leaf Hibiscus			0	Unknown	10	1999	0	Unknown
Flowering Plants	Malvaceae	*Hibiscus meraukensis*	Ballerina Hibiscus			0	Unknown	10	1989	0	Unknown
Flowering Plants	Malvaceae	*Hibiscus panduriformis*	Yellow Hibiscus			0	Unknown	1	1982	0	Unknown
Flowering Plants	Malvaceae	*Hibiscus pentaphyllus*	Native Hibiscus			0	Unknown	22	1999	0	Unknown
Flowering Plants	Malvaceae	*Hibiscus sturtii*	Sturt`s Hibiscus			0	Unknown	7	1999	0	Unknown
Flowering Plants	Malvaceae	*Hibiscus sturtii var. campylochlamys*	Sturt`s Hibiscus			0	Unknown	24	2004	0	Unknown

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Flowering Plants	Malvaceae	*Hibiscus sturtii var. grandiflorus*	Sturt`s Hibiscus			0	Unknown	5	1993	0	Unknown
Flowering Plants	Malvaceae	*Hibiscus verdcourtii*	Bladder Ketmia			0	Unknown	29	2012	0	Unknown
Flowering Plants	Malvaceae	*Hibiscus zonatus*	Pink Perennial Hibiscus			0	Unknown	1	1977	0	Unknown
Flowering Plants	Malvaceae	*Keraudrenia nephrosperma*	Velvet Flower			0	Unknown	1	1969	0	Unknown
Flowering Plants	Malvaceae	*Melhania oblongifolia*	Velvet Hibiscus			0	Unknown	19	1999	0	Unknown
Flowering Plants	Malvaceae	*Sida brachypoda*	Sida			0	Unknown	3	1999	0	Unknown
Flowering Plants	Malvaceae	*Sida fibulifera*	Silver Sida			0	Unknown	9	2010	0	Unknown
Flowering Plants	Malvaceae	*Sida filiformis*	Fine Sida			0	Unknown	3	1989	0	Unknown
Flowering Plants	Malvaceae	*Sida hackettiana*	Sida			0	Unknown	10	1987	0	Unknown
Flowering Plants	Malvaceae	*Sida laevis*	Sida			0	Unknown	2	1969	0	Unknown
Flowering Plants	Malvaceae	*Sida macropoda*	Sida			0	Unknown	2	1969	0	Unknown
Flowering Plants	Malvaceae	*Sida platycalyx*	Lifesaver Burr			0	Unknown	6	1993	0	Unknown
Flowering Plants	Malvaceae	*Sida rohlenae*	Shrub Sida			0	Unknown	10	1994	0	Unknown
Flowering Plants	Malvaceae	*Sida rohlenae subsp. occidentalis*	Shrub Sida	DD		0	Unknown	2	2011	0	Unknown
Flowering Plants	Malvaceae	*Sida rohlenae subsp. rohlenae*	Shrub Sida			0	Unknown	3	1979	0	Unknown
Flowering Plants	Malvaceae	*Sida sp. excedentifolia*	Sida			0	Unknown	1	1993	0	Unknown
Flowering Plants	Malvaceae	*Sida sp. Mt Bundey*	Sida			0	Unknown	3	2001	0	Unknown
Flowering Plants	Malvaceae	*Sida sp. Pindan*	Sida			0	Unknown	1	2004	0	Unknown
Flowering Plants	Malvaceae	*Sida sp. Suplejack Station*	Sida			0	Unknown	1	2010	0	Unknown
Flowering Plants	Malvaceae	*Sida sp. Wakaya Desert*	Sida			0	Unknown	1	2004	0	Unknown
Flowering Plants	Malvaceae	*Sida spinosa*	Spiny Sida			0	Unknown	0	Unknown	49	2010
Flowering Plants	Malvaceae	*Sida trichopoda*	High Sida			0	Unknown	4	2010	0	Unknown
Flowering Plants	Malvaceae	*Triumfetta antrorsa*	Burbark	DD		0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Malvaceae	*Triumfetta fissurata*	Burbark	DD		0	Unknown	2	1977	0	Unknown
Flowering Plants	Malvaceae	*Triumfetta glaucescens*	Burbark			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Malvaceae	*Triumfetta johnstonii*	Burbark			0	Unknown	1	2010	0	Unknown
Flowering Plants	Malvaceae	*Triumfetta micracantha*	Burbark			0	Unknown	9	1994	0	Unknown
Flowering Plants	Malvaceae	*Triumfetta plumigera*	Burbark			0	Unknown	7	1986	0	Unknown
Flowering Plants	Malvaceae	*Waltheria indica*	Waltheria			0	Unknown	11	1994	0	Unknown
Flowering Plants	Thymelaeaceae	*Thecanthes punicea*	Red Wax Plant			0	Unknown	7	2001	0	Unknown
Flowering Plants	Thymelaeaceae	*Thecanthes sanguinea*	Thecanthes			0	Unknown	2	1985	0	Unknown
Flowering Plants	Sapindaceae	*Atalaya hemiglauca*	Whitewood			0	Unknown	4	1999	0	Unknown
Flowering Plants	Sapindaceae	*Atalaya variifolia*	Wing-leaf Whitewood			0	Unknown	1	1956	0	Unknown
Flowering Plants	Sapindaceae	*Cardiospermum halicacabum*	Slender Balloon Vine			0	Unknown	1	1996	0	Unknown
Flowering Plants	Sapindaceae	*Dodonaea barklyana*	False Hopbush	DD		0	Unknown	3	1993	0	Unknown
Flowering Plants	Sapindaceae	*Dodonaea coriacea*	Hopbush			0	Unknown	2	1988	0	Unknown
Flowering Plants	Sapindaceae	*Dodonaea hispidula*	False Hopbush			0	Unknown	3	1993	0	Unknown
Flowering Plants	Sapindaceae	*Dodonaea lanceolata*	Yellow Hop-bush			0	Unknown	4	1989	0	Unknown
Flowering Plants	Sapindaceae	*Dodonaea lanceolata var. lanceolata*	Yellow Hop-bush			0	Unknown	4	1999	0	Unknown
Flowering Plants	Sapindaceae	*Dodonaea oxyptera*	Hop Bush			0	Unknown	2	1977	0	Unknown
Flowering Plants	Sapindaceae	*Dodonaea physocarpa*	Balloon Hopbush			0	Unknown	38	2004	0	Unknown
Flowering Plants	Sapindaceae	*Dodonaea platyptera*	Hop Bush			0	Unknown	0	Unknown	0	Unknown

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Flowering Plants	Sapindaceae	*Dodonaea polyzyga*	Hop Bush			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Sapindaceae	*Dodonaea stenophylla*	Netted Hopbush			0	Unknown	18	2001	0	Unknown
Flowering Plants	Meliaceae	*Owenia vernicosa*	Emu Apple			0	Unknown	2	1988	0	Unknown
Flowering Plants	Rutaceae	*Boronia lanceolata*	Boronia			0	Unknown	2	1977	0	Unknown
Flowering Plants	Ebenaceae	*Diospyros humilis*	Small-leaved Ebony			0	Unknown	5	2007	0	Unknown
Flowering Plants	Ebenaceae	*Diospyros littorea*	Native Ebony			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Ebenaceae	*Diospyros rugosula*	Iron Tree			0	Unknown	3	1993	0	Unknown
Flowering Plants	Boraginaceae	*Coldenia procumbens*	Coldenia			0	Unknown	3	2005	0	Unknown
Flowering Plants	Boraginaceae	*Ehretia saligna*	Coonta			0	Unknown	7	1993	0	Unknown
Flowering Plants	Boraginaceae	*Ehretia saligna var. membranifolia*	Coonta			0	Unknown	5	1993	0	Unknown
Flowering Plants	Boraginaceae	*Halgania cyanea*	Mallee Blue-flower			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium brachythrix*	Heliotrope	DD		0	Unknown	1	1999	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium bracteatum*	Heliotrope			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium conocarpum*	White Heliotrope			0	Unknown	1	2001	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium fasciculatum*	Heliotrope	DD		0	Unknown	3	2007	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium foliatum*	Heliotrope			0	Unknown	1	2011	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium geocharis*	Heliotrope	DD		0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium glabellum*	Heliotrope			0	Unknown	13	2011	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium haesum*	Heliotrope			0	Unknown	2	2007	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium leptaleum*	Heliotrope	DD		0	Unknown	2	2011	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium ovalifolium*	Heliotrope			0	Unknown	3	1982	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium pachyphyllum*	Heliotrope			0	Unknown	3	2011	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium ramulipatens*	Heliotrope			0	Unknown	2	2011	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium sphaericum*	Heliotrope	DD		0	Unknown	3	2011	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium subreniforme*	Heliotrope	DD		0	Unknown	1	2011	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium tanythrix*	Heliotrope			0	Unknown	2	2011	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium tenuifolium*	Devil’s Son			0	Unknown	16	2004	0	Unknown
Flowering Plants	Boraginaceae	*Heliotropium ventricosum*	White Heliotrope			0	Unknown	1	1994	0	Unknown
Flowering Plants	Boraginaceae	*Trichodesma zeylanicum*	Cattle Bush			0	Unknown	3	2010	0	Unknown
Flowering Plants	Boraginaceae	*Trichodesma zeylanicum var. latisepalum*	Cattle Bush			0	Unknown	1	1969	0	Unknown
Flowering Plants	Rubiaceae	*Dentella asperata*	Rough Mat-plant			0	Unknown	3	2010	0	Unknown
Flowering Plants	Rubiaceae	*Dentella minutissima*	Bedstraw			0	Unknown	3	1991	0	Unknown
Flowering Plants	Rubiaceae	*Gardenia ewartii subsp. ewartii*	Native Gardenia			0	Unknown	10	1999	0	Unknown
Flowering Plants	Rubiaceae	*Gardenia megasperma*	Native Gardenia			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Rubiaceae	*Gardenia pyriformis subsp. orientalis*	Native Gardenia			0	Unknown	2	1977	0	Unknown
Flowering Plants	Rubiaceae	*Oldenlandia argillacea*	Oldenlandia			0	Unknown	5	1999	0	Unknown
Flowering Plants	Rubiaceae	*Oldenlandia galioides*	Oldenlandia			0	Unknown	5	1995	0	Unknown
Flowering Plants	Rubiaceae	*Oldenlandia mitrasacmoides*	Oldenlandia			0	Unknown	5	1991	0	Unknown
Flowering Plants	Rubiaceae	*Oldenlandia mitrasacmoides subsp. mitrasacmoides*	Oldenlandia			0	Unknown	1	1996	0	Unknown
Flowering Plants	Rubiaceae	*Psydrax attenuata var. myrmecophila*	Canthium			0	Unknown	5	2006	0	Unknown
Flowering Plants	Rubiaceae	*Spermacoce argillacea*	Buttonweed			0	Unknown	4	2011	0	Unknown

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Flowering Plants	Rubiaceae	*Spermacoce auriculata*	Buttonweed			0	Unknown	2	1988	0	Unknown
Flowering Plants	Rubiaceae	*Spermacoce brachystema*	Buttonweed	DD		0	Unknown	2	1989	0	Unknown
Flowering Plants	Rubiaceae	*Spermacoce breviflora*	Buttonweed			0	Unknown	3	2000	0	Unknown
Flowering Plants	Rubiaceae	*Spermacoce dolichosperma*	Buttonweed			0	Unknown	15	2009	0	Unknown
Flowering Plants	Rubiaceae	*Spermacoce hillii*	Buttonweed			0	Unknown	12	2010	0	Unknown
Flowering Plants	Rubiaceae	*Spermacoce leptoloba*	Silver-blue Buttonweed			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Rubiaceae	*Spermacoce platyloba*	Buttonweed			0	Unknown	2	1977	0	Unknown
Flowering Plants	Rubiaceae	*Spermacoce pogostoma*	Buttonweed			0	Unknown	2	2011	0	Unknown
Flowering Plants	Rubiaceae	*Spermacoce stenophylla*	Blue Buttonweed			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Rubiaceae	*Synaptantha tillaeacea*	Synaptantha			0	Unknown	1	2010	0	Unknown
Flowering Plants	Rubiaceae	*Synaptantha tillaeacea var. Western Tanami*	Synaptantha	DD		0	Unknown	1	2011	0	Unknown
Flowering Plants	Rubiaceae	*Tarenna dallachiana subsp. expandens*	Tree Ixora			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Gentianaceae	*Schenkia australis*	Schenkia			0	Unknown	1	1995	0	Unknown
Flowering Plants	Loganiaceae	*Mitrasacme exserta*	White Flood Plant			0	Unknown	1	1975	0	Unknown
Flowering Plants	Loganiaceae	*Mitrasacme micrantha*	Mitre Plant			0	Unknown	2	2001	0	Unknown
Flowering Plants	Loganiaceae	*Strychnos lucida*	Strychnine Tree			0	Unknown	2	1989	0	Unknown
Flowering Plants	Apocynaceae	*Carissa lanceolata*	Conkerberry			0	Unknown	10	1994	0	Unknown
Flowering Plants	Apocynaceae	*Cynanchum floribundum*	Native Pear			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Apocynaceae	*Marsdenia australis*	Bush Banana			0	Unknown	8	1993	0	Unknown
Flowering Plants	Apocynaceae	*Marsdenia geminata*	Milkvine			0	Unknown	9	2001	0	Unknown
Flowering Plants	Apocynaceae	*Marsdenia trinervis*	Milkvine			0	Unknown	2	1994	0	Unknown
Flowering Plants	Apocynaceae	*Marsdenia viridiflora*	Bush Banana			0	Unknown	1	1999	0	Unknown
Flowering Plants	Apocynaceae	*Marsdenia viridiflora subsp. tropica*	Bush Banana			0	Unknown	12	2007	0	Unknown
Flowering Plants	Apocynaceae	*Sarcostemma viminale*	Caustic Vine			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Apocynaceae	*Sarcostemma viminale subsp. australe*	Caustic Vine			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Apocynaceae	*Sarcostemma viminale subsp. brunonianum*	Caustic Vine			0	Unknown	3	1992	0	Unknown
Flowering Plants	Apocynaceae	*Secamone elliptica*	Corky Milk Vine			0	Unknown	14	2007	0	Unknown
Flowering Plants	Apocynaceae	*Tylophora cinerascens*	Tylophora			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Apocynaceae	*Tylophora flexuosa*	Tylophora			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Apocynaceae	*Wrightia saligna*	Milk Bush			0	Unknown	4	1992	0	Unknown
Flowering Plants	Hydroleaceae	*Hydrolea zeylanica*	False Fiddle-leaf			0	Unknown	4	2001	0	Unknown
Flowering Plants	Solanaceae	*Physalis angulata*	Wild Gooseberry			0	Unknown	2	1988	0	Unknown
Flowering Plants	Solanaceae	*Solanum centrale*	Desert Raisin			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Solanaceae	*Solanum chenopodinum*	Goosefoot Potato-Bush			0	Unknown	2	2006	0	Unknown
Flowering Plants	Solanaceae	*Solanum dioicum*	Wild Tomato			0	Unknown	2	1977	0	Unknown
Flowering Plants	Solanaceae	*Solanum echinatum*	Wild Tomato			0	Unknown	6	1989	0	Unknown
Flowering Plants	Solanaceae	*Solanum esuriale*	Quena			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Solanaceae	*Solanum ferocissimum*	Spiny Potato-bush			0	Unknown	6	2011	0	Unknown
Flowering Plants	Solanaceae	*Solanum lucani*	Thorny Nightshade			0	Unknown	6	1980	0	Unknown
Flowering Plants	Solanaceae	*Solanum quadriloculatum*	Plains Nightshade			0	Unknown	2	1999	0	Unknown
Flowering Plants	Solanaceae	*Solanum succosum*	Solanum	DD		0	Unknown	1	1969	0	Unknown
Flowering Plants	Solanaceae	*Solanum tumulicola*	Black-soil Wild Tomato			0	Unknown	21	2011	0	Unknown

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Flowering Plants	Convolvulaceae	*Bonamia alatisemina*	Bonamia	DD		0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Convolvulaceae	*Bonamia brevifolia*	Bonamia			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Convolvulaceae	*Bonamia deserticola*	Creep Weed			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Convolvulaceae	*Bonamia media*	Grey-vine			0	Unknown	13	1993	0	Unknown
Flowering Plants	Convolvulaceae	*Bonamia media var. media*	Grey-vine			0	Unknown	1	1994	0	Unknown
Flowering Plants	Convolvulaceae	*Bonamia pannosa*	Bonamia			0	Unknown	17	1994	0	Unknown
Flowering Plants	Convolvulaceae	*Davenportia davenportii*	White Morning Glory			0	Unknown	8	2010	0	Unknown
Flowering Plants	Convolvulaceae	*Evolvulus alsinoides*	Blue Periwinkle			0	Unknown	18	1994	0	Unknown
Flowering Plants	Convolvulaceae	*Evolvulus alsinoides var. alsinoides*	Blue Periwinkle			0	Unknown	1	1993	0	Unknown
Flowering Plants	Convolvulaceae	*Evolvulus alsinoides var. decumbens*	Blue Periwinkle			0	Unknown	4	1993	0	Unknown
Flowering Plants	Convolvulaceae	*Evolvulus alsinoides var. villosicalyx*	Blue Periwinkle			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Convolvulaceae	*Ipomoea aquatica*	Kangkong			0	Unknown	2	1994	0	Unknown
Flowering Plants	Convolvulaceae	*Ipomoea argillicola*	Cow-vine			0	Unknown	4	2011	0	Unknown
Flowering Plants	Convolvulaceae	*Ipomoea coptica*	Cow-vine			0	Unknown	2	1963	0	Unknown
Flowering Plants	Convolvulaceae	*Ipomoea costata*	Desert Yam			0	Unknown	1	1980	0	Unknown
Flowering Plants	Convolvulaceae	*Ipomoea diamantinensis*	Desert Cow-vine			0	Unknown	5	2010	0	Unknown
Flowering Plants	Convolvulaceae	*Ipomoea eriocarpa*	Small Pink Convolvulus			0	Unknown	4	1993	0	Unknown
Flowering Plants	Convolvulaceae	*Ipomoea gracilis*	Slender Bindweed			0	Unknown	2	1991	0	Unknown
Flowering Plants	Convolvulaceae	*Ipomoea lonchophylla*	Common Cow-vine			0	Unknown	2	1975	0	Unknown
Flowering Plants	Convolvulaceae	*Ipomoea nil*	Morning Glory			0	Unknown	4	2001	0	Unknown
Flowering Plants	Convolvulaceae	*Ipomoea plebeia*	Bell Vine			0	Unknown	4	2001	0	Unknown
Flowering Plants	Convolvulaceae	*Ipomoea polymorpha*	Silky Cow-vine			0	Unknown	2	1993	0	Unknown
Flowering Plants	Convolvulaceae	*Jacquemontia browniana*	Snake Stem			0	Unknown	7	2004	0	Unknown
Flowering Plants	Convolvulaceae	*Jacquemontia paniculata*	Purple-flowered Jungle Creeper			0	Unknown	4	1991	0	Unknown
Flowering Plants	Convolvulaceae	*Merremia gemella*	Merremia			0	Unknown	2	1988	0	Unknown
Flowering Plants	Convolvulaceae	*Merremia incisa*	Merremia	DD		0	Unknown	4	1993	0	Unknown
Flowering Plants	Convolvulaceae	*Operculina aequisepala*	Potato Vine			0	Unknown	10	1996	0	Unknown
Flowering Plants	Convolvulaceae	*Polymeria ambigua*	Creeping Polymeria			0	Unknown	9	2001	0	Unknown
Flowering Plants	Convolvulaceae	*Polymeria longifolia*	Erect Bindweed			0	Unknown	5	1979	0	Unknown
Flowering Plants	Convolvulaceae	*Xenostegia tridentata*	Morning Vine			0	Unknown	3	1993	0	Unknown
Flowering Plants	Oleaceae	*Jasminum calcareum*	Poison Creeper			0	Unknown	2	2006	0	Unknown
Flowering Plants	Oleaceae	*Jasminum molle*	Stiff Jasmine			0	Unknown	21	2011	0	Unknown
Flowering Plants	Scrophulariaceae	*Eremophila bignoniiflora*	Gooramurra			0	Unknown	5	2010	0	Unknown
Flowering Plants	Scrophulariaceae	*Eremophila goodwinii subsp. ecapitata*	Purple Fuschia Bush			0	Unknown	4	1996	0	Unknown
Flowering Plants	Scrophulariaceae	*Eremophila goodwinii subsp. goodwinii*	Purple Fuschia Bush			0	Unknown	1	2011	0	Unknown
Flowering Plants	Scrophulariaceae	*Eremophila latrobei subsp. glabra*	Georgina Poison Bush			0	Unknown	3	2011	0	Unknown
Flowering Plants	Scrophulariaceae	*Eremophila longifolia*	Long-leaved Desert Fuchsia			0	Unknown	4	2010	0	Unknown
Flowering Plants	Scrophulariaceae	*Myoporum montanum*	Desert Boobialla			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Acanthaceae	*Brunoniella australis*	Blue Trumpet			0	Unknown	5	1991	0	Unknown
Flowering Plants	Acanthaceae	*Dicliptera armata*	Dicpliptera			0	Unknown	0	Unknown	0	Unknown

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Flowering Plants	Acanthaceae	*Hygrophila angustifolia*	Hygrophila			0	Unknown	5	1991	0	Unknown
Flowering Plants	Acanthaceae	*Hypoestes floribunda*	Rosy Hypoestes			0	Unknown	1	1988	0	Unknown
Flowering Plants	Acanthaceae	*Hypoestes floribunda var. angustifolia*	Rosy Hypoestes			0	Unknown	1	1983	0	Unknown
Flowering Plants	Acanthaceae	*Hypoestes floribunda var. cinerea*	Rosy Hypoestes			0	Unknown	4	1991	0	Unknown
Flowering Plants	Acanthaceae	*Rostellularia adscendens*	Pink Tongues			0	Unknown	2	1989	0	Unknown
Flowering Plants	Acanthaceae	*Rostellularia adscendens var. clementii*	Pink Tongues			0	Unknown	4	1989	0	Unknown
Flowering Plants	Acanthaceae	*Rostellularia adscendens var. largiflorens*	Pink Tongues			0	Unknown	1	1964	0	Unknown
Flowering Plants	Acanthaceae	*Rostellularia adscendens var. latifolia*	Pink Tongues			0	Unknown	2	1988	0	Unknown
Flowering Plants	Acanthaceae	*Staurogyne leptocaulis subsp. decumbens*	Staurogyne			0	Unknown	1	1991	0	Unknown
Flowering Plants	Verbenaceae	*Phyla nodiflora var. nodiflora*	Lippia			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Bignoniaceae	*Dolichandrone filiformis*	Whistling Tree			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Bignoniaceae	*Dolichandrone heterophylla*	Lemon Wood			0	Unknown	13	1999	0	Unknown
Flowering Plants	Lamiaceae	*Clerodendrum floribundum*	Smooth Spiderbush			0	Unknown	13	1996	0	Unknown
Flowering Plants	Lamiaceae	*Newcastelia spodiotricha*	Sandhill Sage			0	Unknown	11	1992	0	Unknown
Flowering Plants	Lamiaceae	*Premna acuminata*	Premna			0	Unknown	6	2006	0	Unknown
Flowering Plants	Lamiaceae	*Premna serratifolia*	Creek Premna			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Lamiaceae	*Teucrium integrifolium*	Green Germander			0	Unknown	4	2011	0	Unknown
Flowering Plants	Lamiaceae	*Vitex glabrata*	Black Plum			0	Unknown	1	1962	0	Unknown
Flowering Plants	Phrymaceae	*Glossostigma diandrum*	Two-Anther Mud-Mat			0	Unknown	2	1991	0	Unknown
Flowering Plants	Phrymaceae	*Mimulus gracilis*	Slender Monkey-flower			0	Unknown	5	2006	0	Unknown
Flowering Plants	Phrymaceae	*Peplidium muelleri*	Pepilidium			0	Unknown	7	1995	0	Unknown
Flowering Plants	Phrymaceae	*Uvedalia linearis var. linearis*	Monkey-flower			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Orobanchaceae	*Buchnera linearis*	Dainty Bush Flower			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Orobanchaceae	*Buchnera ramosissima*	Blackrod			0	Unknown	1	2010	0	Unknown
Flowering Plants	Plantaginaceae	*Bacopa floribunda*	Bacopa			0	Unknown	3	1991	0	Unknown
Flowering Plants	Plantaginaceae	*Stemodia glabella*	Smooth Bluerod			0	Unknown	6	2010	0	Unknown
Flowering Plants	Plantaginaceae	*Stemodia lathraia*	Bluerod			0	Unknown	5	2006	0	Unknown
Flowering Plants	Plantaginaceae	*Stemodia lythrifolia*	Bluerod			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Plantaginaceae	*Stemodia sp. Manners Creek*	Bluerod			0	Unknown	1	2003	0	Unknown
Flowering Plants	Plantaginaceae	*Stemodia tephropelina*	Bluerod			0	Unknown	3	2002	0	Unknown
Flowering Plants	Plantaginaceae	*Stemodia viscosa*	Sticky Bluerod			0	Unknown	2	1978	0	Unknown
Flowering Plants	Plantaginaceae	*Striga curviflora*	Witchweed			0	Unknown	3	1991	0	Unknown
Flowering Plants	Plantaginaceae	*Striga squamigera*	Witchweed			0	Unknown	1	2004	0	Unknown
Flowering Plants	Linderniaceae	*Microcarpaea minima*	Microcarpaea			0	Unknown	1	1975	0	Unknown
Flowering Plants	Lentibulariaceae	*Utricularia gibba*	Bladderwort			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Lentibulariaceae	*Utricularia stellaris*	Bladderwort	DD		0	Unknown	5	1987	0	Unknown
Flowering Plants	Lentibulariaceae	*Utricularia triflora*	Bladderwort			0	Unknown	1	2001	0	Unknown
Flowering Plants	Araliaceae	*Trachymene didiscoides*	Wild Parsnip			0	Unknown	2	1977	0	Unknown
Flowering Plants	Pittosporaceae	*Auranticarpa melanosperma*	Auranticarpa			0	Unknown	1	1956	0	Unknown
Flowering Plants	Campanulaceae	*Isotoma sp. Tanumbirini*	Isotome	DD		0	Unknown	4	2001	0	Unknown

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Flowering Plants	Campanulaceae	*Lobelia dioica*	Lobelia			0	Unknown	4	1991	0	Unknown
Flowering Plants	Campanulaceae	*Lobelia douglasiana*	Slender Lobelia			0	Unknown	2	1991	0	Unknown
Flowering Plants	Campanulaceae	*Wahlenbergia caryophylloides*	Northern Bluebell			0	Unknown	2	1977	0	Unknown
Flowering Plants	Stylidiaceae	*Stylidium adenophorum*	Trigger Plant			0	Unknown	3	1977	0	Unknown
Flowering Plants	Stylidiaceae	*Stylidium desertorum*	Desert Triggerplant			0	Unknown	2	2010	0	Unknown
Flowering Plants	Stylidiaceae	*Stylidium floodii*	Trigger Plant			0	Unknown	3	2006	0	Unknown
Flowering Plants	Stylidiaceae	*Stylidium floribundum*	Trigger Plant			0	Unknown	2	1975	0	Unknown
Flowering Plants	Menyanthaceae	*Nymphoides crenata*	Wavy Marshwort			0	Unknown	11	1994	0	Unknown
Flowering Plants	Menyanthaceae	*Nymphoides indica*	Water Snowflake			0	Unknown	1	1994	0	Unknown
Flowering Plants	Goodeniaceae	*Brunonia australis*	Blue Pincushion			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia armitiana*	Narrow-leaved Goodenia			0	Unknown	10	2011	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia byrnesii*	Split-end Goodenia			0	Unknown	7	2000	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia fascicularis*	Silky Goodenia			0	Unknown	7	2011	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia gracilis*	Slender Goodenia			0	Unknown	7	2001	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia hispida*	Goodenia			0	Unknown	11	2001	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia janamba*	Goodenia			0	Unknown	2	1947	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia lamprosperma*	Goodenia			0	Unknown	14	2010	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia leiosperma*	Goodenia			0	Unknown	2	1989	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia lunata*	Heavy-soil Hand-flower			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia odonnellii*	Goodenia			0	Unknown	2	1977	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia pilosa*	Hairy Goodenia			0	Unknown	4	1991	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia ramelii*	Goodenia			0	Unknown	1	1988	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia strangfordii*	Goodenia			0	Unknown	11	2011	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia triodiophila*	Spinifex Goodenia			0	Unknown	1	1993	0	Unknown
Flowering Plants	Goodeniaceae	*Goodenia viscidula*	Goodenia			0	Unknown	6	1994	0	Unknown
Flowering Plants	Goodeniaceae	*Scaevola amblyanthera*	Fanflower			0	Unknown	2	2010	0	Unknown
Flowering Plants	Goodeniaceae	*Scaevola amblyanthera var. amblyanthera*	Fanflower			0	Unknown	3	1999	0	Unknown
Flowering Plants	Goodeniaceae	*Scaevola browniana subsp. browniana*	Fanflower			0	Unknown	1	1969	0	Unknown
Flowering Plants	Goodeniaceae	*Scaevola glabrata*	Fanflower			0	Unknown	1	2010	0	Unknown
Flowering Plants	Goodeniaceae	*Scaevola laciniata*	Fanflower			0	Unknown	3	2010	0	Unknown
Flowering Plants	Goodeniaceae	*Scaevola ovalifolia*	Bushy Fanflower			0	Unknown	6	2010	0	Unknown
Flowering Plants	Goodeniaceae	*Scaevola revoluta*	Fanflower			0	Unknown	8	1993	0	Unknown
Flowering Plants	Asteraceae	*Apowollastonia cylindrica*	Sunflower Daisy			0	Unknown	1	2001	0	Unknown
Flowering Plants	Asteraceae	*Bidens bipinnata*	Cobbler's Pegs			0	Unknown	6	1999	0	Unknown
Flowering Plants	Asteraceae	*Blumea diffusa*	Daisy			0	Unknown	2	1977	0	Unknown
Flowering Plants	Asteraceae	*Blumea integrifolia*	Daisy			0	Unknown	3	2010	0	Unknown
Flowering Plants	Asteraceae	*Blumea saxatilis*	Daisy			0	Unknown	2	1989	0	Unknown
Flowering Plants	Asteraceae	*Blumea tenella*	Daisy			0	Unknown	10	2001	0	Unknown
Flowering Plants	Asteraceae	*Calotis breviseta*	Burr-Daisy			0	Unknown	2	2010	0	Unknown
Flowering Plants	Asteraceae	*Centipeda borealis*	Sneezeweed			0	Unknown	1	2001	0	Unknown
Flowering Plants	Asteraceae	*Centipeda minima*	Spreading Sneezeweed			0	Unknown	1	1999	0	Unknown
Flowering Plants	Asteraceae	*Centipeda minima subsp. macrocephala*	Spreading Sneezeweed			0	Unknown	4	1991	0	Unknown

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Flowering Plants	Asteraceae	*Centipeda minima subsp. minima*	Spreading Sneezeweed			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Asteraceae	*Centipeda nidiformis*	Sneezeweed			0	Unknown	2	1987	0	Unknown
Flowering Plants	Asteraceae	*Eclipta sp. Humpty Doo*	Twin-heads			0	Unknown	2	1978	0	Unknown
Flowering Plants	Asteraceae	*Flaveria australasica*	Yellow Twin Stem			0	Unknown	2	1979	0	Unknown
Flowering Plants	Asteraceae	*Gnaphalium diamantinensis*	Cudweed			0	Unknown	1	1995	0	Unknown
Flowering Plants	Asteraceae	*Hullsia argillicola*	Daisy	DD		0	Unknown	5	2010	0	Unknown
Flowering Plants	Asteraceae	*Minuria integerrima*	Smooth Minuria			0	Unknown	1	1948	0	Unknown
Flowering Plants	Asteraceae	*Pluchea rubelliflora*	Daisy			0	Unknown	2	1975	0	Unknown
Flowering Plants	Asteraceae	*Pterocaulon ciliosum*	Daisy			0	Unknown	1	1957	0	Unknown
Flowering Plants	Asteraceae	*Pterocaulon serrulatum*	Fruit Salad Bush			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Asteraceae	*Pterocaulon serrulatum var. velutinum*	Fruit Salad Bush			0	Unknown	10	2006	0	Unknown
Flowering Plants	Asteraceae	*Pterocaulon sphacelatum*	Apple Bush			0	Unknown	4	1988	0	Unknown
Flowering Plants	Asteraceae	*Rutidosis helichrysoides*	Grey Wrinklewort			0	Unknown	1	1999	0	Unknown
Flowering Plants	Asteraceae	*Siemssenia capillaris*	Wiry Podolepis			0	Unknown	0	Unknown	0	Unknown
Flowering Plants	Asteraceae	*Sphaeranthus indicus*	East Indian Globe-Thistle			0	Unknown	6	1987	0	Unknown
Flowering Plants	Asteraceae	*Streptoglossa bubakii*	Stinkweed			0	Unknown	3	1992	0	Unknown
Flowering Plants	Asteraceae	*Wedelia verbesinoides*	Daisy			0	Unknown	1	1977	0	Unknown
Frogs	Limnodynastidae	*Notaden melanoscaphus*	Northern Spadefoot Toad			0	Unknown	0	Unknown	1	1991
Frogs	Limnodynastidae	*Platyplectrum ornatus*	Ornate Burrowing Frog			0	Unknown	1	1959	1	2000
Frogs	Myobatrachidae	*Crinia bilingua*	Bilingual Froglet			0	Unknown	2	1987	0	Unknown
Frogs	Myobatrachidae	*Crinia deserticola*	Desert Froglet			5	2009	39	1980	0	Unknown
Frogs	Myobatrachidae	*Notaden nichollsi*	Desert Spadefoot Toad			1	1991	12	1983	1	1991
Frogs	Myobatrachidae	*Uperoleia lithomoda*	Stonemason Toadlet			0	Unknown	3	2010	0	Unknown
Frogs	Myobatrachidae	*Uperoleia trachyderma*	Blacksoil Toadlet			7	2009	7	2008	0	Unknown
Frogs	Hylidae	*Litoria australis*	Giant Frog			13	2009	35	2008	15	1991
Frogs	Hylidae	*Litoria caerulea*	Green Tree-frog			26	2009	10	2009	8	2000
Frogs	Hylidae	*Litoria cryptotis*	Hidden-ear Frog			3	1991	9	1999	11	1991
Frogs	Hylidae	*Litoria cultripes*	Knife-footed Frog			1	1993	39	2008	1	1995
Frogs	Hylidae	*Litoria inermis*	Peter`s Frog			1	2009	0	Unknown	0	Unknown
Frogs	Hylidae	*Litoria longipes*	Long-footed Frog			1	1991	0	Unknown	2	1991
Frogs	Hylidae	*Litoria maculosa*	Daly Waters Frog			2	2009	35	2008	0	Unknown
Frogs	Hylidae	*Litoria pallida*	Pale Frog			8	2009	52	2008	0	Unknown
Frogs	Hylidae	*Litoria platycephala*	Water-holding Frog			1	1993	13	1993	0	Unknown
Frogs	Hylidae	*Litoria rothii*	Roth`s Tree-Frog			4	2009	4	2007	1	1999
Frogs	Hylidae	*Litoria rubella*	Red Tree-frog			18	2009	31	2007	1	2000
Reptiles	Crocodylidae	*Crocodylus johnstoni*	Freshwater Crocodile			1	1987	0	Unknown	0	Unknown
Reptiles	Cheluidae	*Chelodina canni*	Cann`s Long-necked Turtle			2	Unknown	6	1992	0	Unknown
Reptiles	Gekkonidae	*Diplodactylus conspicillatus*	Fat-tailed Gecko			13	1994	4	1994	6	1999
Reptiles	Gekkonidae	*Diplodactylus tessellatus*	Tessellated Gecko			0	Unknown	1	2002	3	1996
Reptiles	Gekkonidae	*Gehyra australis*	Northern Dtella			8	1991	23	2009	28	2000
Reptiles	Gekkonidae	*Gehyra montium*	Centralian Dtella			0	Unknown	1	1994	0	Unknown
Reptiles	Gekkonidae	*Gehyra nana*	Northern Spotted Rock Dtella			0	Unknown	1	1977	0	Unknown
Reptiles	Gekkonidae	*Gehyra purpurascens*	Purplish Dtella			2	1997	5	1999	18	1999
Reptiles	Gekkonidae	*Gehyra variegata*	Tree Dtella			7	1986	3	1995	0	Unknown

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Reptiles	Gekkonidae	*Heteronotia binoei*	Bynoe`s Gecko			17	1991	52	2002	46	2000
Reptiles	Gekkonidae	*Lucasium immaculatum*	Pale-striped Ground Gecko			0	Unknown	4	1999	2	1991
Reptiles	Gekkonidae	*Lucasium stenodactylum*	Crowned Gecko			7	1999	12	1988	16	2000
Reptiles	Gekkonidae	*Oedura rhombifer*	Zig-zag Gecko			3	1991	0	Unknown	20	2000
Reptiles	Gekkonidae	*Rhynchoedura ornata*	Beaked Gecko			5	1994	7	1994	14	1999
Reptiles	Gekkonidae	*Strophurus ciliaris*	Spiny-tailed Gecko			24	1995	14	1997	10	1999
Reptiles	Gekkonidae	*Strophurus jeanae*	Southern Phasmid Gecko			0	Unknown	2	1986	0	Unknown
Reptiles	Gekkonidae	*Strophurus taeniatus*	White-striped Gecko			1	1986	1	1986	0	Unknown
Reptiles	Pygopodidae	*Delma borea*	Rusty-topped Delma			2	1994	0	Unknown	1	2000
Reptiles	Pygopodidae	*Delma tincta*	Black-necked Snake-lizard			0	Unknown	0	Unknown	3	1996
Reptiles	Pygopodidae	*Lialis burtonis*	Burton`s Legless Lizard			21	2001	4	1986	2	1999
Reptiles	Pygopodidae	*Pygopus nigriceps*	Western Hooded Scaly-foot			8	2009	6	1986	5	1999
Reptiles	Pygopodidae	*Pygopus steelescotti*	Northern Hooded Scaly-foot			15	1994	0	Unknown	0	Unknown
Reptiles	Scincidae	*Carlia amax*	Two-Spined Rainbow Skink			5	2001	13	1999	19	2000
Reptiles	Scincidae	*Carlia munda*	Striped Rainbow Skink			4	1986	1	1970	3	2000
Reptiles	Scincidae	*Carlia rufilatus*	Red-Sided Rainbow Skink			0	Unknown	4	1977	0	Unknown
Reptiles	Scincidae	*Carlia triacantha*	Three-Spined Rainbow Skink			1	1987	2	1987	0	Unknown
Reptiles	Scincidae	*Cryptoblepharus metallicus*	Metallic Snake-eyed Skink			0	Unknown	18	1999	0	Unknown
Reptiles	Scincidae	*Cryptoblepharus plagiocephalus*	Arboreal Snake-eyed Skink			0	Unknown	6	2002	28	2000
Reptiles	Scincidae	*Ctenotus borealis*	Northern Ctenotus			0	Unknown	3	1989	0	Unknown
Reptiles	Scincidae	*Ctenotus greeri*	Greer`s Ctenotus			1	1982	7	1999	2	1999
Reptiles	Scincidae	*Ctenotus helenae*	Helen`s Ctenotus			0	Unknown	2	1985	0	Unknown
Reptiles	Scincidae	*Ctenotus inornatus*	Plain Ctenotus			9	1995	22	2001	26	2000
Reptiles	Scincidae	*Ctenotus joanae*	Black-Soil Ctenotus			0	Unknown	4	1995	7	1999
Reptiles	Scincidae	*Ctenotus leonhardii*	Leonhardi`s Ctenotus			4	1995	5	1994	0	Unknown
Reptiles	Scincidae	*Ctenotus pallescens*	Pale-Backed Ctenotus			0	Unknown	1	1964	0	Unknown
Reptiles	Scincidae	*Ctenotus pantherinus*	Leopard Ctenotus			8	1994	7	1999	9	1999
Reptiles	Scincidae	*Ctenotus pulchellus*	Pretty Ctenotus			6	1994	11	2001	6	2000
Reptiles	Scincidae	*Ctenotus robustus*	Robust Ctenotus			6	1994	3	1988	2	1999
Reptiles	Scincidae	*Ctenotus saxatilis*	Rock Ctenotus			0	Unknown	10	1994	0	Unknown
Reptiles	Scincidae	*Ctenotus schomburgkii*	Schomburk`s Ctenotus			3	1994	7	1994	10	1999
Reptiles	Scincidae	*Ctenotus spaldingi*	Spalding`s Ctenotus			3	1997	16	2009	17	2000
Reptiles	Scincidae	*Liopholis striata*	Striated Egernia			0	Unknown	1	2001	0	Unknown
Reptiles	Scincidae	*Eremiascincus intermedius*	Northern Narrow-banded Skink			1	1991	1	1996	3	1996
Reptiles	Scincidae	*Eremiascincus isolepis*	Smooth-Tailed Skink			2	1994	3	1994	8	1999
Reptiles	Scincidae	*Glaphyromorphus darwiniensis*	Darwin Skink			0	Unknown	0	Unknown	2	1991
Reptiles	Scincidae	*Lerista bipes*	Two-Toed Lerista			1	1982	3	2001	0	Unknown
Reptiles	Scincidae	*Lerista griffini*	Griffin`s Lerista			0	Unknown	4	1999	6	1999
Reptiles	Scincidae	*Lerista labialis*	Sand Lerista			1	1991	8	1994	3	1999
Reptiles	Scincidae	*Lerista orientalis*	Eastern Lerista			3	1991	7	1999	10	2000
Reptiles	Scincidae	*Lerista xanthura*	Yellow-Tailed Lerista			0	Unknown	0	Unknown	1	1991
Reptiles	Scincidae	*Menetia greyii*	Grey`s Menetia			3	1991	8	2001	20	2000
Reptiles	Scincidae	*Menetia maini*	Main`s Menetia			2	1991	3	2000	22	2000

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Reptiles	Scincidae	*Morethia ruficauda*	Red-Tailed Snake-Eyed Skink			1	1991	0	Unknown	8	1999
Reptiles	Scincidae	*Morethia storri*	Storr`s Snake-Eyed Skink			0	Unknown	2	1988	3	2000
Reptiles	Scincidae	*Notoscincus ornatus*	Ornate Snake-Eyed Skink			1	1982	0	Unknown	1	2000
Reptiles	Scincidae	*Proablepharus kinghorni*	Kinghorn`s Snake-Eyed Skink			0	Unknown	2	1995	7	1996
Reptiles	Scincidae	*Proablepharus tenuis*	Slender Snake-Eyed Skink			0	Unknown	2	1976	9	2000
Reptiles	Scincidae	*Tiliqua multifasciata*	Centralian Blue-Tongued Lizard			12	2009	4	1978	1	1991
Reptiles	Scincidae	*Tiliqua scincoides*	Common Blue-Tongued Lizard	DD		3	1994	6	1988	0	Unknown
Reptiles	Agamidae	*Chelosania brunnea*	Chameleon Dragon			0	Unknown	0	Unknown	1	1999
Reptiles	Agamidae	*Chlamydosaurus kingii*	Frilled Lizard			2	1991	0	Unknown	5	1999
Reptiles	Agamidae	*Ctenophorus caudicinctus*	Ring-tailed Dragon			0	Unknown	3	1975	0	Unknown
Reptiles	Agamidae	*Ctenophorus isolepis*	Military Dragon			7	1991	11	1994	4	1999
Reptiles	Agamidae	*Ctenophorus nuchalis*	Central Netted Dragon			6	1992	12	1978	1	1993
Reptiles	Agamidae	*Diporiphora albilabris*	White-lipped Dragon			0	Unknown	4	2005	0	Unknown
Reptiles	Agamidae	*Diporiphora bennettii*	Robust Dragon			0	Unknown	1	1983	1	1999
Reptiles	Agamidae	*Diporiphora bilineata*	Two-Lined Dragon			0	Unknown	7	2007	1	2000
Reptiles	Agamidae	*Diporiphora lalliae*	Lally`s Two-line Dragon			2	1995	6	1995	3	1999
Reptiles	Agamidae	*Diporiphora magna*	Yellow-sided Two-line Dragon			0	Unknown	10	2005	14	2000
Reptiles	Agamidae	*Lophognathus gilberti*	Gilbert`s Dragon			9	2001	34	2009	37	2000
Reptiles	Agamidae	*Pogona vitticeps*	Central Bearded Dragon			0	Unknown	0	Unknown	1	1995
Reptiles	Agamidae	*Tympanocryptis lineata*	Lined Earless Dragon			0	Unknown	3	1976	4	1995
Reptiles	Varanidae	*Varanus acanthurus*	Ridge-tailed Monitor			9	2001	12	1995	3	2000
Reptiles	Varanidae	*Varanus gouldii*	Sand Goanna			9	2001	3	1999	12	1999
Reptiles	Varanidae	*Varanus mertensi*	Mertens` Water Monitor	VU		3	1993	0	Unknown	1	1993
Reptiles	Varanidae	*Varanus scalaris*	Spotted Tree Monitor	DD		2	1988	0	Unknown	1	1999
Reptiles	Varanidae	*Varanus spenceri*	Spencer`s Monitor	DD		3	1987	0	Unknown	0	Unknown
Reptiles	Varanidae	*Varanus tristis*	Black-tailed Monitor			2	2001	5	1991	4	1999
Reptiles	Typhlopidae	*Ramphotyphlops diversus*	Northern Blind Snake			1	1986	10	2001	4	1999
Reptiles	Typhlopidae	*Ramphotyphlops ligatus*	Robust Blind Snake			0	Unknown	2	1999	0	Unknown
Reptiles	Typhlopidae	*Ramphotyphlops unguirostris*	Claw-snouted Blind Snake			1	1988	1	1988	0	Unknown
Reptiles	Pythonidae	*Antaresia childreni*	Children`s Python			4	1994	6	1999	1	1991
Reptiles	Pythonidae	*Antaresia stimsoni*	Stimson`s Python			5	2009	5	1994	0	Unknown
Reptiles	Pythonidae	*Aspidites melanocephalus*	Black-headed Python			3	2009	8	2006	1	1993
Reptiles	Pythonidae	*Aspidites ramsayi*	Woma Python			0	Unknown	2	1973	0	Unknown
Reptiles	Pythonidae	*Liasis olivaceus*	Olive Python			1	2001	0	Unknown	0	Unknown
Reptiles	Elapidae	*Acanthophis hawkei*	Plains Death Adder	VU	VU	0	Unknown	1	1968	0	Unknown
Reptiles	Elapidae	*Brachyurophis fasciolatus*	Narrow-banded Burrowing Snake			0	Unknown	1	Unknown	0	Unknown
Reptiles	Elapidae	*Brachyurophis incinctus*	Unbanded Shovel-nosed Snake			1	1994	0	Unknown	0	Unknown
Reptiles	Elapidae	*Brachyurophis roperi*	Northern Shovel-nosed Snake			2	1994	1	1987	0	Unknown

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Reptiles	Elapidae	*Brachyurophis semifasciatus*	Half-girdled Snake			0	Unknown	0	Unknown	1	1995
Reptiles	Elapidae	*Demansia olivacea*	Olive Whip Snake	DD		3	1994	1	1986	0	Unknown
Reptiles	Elapidae	*Demansia papuensis*	Papaun Whip Snake			0	Unknown	1	1978	0	Unknown
Reptiles	Elapidae	*Demansia rimicola*	Whip Snake			1	1986	3	2009	0	Unknown
Reptiles	Elapidae	*Demansia shinei*	Whip Snake			0	Unknown	2	1999	0	Unknown
Reptiles	Elapidae	*Furina ornata*	Orange-naped Snake			2	1994	10	1999	1	1999
Reptiles	Elapidae	*Pseudechis australis*	King Brown Snake			6	2009	9	1980	1	1999
Reptiles	Elapidae	*Pseudonaja guttata*	Speckled Brown Snake			0	Unknown	3	1995	3	1995
Reptiles	Elapidae	*Pseudonaja ingrami*	Ingram`s Brown Snake			0	Unknown	1	1977	0	Unknown
Reptiles	Elapidae	*Pseudonaja modesta*	Ringed Brown Snake			0	Unknown	1	Unknown	0	Unknown
Reptiles	Elapidae	*Pseudonaja nuchalis*	Western Brown Snake			3	1994	4	1973	0	Unknown
Reptiles	Elapidae	*Suta punctata*	Little Spotted Snake			15	1994	19	1999	4	1999
Reptiles	Elapidae	*Suta suta*	Curl Snake			12	1986	4	1986	2	1995
Reptiles	Elapidae	*Vermicella annulata*	Bandy Bandy			2	1991	4	1999	1	1991
Birds	Casuariidae	*Dromaius novaehollandiae*	Emu			4	1999	0	Unknown	0	Unknown
Birds	Phasianidae	*Coturnix ypsilophora*	Brown Quail			12	2001	0	Unknown	10	2000
Birds	Anseranatidae	*Anseranas semipalmata*	Magpie Goose			4	2000	0	Unknown	23	1995
Birds	Anatidae	*Dendrocygna arcuata*	Wandering Whistling-Duck			8	2001	0	Unknown	2	1995
Birds	Anatidae	*Dendrocygna eytoni*	Plumed Whistling-Duck			29	2001	4	1982	33	1995
Birds	Anatidae	*Stictonetta naevosa*	Freckled Duck			1	2001	0	Unknown	11	1995
Birds	Anatidae	*Cygnus atratus*	Black Swan			0	Unknown	0	Unknown	1	1994
Birds	Anatidae	*Tadorna radjah*	Radjah Shelduck			1	2001	0	Unknown	0	Unknown
Birds	Anatidae	*Chenonetta jubata*	Australian Wood Duck			16	1992	1	1982	7	1995
Birds	Anatidae	*Malacorhynchus membranaceus*	Pink-eared Duck			23	2001	0	Unknown	24	1995
Birds	Anatidae	*Anas querquedula*	Garganey			0	Unknown	0	Unknown	1	1993
Birds	Anatidae	*Anas rhynchotis*	Australasian Shoveler			2	1986	0	Unknown	0	Unknown
Birds	Anatidae	*Anas gracilis*	Grey Teal			33	2001	1	1982	36	1995
Birds	Anatidae	*Anas castanea*	Chestnut Teal			1	1992	0	Unknown	0	Unknown
Birds	Anatidae	*Anas superciliosa*	Pacific Black Duck			44	2001	1	1982	26	1995
Birds	Anatidae	*Aythya australis*	Hardhead			30	2001	0	Unknown	22	1995
Birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe			31	2001	0	Unknown	4	1995
Birds	Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe			9	2006	0	Unknown	1	1995
Birds	Podicipedidae	*Podiceps cristatus*	Great Crested Grebe			7	2006	0	Unknown	3	1993
Birds	Columbidae	*Phaps chalcoptera*	Common Bronzewing			17	2001	0	Unknown	6	1999
Birds	Columbidae	*Phaps histrionica*	Flock Bronzewing			13	1996	19	1966	0	Unknown
Birds	Columbidae	*Ocyphaps lophotes*	Crested Pigeon			156	2009	1	1966	27	2000
Birds	Columbidae	*Geophaps plumifera*	Spinifex Pigeon			0	Unknown	1	1891	1	1993
Birds	Columbidae	*Geophaps smithii*	Partridge Pigeon	VU	VU	0	Unknown	1	1898	0	Unknown
Birds	Columbidae	*Geopelia cuneata*	Diamond Dove			96	2001	6	2009	46	2000
Birds	Columbidae	*Geopelia striata*	Peaceful Dove			139	2009	2	1987	39	2000
Birds	Columbidae	*Geopelia humeralis*	Bar-shouldered Dove			13	2001	0	Unknown	4	1993
Birds	Podargidae	*Podargus strigoides*	Tawny Frogmouth			11	1999	3	1987	15	2000
Birds	Eurostopodidae	*Eurostopodus argus*	Spotted Nightjar			17	2001	3	1979	13	2000
Birds	Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar			30	2009	0	Unknown	14	2000
Birds	Apodidae	*Apus pacificus*	Fork-tailed Swift			7	2001	2	1975	1	1991

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Birds	Anhingidae	*Anhinga novaehollandiae*	Australasian Darter			42	2001	1	1982	18	1995
Birds	Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant			23	2001	0	Unknown	6	1995
Birds	Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant			6	2001	0	Unknown	2	1993
Birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant			22	2001	0	Unknown	9	1994
Birds	Phalacrocoracidae	*Phalacrocorax varius*	Pied Cormorant			10	2000	0	Unknown	5	1994
Birds	Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican			34	2001	2	1980	20	1995
Birds	Ciconiidae	*Ephippiorhynchus asiaticus*	Black-necked Stork			13	2006	0	Unknown	4	1995
Birds	Ardeidae	*Ixobrychus flavicollis*	Black Bittern			1	2009	0	Unknown	0	Unknown
Birds	Ardeidae	*Ardea pacifica*	White-necked Heron			54	2001	0	Unknown	20	1995
Birds	Ardeidae	*Ardea modesta*	Eastern Great Egret			39	2001	0	Unknown	26	1995
Birds	Ardeidae	*Ardea intermedia*	Intermediate Egret			28	2001	0	Unknown	17	1995
Birds	Ardeidae	*Ardea ibis*	Cattle Egret			3	2001	0	Unknown	0	Unknown
Birds	Ardeidae	*Egretta picata*	Pied Heron			5	2001	0	Unknown	1	1993
Birds	Ardeidae	*Egretta novaehollandiae*	White-faced Heron			36	2001	0	Unknown	20	1995
Birds	Ardeidae	*Egretta garzetta*	Little Egret			14	2001	0	Unknown	3	1994
Birds	Ardeidae	*Nycticorax caledonicus*	Nankeen Night Heron			27	2001	0	Unknown	15	1995
Birds	Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis			22	2001	2	1891	26	1995
Birds	Threskiornithidae	*Threskiornis molucca*	Australian White Ibis			22	2001	0	Unknown	15	1995
Birds	Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis			49	2002	0	Unknown	23	1995
Birds	Threskiornithidae	*Platalea regia*	Royal Spoonbill			35	2001	0	Unknown	16	1995
Birds	Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill			19	2001	0	Unknown	13	1995
Birds	Accipitridae	*Elanus axillaris*	Black-shouldered Kite			2	2001	0	Unknown	0	Unknown
Birds	Accipitridae	*Elanus scriptus*	Letter-winged Kite			2	2000	2	1970	0	Unknown
Birds	Accipitridae	*Lophoictinia isura*	Square-tailed Kite			3	2001	0	Unknown	0	Unknown
Birds	Accipitridae	*Hamirostra melanosternon*	Black-breasted Buzzard			19	2001	0	Unknown	0	Unknown
Birds	Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-eagle			3	2008	0	Unknown	1	1995
Birds	Accipitridae	*Haliastur sphenurus*	Whistling Kite			100	2001	0	Unknown	5	1999
Birds	Accipitridae	*Milvus migrans*	Black Kite			144	2002	0	Unknown	13	2000
Birds	Accipitridae	*Accipiter fasciatus*	Brown Goshawk			24	2001	0	Unknown	7	1999
Birds	Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk			8	2000	0	Unknown	2	1999
Birds	Accipitridae	*Circus assimilis*	Spotted Harrier			22	2001	0	Unknown	1	1991
Birds	Accipitridae	*Circus approximans*	Swamp Harrier			3	1987	0	Unknown	8	1994
Birds	Accipitridae	*Aquila audax*	Wedge-tailed Eagle			32	2001	1	1972	2	1993
Birds	Accipitridae	*Hieraaetus morphnoides*	Little Eagle			8	2001	0	Unknown	0	Unknown
Birds	Falconidae	*Falco cenchroides*	Nankeen Kestrel			36	2001	0	Unknown	3	1999
Birds	Falconidae	*Falco berigora*	Brown Falcon			95	2009	0	Unknown	14	1999
Birds	Falconidae	*Falco longipennis*	Australian Hobby			8	2001	0	Unknown	1	1993
Birds	Falconidae	*Falco hypoleucos*	Grey Falcon	VU		6	2008	0	Unknown	0	Unknown
Birds	Falconidae	*Falco subniger*	Black Falcon			11	2001	0	Unknown	0	Unknown
Birds	Falconidae	*Falco peregrinus*	Peregrine Falcon			5	2000	0	Unknown	0	Unknown
Birds	Gruidae	*Grus rubicunda*	Brolga			50	2002	0	Unknown	16	1995
Birds	Rallidae	*Porphyrio porphyrio*	Purple Swamphen			0	Unknown	0	Unknown	19	1995
Birds	Rallidae	*Gallirallus philippensis*	Buff-banded Rail			0	Unknown	0	Unknown	1	1993
Birds	Rallidae	*Porzana pusilla*	Baillon`s Crake	DD		0	Unknown	0	Unknown	1	1993
Birds	Rallidae	*Porzana fluminea*	Australian Spotted Crake	DD		0	Unknown	0	Unknown	3	1993
Birds	Rallidae	*Tribonyx ventralis*	Black-tailed Native-hen			6	1992	0	Unknown	8	1995
Birds	Rallidae	*Fulica atra*	Eurasian Coot			25	2001	0	Unknown	14	1995

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Birds	Otididae	*Ardeotis australis*	Australian Bustard			77	2001	4	1967	3	2000
Birds	Burhinidae	*Burhinus grallarius*	Bush Stone-curlew			26	2001	0	Unknown	9	1999
Birds	Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt			33	2001	0	Unknown	23	1995
Birds	Recurvirostridae	*Recurvirostra novaehollandiae*	Red-necked Avocet			0	Unknown	0	Unknown	2	1995
Birds	Charadriidae	*Charadrius ruficapillus*	Red-capped Plover			0	Unknown	0	Unknown	1	1993
Birds	Charadriidae	*Charadrius veredus*	Oriental Plover			1	1987	0	Unknown	5	1999
Birds	Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel			37	2001	0	Unknown	15	1995
Birds	Charadriidae	*Erythrogonys cinctus*	Red-kneed Dotterel			21	2001	0	Unknown	13	1995
Birds	Charadriidae	*Vanellus tricolor*	Banded Lapwing			1	1996	0	Unknown	0	Unknown
Birds	Charadriidae	*Vanellus miles*	Masked Lapwing			41	2001	0	Unknown	21	1995
Birds	Rostratulidae	*Rostratula australis*	Australian Painted Snipe	VU	EN	4	1991	0	Unknown	1	1993
Birds	Scolopacidae	*Gallinago megala*	Swinhoe`s Snipe	DD		0	Unknown	0	Unknown	2	1995
Birds	Scolopacidae	*Limosa limosa*	Black-tailed Godwit			0	Unknown	0	Unknown	1	1993
Birds	Scolopacidae	*Numenius minutus*	Little Curlew			1	1992	0	Unknown	7	1995
Birds	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper			7	1999	0	Unknown	5	1995
Birds	Scolopacidae	*Tringa nebularia*	Common Greenshank			4	1996	0	Unknown	8	1995
Birds	Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper			4	2001	0	Unknown	5	1995
Birds	Scolopacidae	*Tringa glareola*	Wood Sandpiper			2	1992	0	Unknown	4	1995
Birds	Scolopacidae	*Calidris ruficollis*	Red-necked Stint			0	Unknown	0	Unknown	1	1993
Birds	Scolopacidae	*Calidris subminuta*	Long-toed Stint			1	Unknown	0	Unknown	0	Unknown
Birds	Scolopacidae	*Calidris melanotos*	Pectoral Sandpiper	DD		0	Unknown	0	Unknown	1	1993
Birds	Scolopacidae	*Calidris acuminata*	Sharp-tailed Sandpiper			3	1985	0	Unknown	11	1995
Birds	Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper	VU	CE	0	Unknown	0	Unknown	2	1993
Birds	Turnicidae	*Turnix maculosus*	Red-backed Button-quail			3	2001	0	Unknown	2	1991
Birds	Turnicidae	*Turnix pyrrhothorax*	Red-chested Button-quail			3	2001	0	Unknown	4	1999
Birds	Turnicidae	*Turnix velox*	Little Button-quail			10	2001	0	Unknown	18	1999
Birds	Glareolidae	*Glareola maldivarum*	Oriental Pratincole			5	2001	0	Unknown	10	1995
Birds	Glareolidae	*Stiltia isabella*	Australian Pratincole			20	2001	0	Unknown	9	1999
Birds	Laridae	*Gelochelidon nilotica*	Gull-billed Tern			12	2001	0	Unknown	14	1995
Birds	Laridae	*Hydroprogne caspia*	Caspian Tern			13	2000	0	Unknown	0	Unknown
Birds	Laridae	*Chlidonias hybrida*	Whiskered Tern			13	2000	1	1962	23	1995
Birds	Laridae	*Chlidonias leucopterus*	White-winged Black Tern			3	1995	0	Unknown	2	1995
Birds	Laridae	*Chroicocephalus novaehollandiae*	Silver Gull			5	2000	0	Unknown	0	Unknown
Birds	Cacatuidae	*Calyptorhynchus banksii samueli*	Red-tailed Black-cockatoo	N		1	2009	0	Unknown	0	Unknown
Birds	Cacatuidae	*Calyptorhynchus banksii macrorhynchus*	Red-tailed Black-cockatoo	N		83	2002	2	1902	4	1999
Birds	Cacatuidae	*Eulophus roseicapilla*	Galah			177	2009	0	Unknown	18	1999
Birds	Cacatuidae	*Cacatua sanguinea*	Little Corella			42	2001	1	1982	0	Unknown
Birds	Cacatuidae	*Cacatua galerita*	Sulphur-Crested Cockatoo	N		4	2000	0	Unknown	0	Unknown
Birds	Cacatuidae	*Nymphicus hollandicus*	Cockatiel			89	2001	0	Unknown	12	1999
Birds	Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet			19	2001	0	Unknown	3	2000
Birds	Psittacidae	*Psitteuteles versicolor*	Varied Lorikeet			31	2001	0	Unknown	2	1993
Birds	Psittacidae	*Aprosmictus erythropterus*	Red-winged Parrot			61	2001	0	Unknown	12	2000
Birds	Psittacidae	*Polytelis alexandrae*	Princess Parrot	VU	VU	2	1977	4	1891	0	Unknown

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Birds	Psittacidae	*Barnardius zonarius*	Australian Ringneck			5	2001	0	Unknown	1	2000
Birds	Psittacidae	*Psephotus dissimilis*	Hooded Parrot			1	1985	0	Unknown	1	1993
Birds	Psittacidae	*Melopsittacus undulatus*	Budgerigar			61	2001	0	Unknown	12	1996
Birds	Cuculidae	*Centropus phasianinus*	Pheasant Coucal			12	2001	0	Unknown	1	1993
Birds	Cuculidae	*Eudynamys orientalis*	Eastern Koel			12	2001	0	Unknown	2	1991
Birds	Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo			6	1999	0	Unknown	1	1999
Birds	Cuculidae	*Chalcites basalis*	Horsfield`s Bronze-Cuckoo			27	2009	0	Unknown	13	2000
Birds	Cuculidae	*Chalcites osculans*	Black-eared Cuckoo			2	2000	0	Unknown	1	1991
Birds	Cuculidae	*Chalcites minutillus*	Little Bronze-Cuckoo			1	1999	0	Unknown	0	Unknown
Birds	Cuculidae	*Cacomantis pallidus*	Pallid Cuckoo			19	2009	0	Unknown	4	1991
Birds	Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo			1	1977	0	Unknown	0	Unknown
Birds	Cuculidae	*Cacomantis variolosus*	Brush Cuckoo			12	2001	0	Unknown	10	1995
Birds	Strigidae	*Ninox novaeseelandiae*	Southern Boobook			22	2001	1	2001	14	2000
Birds	Tytonidae	*Tyto javanica*	Eastern Barn Owl			10	2001	0	Unknown	0	Unknown
Birds	Tytonidae	*Tyto longimembris*	Eastern Grass Owl			0	Unknown	1	1976	0	Unknown
Birds	Alcedinidae	*Ceyx azureus*	Azure Kingfisher			1	1987	0	Unknown	0	Unknown
Birds	Halcyonidae	*Dacelo leachii*	Blue-winged Kookaburra			22	2001	2	1992	4	2000
Birds	Halcyonidae	*Todiramphus macleayii*	Forest Kingfisher			1	1994	0	Unknown	0	Unknown
Birds	Halcyonidae	*Todiramphus pyrrhopygius*	Red-backed Kingfisher			42	2001	1	1962	14	2000
Birds	Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher			32	2009	0	Unknown	17	1999
Birds	Meropidae	*Merops ornatus*	Rainbow Bee-eater			104	2009	1	1980	12	2000
Birds	Coraciidae	*Eurystomus orientalis*	Dollarbird			7	2001	0	Unknown	4	1999
Birds	Climacteridae	*Climacteris melanura*	Black-tailed Treecreeper			43	2001	4	1992	23	2000
Birds	Ptilonorhynchidae	*Ptilonorhynchus nuchalis*	Great Bowerbird			54	2002	0	Unknown	7	2000
Birds	Maluridae	*Malurus melanocephalus*	Red-backed Fairy-wren			66	2001	1	2009	26	2000
Birds	Maluridae	*Malurus lamberti*	Variegated Fairy-wren			54	2001	2	1992	40	1999
Birds	Maluridae	*Amytornis purnelli*	Dusky Grasswren			0	Unknown	1	1971	0	Unknown
Birds	Acanthizidae	*Smicrornis brevirostris*	Weebill			94	2009	4	1967	48	2000
Birds	Acanthizidae	*Gerygone fusca*	Western Gerygone			6	1991	2	1974	5	1999
Birds	Acanthizidae	*Gerygone albogularis*	White-throated Gerygone			28	2001	0	Unknown	14	1999
Birds	Acanthizidae	*Acanthiza apicalis*	Inland Thornbill			0	Unknown	0	Unknown	1	1999
Birds	Pardalotidae	*Pardalotus rubricatus*	Red-browed Pardalote			51	2001	0	Unknown	8	1999
Birds	Pardalotidae	*Pardalotus striatus*	Striated Pardalote			64	2002	2	1977	35	2000
Birds	Meliphagidae	*Lichenostomus virescens*	Singing Honeyeater			108	2009	3	1992	64	2000
Birds	Meliphagidae	*Lichenostomus unicolor*	White-gaped Honeyeater			1	1983	0	Unknown	0	Unknown
Birds	Meliphagidae	*Lichenostomus keartlandi*	Grey-headed Honeyeater			7	2000	0	Unknown	1	1999
Birds	Meliphagidae	*Lichenostomus plumulus*	Grey-fronted Honeyeater			49	2001	5	1992	15	2000
Birds	Meliphagidae	*Lichenostomus flavescens*	Yellow-tinted Honeyeater			45	2001	1	1992	15	2000
Birds	Meliphagidae	*Lichenostomus penicillatus*	White-plumed Honeyeater			34	2001	0	Unknown	0	Unknown
Birds	Meliphagidae	*Manorina flavigula*	Yellow-throated Miner			69	2001	1	1992	2	1999
Birds	Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater			20	2001	0	Unknown	8	1999
Birds	Meliphagidae	*Ramsayornis fasciatus*	Bar-breasted Honeyeater			4	1998	0	Unknown	1	1991
Birds	Meliphagidae	*Conopophila rufogularis*	Rufous-throated Honeyeater			86	2009	2	1971	49	2000
Birds	Meliphagidae	*Epthianura tricolor*	Crimson Chat			2	1992	0	Unknown	0	Unknown
Birds	Meliphagidae	*Epthianura crocea crocea*	Yellow Chat (inland)			2	1991	5	1987	12	1994
Birds	Meliphagidae	*Sugomel niger*	Black Honeyeater			2	2001	0	Unknown	0	Unknown
Birds	Meliphagidae	*Cissomela pectoralis*	Banded Honeyeater			23	2001	0	Unknown	15	2000

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Birds	Meliphagidae	*Lichmera indistincta*	Brown Honeyeater			105	2001	0	Unknown	41	2000
Birds	Meliphagidae	*Melithreptus gularis*	Black-chinned Honeyeater			24	2009	0	Unknown	5	1999
Birds	Meliphagidae	*Melithreptus albogularis*	White-throated Honeyeater			7	2001	0	Unknown	0	Unknown
Birds	Meliphagidae	*Entomyzon cyanotis*	Blue-faced Honeyeater			5	2000	0	Unknown	1	1993
Birds	Meliphagidae	*Philemon argenticeps*	Silver-crowned Friarbird			9	2001	0	Unknown	5	2000
Birds	Meliphagidae	*Philemon citreogularis*	Little Friarbird			59	2001	0	Unknown	24	2000
Birds	Meliphagidae	*Grantiella picta*	Painted Honeyeater	VU	VU	2	2001	0	Unknown	0	Unknown
Birds	Pomatostomidae	*Pomatostomus temporalis*	Grey-crowned Babbler			152	2002	0	Unknown	55	2000
Birds	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella			31	2001	1	1971	28	2000
Birds	Campephagidae	*Coracina maxima*	Ground Cuckoo-shrike			9	2001	0	Unknown	0	Unknown
Birds	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike			127	2009	2	1962	22	2000
Birds	Campephagidae	*Coracina papuensis*	White-bellied Cuckoo-shrike			17	2001	0	Unknown	6	2000
Birds	Campephagidae	*Lalage sueurii*	White-winged Triller			134	2009	3	2009	35	2000
Birds	Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler			156	2001	0	Unknown	94	2000
Birds	Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush			46	2001	4	1977	30	2000
Birds	Pachycephalidae	*Oreoica gutturalis*	Crested Bellbird			34	2001	0	Unknown	18	2000
Birds	Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole			11	2000	0	Unknown	7	2000
Birds	Artamidae	*Artamus leucorynchus*	White-breasted Woodswallow			58	2009	0	Unknown	3	1999
Birds	Artamidae	*Artamus personatus*	Masked Woodswallow			26	2001	0	Unknown	3	1991
Birds	Artamidae	*Artamus superciliosus*	White-browed Woodswallow			14	2001	0	Unknown	1	1999
Birds	Artamidae	*Artamus cinereus*	Black-faced Woodswallow			174	2009	6	1992	57	2000
Birds	Artamidae	*Artamus minor*	Little Woodswallow			37	2001	6	1987	26	2000
Birds	Artamidae	*Cracticus torquatus*	Grey Butcherbird			2	1999	0	Unknown	0	Unknown
Birds	Artamidae	*Cracticus nigrogularis*	Pied Butcherbird			156	2001	0	Unknown	42	2000
Birds	Artamidae	*Cracticus tibicen*	Australian Magpie			40	2001	0	Unknown	3	1999
Birds	Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail			4	2001	0	Unknown	3	1991
Birds	Rhipiduridae	*Rhipidura rufiventris*	Northern Fantail			1	2001	0	Unknown	0	Unknown
Birds	Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail			203	2009	0	Unknown	72	2000
Birds	Corvidae	*Corvus coronoides*	Australian Raven			2	1987	0	Unknown	0	Unknown
Birds	Corvidae	*Corvus bennetti*	Little Crow			18	2001	3	1986	0	Unknown
Birds	Corvidae	*Corvus orru*	Torresian Crow			133	2001	3	1986	20	1999
Birds	Monarchidae	*Myiagra rubecula*	Leaden Flycatcher			7	2000	0	Unknown	3	2000
Birds	Monarchidae	*Myiagra inquieta*	Restless Flycatcher			41	2001	2	1979	31	2000
Birds	Monarchidae	*Grallina cyanoleuca*	Magpie-lark			221	2009	1	1982	17	2000
Birds	Corcoracidae	*Struthidea cinerea*	Apostlebird			106	2002	8	1983	40	2000
Birds	Petroicidae	*Microeca fascinans*	Jacky Winter			85	2001	2	1967	48	2000
Birds	Petroicidae	*Melanodryas cucullata picata/westralensis*	Hooded Robin			33	2001	2	1992	26	1999
Birds	Alaudidae	*Mirafra javanica rufescens/ forresti*	Horsfield's Bushlark (Mainland)			11	2009	1	1983	8	1999
Birds	Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola			6	2001	0	Unknown	0	Unknown
Birds	Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler			0	Unknown	0	Unknown	1	1993
Birds	Acrocephalidae	*Acrocephalus orientalis*	Oriental Reed-Warbler			0	Unknown	0	Unknown	1	1995
Birds	Megaluridae	*Megalurus gramineus*	Little Grassbird			0	Unknown	0	Unknown	1	1995
Birds	Megaluridae	*Cincloramphus mathewsi*	Rufous Songlark			28	2009	2	1955	6	2000
Birds	Megaluridae	*Cincloramphus cruralis*	Brown Songlark			7	2001	0	Unknown	4	1996

Group	Family Name	Scientific Name	Common Name	NT Status	National Status	#Observations	#Latest Observation Date	#Specimens	#Latest Speciman Date	#Surveys	#Latest Survey Record
Birds	Megaluridae	*Eremiornis carteri*	Spinifexbird			2	2001	0	Unknown	0	Unknown
Birds	Hirundinidae	*Petrochelidon ariel*	Fairy Martin			22	2002	0	Unknown	1	1993
Birds	Hirundinidae	*Petrochelidon nigricans*	Tree Martin			20	2001	0	Unknown	1	1999
Birds	Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird			57	2001	0	Unknown	36	2000
Birds	Estrildidae	*Taeniopygia guttata*	Zebra Finch			134	2009	4	1935	16	2000
Birds	Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch			44	2002	0	Unknown	17	2000
Birds	Estrildidae	*Poephila acuticauda*	Long-tailed Finch			52	2002	0	Unknown	11	2000
Birds	Estrildidae	*Poephila personata*	Masked Finch			8	2001	0	Unknown	0	Unknown
Birds	Estrildidae	*Erythrura gouldiae*	Gouldian Finch	VU	EN	3	2006	0	Unknown	0	Unknown
Birds	Estrildidae	*Heteromunia pectoralis*	Pictorella Mannikin			4	2001	0	Unknown	1	1993
Birds	Motacillidae	*Anthus novaeseelandiae*	Australasian Pipit			8	2001	0	Unknown	0	Unknown
Mammals	Tachyglossidae	*Tachyglossus aculeatus*	Echidna			4	2009	0	Unknown	1	1993
Mammals	Dasyuridae	*Dasyurus geoffroii*	Western Quoll	EX	VU	5	1969	0	Unknown	0	Unknown
Mammals	Dasyuridae	*Dasyurus hallucatus*	Northern Quoll	CR	EN	1	Unknown	1	Unknown	0	Unknown
Mammals	Dasyuridae	*Pseudantechinus bilarni*	Sandstone Antechinus			0	Unknown	1	Unknown	0	Unknown
Mammals	Dasyuridae	*Pseudantechinus mimulus*	Carpentarian Antechinus		VU	0	Unknown	1	1987	0	Unknown
Mammals	Dasyuridae	*Planigale ingrami*	Long-tailed Planigale			0	Unknown	11	1999	9	1999
Mammals	Dasyuridae	*Planigale maculata*	Common Planigale			3	1991	4	1999	3	1999
Mammals	Dasyuridae	*Sminthopsis macroura*	Stripe-faced Dunnart			3	1991	5	1987	5	1999
Mammals	Dasyuridae	*Sminthopsis youngsoni*	Lesser Hairy-footed Dunnart			2	1982	0	Unknown	0	Unknown
Mammals	Peramelidae	*Isoodon auratus*	Golden Bandicoot	EN	VU	1	1969	0	Unknown	0	Unknown
Mammals	Thylacomyidae	*Macrotis lagotis*	Greater Bilby	VU	VU	12	2011	0	Unknown	0	Unknown
Mammals	Pseudocheiridae	*Petropseudes dahli*	Rock Ringtail			1	1987	0	Unknown	0	Unknown
Mammals	Phalangeridae	*Trichosurus vulpecula vulpecula*	Common Brushtail Possum (southern)	EN		2	1969	0	Unknown	0	Unknown
Mammals	Macropodidae	*Lagorchestes conspicillatus*	Spectacled Hare-wallaby			98	2000	35	1998	13	2000
Mammals	Macropodidae	*Macropus agilis*	Agile Wallaby	N		7	2009	3	1996	3	2000
Mammals	Macropodidae	*Macropus antilopinus*	Antilopine Wallaroo			10	2001	0	Unknown	9	2000
Mammals	Macropodidae	*Macropus robustus*	Common Wallaroo			10	2001	2	1953	8	1999
Mammals	Macropodidae	*Macropus rufus*	Red Kangaroo			10	1999	1	1944	2	1993
Mammals	Macropodidae	*Onychogalea unguifera*	Northern Nailtail Wallaby			216	1999	72	1990	22	1999
Mammals	Pteropodidae	*Pteropus scapulatus*	Little Red Flying-fox			1	1994	1	1965	2	1999
Mammals	Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheath-tailed Bat			0	Unknown	1	1959	0	Unknown
Mammals	Emballonuridae	*Taphozous georgianus*	Common Sheath-tailed Bat			0	Unknown	1	1977	0	Unknown
Mammals	Molossidae	*Chaerephon jobensis*	Northern Free-tailed Bat			0	Unknown	1	1982	0	Unknown
Mammals	Molossidae	*Mormopterus beccarii*	Beccari`s Free-tailed Bat			1	1982	1	1982	0	Unknown
Mammals	Molossidae	*Tadarida australis*	White-striped Free-tailed bat			0	Unknown	0	Unknown	1	2000
Mammals	Miniopteridae	*Miniopterus schreibersii*	Large Bent-winged Bat			1	1982	1	1982	0	Unknown
Mammals	Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat			4	1987	5	1987	0	Unknown
Mammals	Vespertilionidae	*Chalinolobus gouldii*	Gould`s Wattled Bat			1	1981	1	1982	0	Unknown
Mammals	Vespertilionidae	*Chalinolobus nigrogriseus*	Hoary Wattled Bat			4	1987	4	1987	0	Unknown
Mammals	Vespertilionidae	*Scotorepens greyii*	Little Broad-nosed Bat			1	1982	1	1982	0	Unknown
Mammals	Muridae	*Leggadina lakedownensis*	Northern Short-tailed Mouse			2	1988	7	2001	10	1999
Mammals	Muridae	*Notomys alexis*	Spinifex Hopping-mouse			9	1999	1	1976	0	Unknown
Mammals	Muridae	*Pseudomys delicatulus*	Delicate Mouse			2	1986	7	2001	0	Unknown
Mammals	Muridae	*Pseudomys desertor*	Desert Mouse			2	1982	1	1982	0	Unknown

Group	Family Name	Scientific Name	Common Name	NT Status	National Status	#Observations	#Latest Observation Date	#Specimens	#Latest Speciman Date	#Surveys	#Latest Survey Record
Mammals	Muridae	*Pseudomys hermannsburgensis*	Sandy Inland Mouse			2	1982	1	1972	5	1999
Mammals	Muridae	*Pseudomys nanus*	Western Chestnut Mouse			2	1982	1	2000	10	2000
Mammals	Muridae	*Zyzomys argurus*	Common Rock-rat			0	Unknown	0	Unknown	1	1993
Mammals	Muridae	*Rattus tunneyi*	Pale Field-rat	VU		0	Unknown	1	1999	0	Unknown
Mammals	Muridae	*Rattus villosissimus*	Long-haired Rat			0	Unknown	9	1994	0	Unknown
Mammals	Canidae	*Canis lupus*	Dingo / Wild dog	N		11	1999	61	1973	7	1993

EX = Extinct EW = Extinct in the Wild ER= Extinct in the NT EN = Endangered
EN/VU = One Endangered subspecies/One Vulnerable subspecies
VU=Vulnerable
VU/- = One or more subspecies vulnerable EN/- = One or more subspecies endangered

Survey = this category refers to data collected using systematic survey methodology
Specimen = this category refers to museum or other records where a specimen has been collected and lodged
Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to www.landmanager.org.au/view/index.aspx?id=####
where #### is the ID number from the tables above for the species of interest.

Species listed in the table above were recorded from all the grid cells (red/blue line) shown below that overlap 2018 Beetaloo

2018 Beetaloo Weeds and Potential Weeds

 Introduced plants recorded in the grid cell(s) in which 2018 Beetaloo occurs and that have been identified as problem weeds in one or more locations in northern Australia. Occurrence based on Northern Territory Government databases.

Family Name	Scientific Name	Common Name	NT Status	National Status	Other Status	#Surveys	Latest Record
Amaranthaceae	*Alternanthera pungens*	Khaki Weed	*B C*		*DEU NSW SA*	0	Unknown
Meliaceae	*Azadirachta indica*	Neem			*MP K1 C&E G&M CYP WeedsAus*	0	Unknown
Poaceae	*Bothriochloa pertusa*	Indian Bluegrass			*DEU*	0	Unknown
Poaceae	*Cenchrus biflorus*	Gallon`s Curse			*NSW*	0	Unknown
Poaceae	*Cenchrus ciliaris*	Buffel Grass			*MP Gr G&M DEU*	0	Unknown
Poaceae	*Cenchrus echinatus*	Mossman River Grass	*B C*		*NSW*	3	1990
Cucurbitaceae	*Citrullus lanatus*	Camel Melon			*G&M*	1	1990
Cucurbitaceae	*Cucumis melo*	Ulcardo Melon			*DEU*	18	2009
Solanaceae	*Datura ferox*	Fierce Thornapple	*A C*		*WA1 WA3 WA4 G&M*	0	Unknown
Fabaceae	*Delonix regia*	Poinciana			*C&E*	0	Unknown
Poaceae	*Echinochloa colona*	Awnless Barnyard Grass			*DEU*	18	2009
Poaceae	*Eragrostis minor*	Smaller Stinkgrass			*DEU*	1	1995
Amaranthaceae	*Gomphrena celosioides*	Gomphrena Weed			*DEU*	0	Unknown
Lamiaceae	*Hyptis suaveolens*	Hyptis	*B C*		*G&M*	0	Unknown
Euphorbiaceae	*Jatropha gossypiifolia*	Bellyache Bush	*B C*	*WONS*	*K2 WA1 WA4 Q2 C&E G&M CYP DEU*	0	Unknown
Fabaceae	*Macroptilium atropurpureum*	Siratro			*C&E*	0	Unknown
Malvaceae	*Malvastrum americanum*	Spiked Malvastrum			*DEU*	11	1990
Fabaceae	*Parkinsonia aculeata*	Parkinsonia	*B C*	*WONS*	*MP K2 WA1 WA4 Q2 G&M CYP DEU NSW SA*	34	1990
Verbenaceae	*Phyla nodiflora var. nodiflora*	Lippia			*G&M NSW*	0	Unknown
Fabaceae	*Prosopis pallida*	Mesquite	*A C*	*WONS*	*K2 WA1 WA2 WA4 Q2 G&M NSW SA*	0	Unknown
Combretaceae	*Quisqualis indica*	Rangoon Creeper			*C&E*	0	Unknown
Plantaginaceae	*Scoparia dulcis*	Bitter Broom			*DEU*	0	Unknown
Malvaceae	*Sida cordifolia*	Flannel Weed	*B C*		*WA1 G&M DEU*	2	1995
Malvaceae	*Sida rhombifolia*	Paddy`s Lucerne	*B C*		*MP G&M DEU*	0	Unknown
Malvaceae	*Sida spinosa*	Spiny Sida			*DEU*	49	2010
Poaceae	*Sorghum almum*	Columbus Grass			*NSW*	0	Unknown
Poaceae	*Sporobolus pyramidalis*	Giant Rat`s Tail Grass			*Q2 G&M CYP NSW*	1	1995
Fabaceae	*Stylosanthes hamata*	Caribbean Stylo			*DEU*	3	2009
Zygophyllaceae	*Tribulus terrestris*	Caltrop	*B C*		*CYP SA*	7	1990
Poaceae	*Urochloa mosambicensis*	Sabi Grass			*DEU*	0	Unknown
Fabaceae	*Vachellia farnesiana*	Sweet Acacia			*DEU*	13	1990

Family Name	Scientific Name	Common Name	NT Status	National Status	Other Status	#Surveys	Latest Record
Asteraceae	*Xanthium strumarium*	Noogoora Burr	*B C*		*MP WA1 WA2 WA4 DEU NSW SA*	0	Unknown

Status Codes:
1. NATIONAL STATUS CODES
Alert, Alert List for Environmental Weeds (Please call Exotic Plant Pest Hotline 1800 084 881 if you think you have seen this weed)
Sleeper, National Sleeper Weed
Target,Targeted for eradication. (www.landmanager.com.au/view/index.aspx?id=449837)
WONS, Weeds of National Significance

2. NT STATUS CODES
A, NT Class A Weed (to be eradicated)
B, NT Class B Weed (growth & spread to be controlled)
C, NT Class C Weed (not to be introduced) (www.landmanager.com.au/view/index.aspx?id=449869)

3. OTHER STATUS CODES
C&E, Csurhes, S. & Edwards, R. (1998) Potential Environmental Weeds in Australia. Candidate Species for Preventative Control. Environment Australia, Canberra (www.landmanager.com.au/view/index.aspx?id=394504)
CYP, Draft Cape York Peninsula Pest Management Plan 2006-2011 (www.landmanager.com.au/view/index.aspx?id=371200)
DEU, Plants listed as environmental weeds by the Desert Uplands Strategic Land Resource
Assessment (www.landmanager.com.au/view/index.aspx?id=332123)
G&M, Grice AC, Martin TG. 2005. The Management of Weeds and Their Impact on Biodiversity in the Rangelands. Cooperative Research Centre (CRC) for Australian Weed Management and CSIRO Sustainable Ecosystems. Commonwealth Australia (www.landmanager.com.au/view/index.aspx?id=163572)
Gr, Groves et al. 2003. Weed categories for natural and agricultural ecosystem management. Bureau of
Rural Sciences (www.landmanager.com.au/view/index.aspx?id=388018)
K0, High Priority Weeds not yet established in the Katherine region
K1, High Priority Weeds posing environmental threats in the Katherine region
K2, High Priority Weeds posing existing threats in the Katherine region, as described in the Katherine Regional Weed Management Strategy 2005-2010 (www.landmanager.com.au/view/index.aspx?id=130286)
MP, Northern Territory Parks & Conservation Masterplan (www.landmanager.com.au/view/index.aspx?id=144141)
NAQS, North Australian Quarantine Strategy Target List (www.landmanager.com.au/view/index.aspx?id=449416)
NSW, Declared Noxious Weed in NSW (www.landmanager.com.au/view/index.aspx?id=449983)
Q1, QLD Class 1 Weed (not to be introduced, kept or supplied-
Q2, Class 2 Weed (eradicate where possible, not to be introduced, kept or supplied)
Q3, Qld Class 3 Weed (to be controlled near environmentally sensitive areas- not to be supplied/sold without a permit) (www.landmanager.com.au/view/index.aspx?id=190714)
SA, Declared Plant in South Australia (www.landmanager.com.au/view/index.aspx?id=449996)
WeedsAus, Listed as a significant weed by Weeds Australia (www.landmanager.com.au/view/index.aspx?id=14576)
WA1, WA Weed Class P1 (movement prohibited)
WA2, WA Weed Class P2 (aim to eradicate)
WA3, WA Weed Class P3 (control infestations)
WA4, WA Weed Class P4 (prevent spread)
WA5, WA Weed Class P3 (control infestations on public land) (www.landmanager.com.au/view/index.aspx?id=449884).

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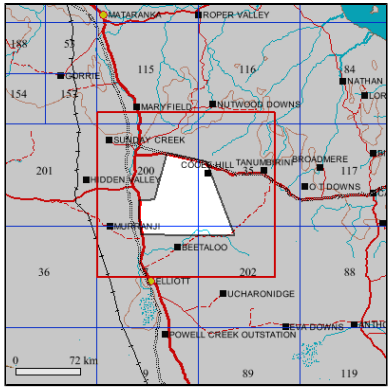
More species info: Go to www.landmanager.org.au/view/index.aspx?id=####
where #### is the ID number from the tables above for the species of interest.

Plants listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap 2018 Beetaloo



2018 Beetaloo Introduced Species

Introduced plants in 2018 Beetaloo (ordered alphabetically) that have been identified as introduced species in one or more locations in northern Australia.

Family Name	Scientific Name	Common Name	NT Status	National Status	Other Status	ID	#Surveys (Latest)	Latest Record
Euphorbiaceae	*Euphorbia hirta*	Asthma Plant				289244	0	Unknown
Cucurbitaceae	*Momordica balsamina*	Balsam Apple				291344	0	Unknown
Fabaceae	*Clitoria ternatea*	Butterfly Pea				289514	0	Unknown
Malvaceae	*Triumfetta pentandra*	Chinese Burr				293204	0	Unknown
Poaceae	*Dactyloctenium aegyptium*	Coastal Button Grass				289864	0	Unknown
Cucurbitaceae	*Citrullus colocynthis*	Colocynth Melon				289434	0	Unknown
Aizoaceae	*Trianthema portulacastrum*	Giant Pigweed				293164	0	Unknown
Amaranthaceae	*Amaranthus viridis*	Green Amaranth				372033	0	Unknown
Poaceae	*Digitaria bicornis*	Hairy Finger Grass				361165	0	Unknown
Fabaceae	*Indigofera hirsuta*	Hairy Indigo				290754	0	Unknown
Portulacaceae	*Portulaca pilosa subsp. pilosa*	Hairy Pigface				292104	0	Unknown
Portulacaceae	*Portulaca pilosa*	Hairy Pigface				292104	0	Unknown
Amaranthaceae	*Alternanthera brasiliana*	Joyweed				360945	0	Unknown
Verbenaceae	*Lippia alba var. alba*	Lemon Verbena				.	0	Unknown
Poaceae	*Eragrostis amabilis var. amabilis*	Lovegrass				.	0	Unknown
Portulacaceae	*Portulaca oleracea*	Munyeroo				292104	0	Unknown
Euphorbiaceae	*Euphorbia heterophylla*	Painted Spurge				290344	0	Unknown
Malvaceae	*Melochia pyramidata*	Pyramid Flower				291234	0	Unknown
Fabaceae	*Stylosanthes viscosa*	Sticky Stylo				293004	0	Unknown
Passifloraceae	*Passiflora foetida*	Stinking Passion Flower				291774	0	Unknown
Poaceae	*Digitaria ciliaris*	Summer Grass				289974	0	Unknown
Fabaceae	*Crotalaria juncea*	Sunhemp				289684	0	Unknown
Asteraceae	*Tridax procumbens*	Tridax Daisy				293184	0	Unknown
Convolvulaceae	*Merremia dissecta var. dissecta*	White Convolvulus Creeper				291254	0	Unknown

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Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

2018 Beetaloo Pest and Potential Pest Animals


Animals with pest potential recorded in the grid cell(s) in which 2018 Beetaloo occurs. Occurrence based on Northern Territory Government databases.

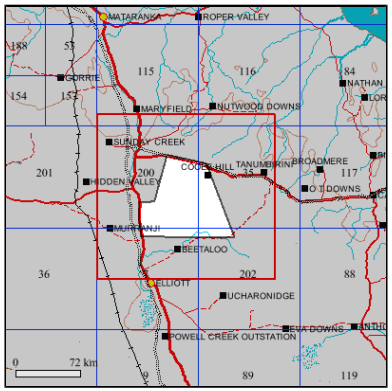
Common Name	Scientific Name	NT Status	National Status	ID	#Observations (Latest)	#Specimens (Latest)	#Surveys (Latest)
Cane Toad	*Rhinella marina*	P	.	183252	7 (2009)	0 (Unknown)	1 (1993)
Asian House Gecko	*Hemidactylus frenatus*	P	.	188964	1 (1989)	2 (1989)	0 (Unknown)
Red-tailed Black-cockatoo	*Calyptorhynchus banksii samueli*	N	.	223765	1 (2009)	0 (Unknown)	0 (Unknown)
Red-tailed Black-cockatoo	*Calyptorhynchus banksii macrorhynchus*	N	.	223765	83 (2002)	2 (1902)	4 (1999)
Sulphur-Crested Cockatoo	*Cacatua galerita*	N	.	223772	4 (2000)	0 (Unknown)	0 (Unknown)
Agile Wallaby	*Macropus agilis*	N	.	223786	7 (2009)	3 (1996)	3 (2000)
Black Rat	*Rattus rattus*	P	.	183236	0 (Unknown)	1 (1999)	0 (Unknown)
Dingo / Wild dog	*Canis lupus*	N	.	183280	11 (1999)	61 (1973)	7 (1993)
Cat	*Felis catus*	P	.	183259	5 (1999)	2 (1970)	2 (1993)
Horse	*Equus caballus*	P	.	183315	1 (1987)	0 (Unknown)	0 (Unknown)
Swamp Buffalo	*Bubalus bubalis*	P	.	183245	1 (1985)	0 (Unknown)	0 (Unknown)
Cattle	*Bos taurus*	P	.	183266	6 (1999)	0 (Unknown)	5 (1993)

NT STATUS CODES:
Int, Introduced species (all non-prohibited vertebrates, and all other exotic species (www.landmanager.com.au/view/index.aspx?id=280771)
N, Native species with pest potential.
P, Prohibited species (all exotic vertebrates except those listed as non-prohibited (www.landmanager.com.au/view/index.aspx?id=450509)

Survey = this category refers to data collected using systematic survey methodology
Specimen = this category refers to museum or other records where a specimen has been collected and lodged
Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to www.landmanager.org.au/view/index.aspx?id=####
where #### is the ID number from the tables above for the species of interest.

Potential pest animals listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap 2018 Beetaloo



Soils and vegetation graphs and tables refer to area of soils and vegetation only. Fire graphs and tables refer to entire selected area including sea if present. Calculations are derived from map images or vector data, and should be taken as a guide only. Accuracy cannot be guaranteed. For small areas, figures should be rounded to the nearest whole number.

Fire map layers used in these reports have been updated in 2018 so their pixels are aligned to the same grid.

Appendix D Heritage Report

AECOM Australia Pty Ltd
Level 8
540 Wickham Street
PO Box 1307
Fortitude Valley QLD 4006
Australia
www.aecom.com

+61 7 3553 2000 tel
+61 7 3553 2050 fax
ABN 20 093 846 925

11 September 2018

Matthew Hanson
Beetaloo Project Manager
Origin
339 Coronation Drive
Milton QLD 4064

Dear Matthew

Aboriginal & Historic Heritage Assessment: 2018 Exploration Lease Areas

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was commissioned by Origin Energy Resources Limited (Origin) to conduct a heritage assessment of eight proposed groundwater bore drill locations (Velkerri 98 E1-1, Kyalla 98 W1-1, Velkerri 76 S1-1, Velkerri 76 S2-1, Kyalla 117 N2-1, Velkerri 117 E1-1, Kyalla 117 W1-2 and Kyalla 117 W2-1) within the Beetaloo Basin covering exploration permit areas EP76. EP98, EP117 located west of Daly Waters, Northern Territory. This assessment included the associated access tracks.

The assessment involved a field inspection for the area of proposed works (study area).

2.0 Proposed Activities

Origin are proposing to undertake a series of low impact activities required to establish a comprehensive baseline groundwater monitoring program in preparation for its' 2019 exploration program. The groundwater monitoring program will involve the installation of up to four groundwater monitoring bores from eight (8) proposed lease sites within the Origin Beetaloo Exploration Area.

The project boundaries for the heritage assessment was defined as the area which may be affected by the groundwater monitoring bore installation program and the potential future exploration activities. Including:

- The eight (8) proposed 4 hectare lease area with an additional 500 m buffer, which encompassed the 50 x 50 m groundwater monitoring bore lease sites.
- The upgrade of approximately 205 km of existing access tracks and boundary fence tracks to allow the groundwater bore drilling rig access; and
- The installation of approximately 15km of new access tracks to connect the groundwater monitoring sites to the existing access tracks.
- Potential establishment of three 50m x 50 m gravel pits.

It is noted that the heritage assessment allowed for a 250 m buffer either side of an existing access track to allow for locating camps, gravel pits and water supply bores in the future. Where the access track is located on a property boundary, the buffer will be 500 m out into the property the road is located on.

It is noted that not all of the nominated areas for the monitoring bore lease and/or access tracks will be affected by site activities, but sufficient size has been allowed to provide flexibility in the siting of infrastructure, 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 Existing Data Sources

Information on the location of heritage sites within the study area was obtained from:

- a review of Native Title claims and Indigenous Land Use Agreements over the proposed activity areas
- a review of existing Northern Territory Heritage Register managed by the NT Heritage Branch

- a review of the Sacred Sites Register maintained by the Aboriginal Areas Protection Authority
- a review of past archaeological survey reports and assessments undertaken within the local area.

3.1 Native Title

Three Native Title claims have been determined as non-exclusive and one Indigenous Land Use Agreement (ILUA) are current over the permit areas (see Table 1).

Table 1 Native Title & ILUA Agreements

Type	Bore	Name	Summary
Native Title	Kyalla 98 W1-1	NTD21/2010 Shenandoah Pastoral Lease	[redacted]
	Kyalla 117 N2-1	NTD21/2010 Shenandoah Pastoral Lease	[redacted]
	Kyalla 117 W2-1	NTD27/2010 Beetaloo Pastoral Lease	[redacted]
	Kyalla 117 W1-2	NTD27/2010 Beetaloo Pastoral Lease	[redacted]
	Velkerri 98 E1-1	NTD17/2010 Amungee Mungee Pastoral Lease	[redacted]
	Velkerri 76 S2-1	NTD17/2010 Amungee Mungee Pastoral Lease	[redacted]
	Velkerri 76 S1-1	NTD27/2010 Beetaloo Pastoral Lease	[redacted]
	Kyalla 117 E1-1	NTD27/2010 Beetaloo Pastoral Lease	[redacted]
Indigenous Land Use Agreement	All Sites	D12004/014 Jingaloo CLA ILUA	[redacted]

The Native Title Petroleum Exploration Agreement between Permit Holder and the NLC includes clauses for the protection of Sacred Sites, objects and sensitive areas related to Aboriginal activities in the area, including cultural, hunting and foraging activities. Site clearance will occur prior to any on ground activities. The Native Title Agreement also includes clauses for the protection of the environment and rehabilitation.

3.2 Australian Heritage Database

A search of the Australia Heritage Database identified that no statutory listed heritage places within the proposed impact areas.

3.3 NT Heritage Register

A search of the Northern Territory Heritage Register identified two artefact scatters located adjacent to the Stuart Highway (Table 2). Goochegoochena Creek Site 1 and Goochegoochena Creek Site 2 are recorded within 600 m and 350 m respectively of the proposed access track entrance. These sites will not be directly affected by the proposed works.

Table 2 NT Heritage Register - Aboriginal Heritage Sites

Site Name	Zone	Easting	Northing	Site Type
Goochegoochena Creek Site 1	53	335612	8107484	Stone artefact scatter
Goochegoochena Creek Site 2	53	335812	8106684	Stone artefact scatter

3.4 Aboriginal Areas Protection Authority

AAPA clearance surveys by AAPA anthropologis [redacted]. Previous clearances have previously been completed for the Origin exploration permit areas. The most current clearance certifciates issued for Origin exploration program including:

- AAPA 2014/1021 (C2014/183) – EP117 for Beetaloo W-1
- AAPA 2014/1022 (C2014/184) – EP98 for Kalala S-1 and Amungee NW-1
- AAPA 2015/550 (C2015/212) – EP98 for Kalala NE-1 and Nutwood Downs SW-1. AAPA 2015/550 was reviewed to update a change of exploration sites on EP98 for the CY2016 program.

Based on previous clearance certificates the only area restricted work area for the current clearance AAPA 2014/1021 (C2014/183) which lists AAPA #5663-45. This area is described as *open country surrounded by dense vegetation on the road to Jingaloo – no access and no work permitted on south side of Beetaloo access track within a radius of 300 m*.

Other restricted works areas are identified across the entire permit area. Refer to Appendix E for the available AAPA Clearance Certificates. Origin have committed to comply with conditions as prescribed by AAPA for the duration of the program.

3.5 Previous Archaeological Investigations

The majority of archaeological investigations near the study area have been predominately associated with either linear infrastructure in an alignment parallel to the Stuart Highway or natural gas exploration activities associated with the Beetaloo Basin. Of the assessments of relevance to the study area, the majority of sites identified are artefact scatters composed of raw material commonly found in the immediate area (quartz, silcrete and quartzite).

Table 3 provides a summary of previous archaeological investigations undertaken in the local area.

Table 3 Previous Archaeological Assessments in the Local Area

Researchers	Assessment Type	Locality	Key Findings
Smith, 1986	Excavation	Lake Woods	Insitu artefacts dated to 6,000 years.
Hermes, 1986	Survey	Amadeus Basin to Katherine	Large scale survey for a proposed natural gas pipeline targeting areas of major cultural sensitivity from Daly Waters to Katherine. Thirty-two sites were identified with the majority being artefact scatters associated with watercourses.

Researchers	Assessment Type	Locality	Key Findings
Quaternary Archaeological Surveys, 1998	Survey	Stuart Highway to Mataranka Homestead	Large scale survey for a fibre optic cable corridor. Three isolated artefacts and one historic heritage site identified.
Heritage Surveys, 1999	Survey	Daly Waters to McArthur River	Nine archaeological sites identified including rockshelters and artefact scatters.
HLA-Envirosciences Pty Ltd, 2006a, 2006b, 2006c, 2006d, 2007	Survey	Beetaloo Basin	Several archaeological sites identified across the exploration permits including artefact scatters, isolated artefacts and stone cairns.
AECOM Australia Pty Ltd, n.d., 2011, 2012a, 2012b	Survey	Beetaloo Basin	Several archaeological sites identified as part of seismic line clearance including large artefact scatters (>1 km), quarry sites and isolated artefacts.
AECOM Australia Pty Ltd, 2014	Survey	Beetaloo Basin	One isolated artefact identified as part of an exploration drilling program clearance.
AECOM Australia Pty Ltd, 2016	Survey	Beetaloo Basin	One isolated artefact identified on Newcastle Waters firebreak

4.0 Heritage Assessment

A heritage assessment involving field survey was undertaken by AECOM archaeologist, Luke Kirkwood for the proposal area on 28 to 29 August 2017. The archaeological inspection involved helicopter and pedestrian survey of the proposed water bore lease area and access tracks.

During the inspection notes were taken on landform, ground surface visibility and areas of exposure. The aim of the inspection was to identify any surface expressions of Aboriginal archaeological and cultural heritage values within the proposal area. Photographic records were taken at each proposed disturbance location.

Results of the inspection are provided in Table 4. Appendix B provides details on ground surface visibility classes and subsurface archaeological potential assessment. Plate 1 to Plate 8 present the general context shot of the proposed monitoring bore lease area.

Table 4 Monitoring Bore Inspection Results

Location	Easting (mE)[a]	Northing (mN)[a]	GSV[b]	GSI[c]	Surface Archaeology	Subsurface Potential	Impact Potential
Kyalla 98 W1-1	364955	8177458	Very good	High	None identified	Low	Low to No Impact
Kyalla 117 N2-1	356175	8137500	Fair	High	None identified	Low	Low to No Impact
Kyalla 117 W1-2	368079	8106696	Fair	Moderate	None identified	Low	Low to No Impact
Kyalla 117 W2-1	358321	8108680	Good	High	BT-18-IA1	Low	Low to No Impact
Velkerri 76 S2-1	435488	8136321	Good	High	None identified	Low	Low to No Impact
Velkerri 76 S1-1	424362	8113273	Very good	High	None identified	Low	Low to No Impact
Velkerri 98 E1-1	415515	8180683	Very poor	High	None identified	Low	Low to No Impact
Velkerri 117 E1-1	428861	8120782	Very good	High	None identified	Low	Low to No Impact

a GDA94 Zone 53; b GSV = Ground Surface Visibility; c GSI = Ground Surface Integrity

Plate 1 Kyalla 98 W1-1 general context shot

Plate 2 Kyalla 117 N2-1 general context shot

Plate 3 Kyalla 117 W1-2 general context shot

Plate 4 Kyalla 117 W2-1 general context shot

Plate 5 Velkerri 76 S1-1 general context shot

Plate 6 Velkerri 76 S2-1 general context shot

Plate 7 Velkerri 98 E1-1 general context shot

Plate 8 Velkerri 117 E1-1 general context shot

5.0 Identified Archaeological Heritage

No culturally sensitive landforms were identified during the survey of the proposed lease sites. One Aboriginal isolated artefact (BT-18-IA1, a silcrete unifacial point) was identified 100 m north west of the proposed Kyalla 117 W2-1 lease. Details of the find are provided below:

Site Name: BT-18-IA1

Co-ordinates: 358243mE 8108739mN GDA94 Zone 53

Site Description: Isolated silcrete unifacial point. Retouch is present along all margins of the artefact with the platform also removed. Extreme tip of point shows evidence of impact damage. No other obvious signs of usewear or residues. Darkening on ventral surface of tool, may be from exposure to soil.

Site is located on the boundary of two ecotones: Spinifex and laterite rich lower slopes. Soil is light grey/yellow sandy matrix typical of spinfex suitable habitats. Immediately adjacent is a very gently inclined slope composed on ironstone nodules. No evidence of archaeology was identified in the ironstone rich areas. Nearest wetland is 400m to the southeast

Ground Surface Visibility: 80%. Generally GSV is considered to be extremely good in this area due to low grass cover. Despite intensive survey of the immediate area (50m) no further archaeological finds were identified.

Ground Surface Integrity: 100%.

Site Interpretation: Site is an isolated discard event and likely represents small groups/individuals moving across the landscape for hunting purposes. Points are thought to be a late Holocene technology that was developed in response to increasingly marginal environments. The popularity of points is thought to be a response to reducing foraging risk by developing a highly maintainable technology that allowed for greater adaptation to these new conditions.

Table 5 Artefacts Identified in Disturbance Area

Archaeological Site	Artefact Type	Raw Material	Length (mm)	Width (mm)	Breadth (mm)
BT-18-IA1	Isolated unifacial point	Silcrete	38	22	5

REDACTED

Plate 9 BT-18-IA1 (dorsal)	**Plate 10 Kyalla 117 W2-1 ground cover context shot showing surface visibility. Artefact in foreground**

6.0 Key Findings and Recommendations

The key findings of this heritage assessment are:

- A review of existing heritage data and reports for the study area indicate that no previously recorded heritage sites will be impacted by the proposed works.
- One isolated artefact, BT-18-IA1, was identified. This artefact was found on the surface and has likely been moved by hydrological processes common across this area during the wet season.
- AAPA clearance surveys by AAPA anthropologist and traditional owners are currently being undertaken and will be finalised prior to commencement of activities.

On the basis of the above findings, the following recommendations are made:

- Heritage specialist to report site to NT Heritage Branch
- Avoid impact to the site by temporarily fencing a 10 m buffer around its location during construction works.
- If impact cannot be avoided:
    - Consult with the NT Heritage Branch and traditional owners and identify a suitable relocation area. Under law, the NT Heritage Branch are the determining body with respect to impacts to Indigenous heritage, but generally default to the wishes of community.
    - Update site details to the NT Heritage Branch. Relocation of isolated artefacts is allowed under the NT Heritage Act provided, the site is extensively documented prior to relocation.
- An unexpected heritage finds stop works procedure is to be implemented for the duration of the project.
- Induction of staff on site is to include reference to the wider area having Indigenous heritage values and the stop works procedure.

7.0 References

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Smith, M. A. (1986). An Investigation of Possible Pleistocene Occupation at Lake Woods, Northern Territory. *Australian Archaeology*, *22*, 60–74.

Yours faithfully

Luke Kirkwood
Principal Archaeologist
luke.kirkwood@aecom.com

Direct Dial: +61 7 3553 3064
Direct Fax: +61 7 3553 2050

Appendix A - Legislation

Commonwealth Legislation

Environment Protection and Biodiversity Conservation Act

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) took effect on the 16 July 2000 (NSW Department of Urban Affairs and Planning, 2000). Under section 26 of the EPBC Act it is stated that:

> *A person must not take on Commonwealth land an action that has, will have or is likely to have a significant impact on the environment.*

Under section 28 of the EPBC Act it is stated that:

> *The Commonwealth or a Commonwealth agency must not take inside or outside the Australian jurisdiction an action that has, will have or is likely to have a significant impact on the environment inside or outside the Australian jurisdiction.*

An action is defined as a project, development, undertaking, activity, series of activities, or alteration. An action will also require approval if:

> *It is undertaken on Commonwealth land and will have or is likely to have a significant impact;*
>
> *It is undertaken outside Commonwealth land and will have or is likely to have a significant impact on the environment on Commonwealth land; and*
>
> *It is undertaken by the Commonwealth and will have or is likely to have a significant impact.*

The EPBC Act defines 'environment' as both natural and cultural environments and therefore includes Aboriginal and historic heritage items. Under the Act, protected heritage items are listed on the National Heritage List (items of significance to the nation) or the Commonwealth Heritage List (items belonging to the Commonwealth or its agencies). These two lists replaced the Register of the National Estate (RNE) which is no longer a statutory list.

Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (the ATSIHP Act) provides for the preservation and protection of places, areas and objects of particular significance to Indigenous Australians. The stated purpose of the ATSIHP Act is the 'preservation and protection from injury or desecration of areas and objects in Australia and in Australian waters, being areas and objects that are of particular significance to Aboriginals in accordance with Aboriginal tradition' (section 4).

Under the Act, 'Aboriginal tradition' is defined as "the body of traditions, observances, customs and beliefs of Aboriginals generally or of a particular community or group of Aboriginals, and includes any such traditions, observances, customs or beliefs relating to particular persons, areas, objects or relationships" (Section 3). A 'significant Aboriginal area' is an area of land or water in Australia that is of 'particular significance to Aboriginals in accordance with Aboriginal tradition' (Section 3). A 'significant Aboriginal object', on the other hand, refers to an object (including Aboriginal remains) of like significance.

For the purposes of the Act, an area or object is considered to be injured or desecrated if:

- In the case of an area:
  - it is used or treated in a manner inconsistent with Aboriginal tradition;
  - the use or significance of the area in accordance with Aboriginal tradition is adversely affected;
  - passage through, or over, or entry upon, the area by any person occurs in a manner inconsistent with
  - Aboriginal tradition;
- In the case of an object:
  - it is used or treated in a manner inconsistent with Aboriginal tradition.

The ATSIHP Act can override state and territory laws in situations where a state or territory has approved an activity, but the Commonwealth Minister prevents the activity from occurring by making a declaration to protect an area or object. However, the Minister can only make a decision after receiving a legally valid application under the ATSIHP Act and, in the case of long term protection, after considering a report on the matter. Before making a declaration to protect an area or object in a state or territory, the Commonwealth Minister must consult the appropriate Minister of that state or territory (section 13).

Northern Territory Legislation

Northern Territory Aboriginal Sacred Sites Act

Provides for the protection of Aboriginal sacred sites through the establishment of different categories of site based on land tenure, including sites on Aboriginal Freehold land. The Act also establishes the Aboriginal Areas Protection Authority (AAPA) as the central administering body which supports Aboriginal custodians in achieving the objectives of the Act. Consultation with the NLC and TO's required and the issue of the AAPA clearance certificates.

The Act establishes a duty-of-care to notify the AAPA of any potential disturbance to Aboriginal sacred sites. It is an offence to desecrate or disturb a site without the approval of the relevant custodians. A register of known sites exists to assist in identifying the likelihood of disturbance and potential need to obtain approval.

Heritage Act

Protects both natural and cultural heritage, including Aboriginal, historic and Macassan heritage. The Act establishes the Heritage Council (consisting of eleven members) and the NT Heritage Register. It sets the process by which places become heritage places and allows for interim protection of places.

It is an offence to remove or damage heritage places or objects or to mislead or obstruct heritage officers regarding the provision of requested information or entry to works, vehicles or premises that are likely to have been involved in an offence against the Heritage Act. Compliance with the requirements of the Act must be adhered to at all times.

Appendix B – Archaeological Assessment Criteria

Table B1 Ground Surface Visibility (GSV) Rating Scheme

GSV rating	Percentage GSV
No ground surface visibility	0%
Very poor	1-10%
Poor	11-30%
Fair	31-50%
Good	51-70%
Very good	71-90%
Excellent	91-100%

Table B2 Ground Surface Integrity (GSI) Rating Scheme

GSI rating	Definition
Low	Ground surface has been subjected to significant disturbance (e.g. earthworks, excavation). Little to no integrity remains.
Moderate	Ground surface has been subject to moderate disturbance (e.g. native vegetation clearance) but retains a reasonable degree of integrity.
High	An unmodified or minimally modified ground surface.

Table B3 Definitions for Subsurface Archaeological Potential

Subsurface Archaeological Potential	Definition
Low	Areas in which subsurface archaeological materials are unlikely to occur. This may be due to unfavourable environmental conditions and/or prior disturbance(s).
Moderate	Areas in which subsurface archaeological materials may occur. Reasonable environmental conditions exist though high artefact counts/densities are unlikely. Subsurface evidence likely to be the product of random discard events as opposed to repeated or extensive activity by Aboriginal people in antiquity.
High	Areas known or highly likely to contain subsurface archaeological materials. Presence of archaeological materials typically reflects optimal environmental conditions and little to no prior landscape disturbance. High artefact counts/densities are likely.

Table B4 Impact Potential Ranking for Aboriginal Objects

Impact Potential	Definition	Management Action
No Impact	Aboriginal objects will not be affected by the proposed activity.	No action required
Low Impact	The proposed activity is unlikely to disturb, destroy, damage or deface an Aboriginal object or objects.	No action required
Moderate Impact	The proposed activity has reasonable potential to disturb, destroy, damage or deface an Aboriginal object or objects.	Avoid area if possible. If avoidance not an option, test excavate area to determine nature and extent of potential archaeological deposits

Impact Potential	Definition	Management Action
High Impact	The proposed activity will, or is highly likely to, disturb, destroy, damage or deface an Aboriginal object or objects.	Avoid area if possible. If avoidance not an option, test excavate area to determine nature and extent of potential archaeological deposits

Appendix E AAPA Certificates Current

Aboriginal Areas
Protection Authority
protecting sacred sites across the territory

Our File: 2018/651
In reply please quote: 201808625

Origin Energy Limited
PO Box 4095
Darwin NT 0801

ATTENTION: STEPHANIE STONIER

RE: ISSUE OF AUTHORITY CERTIFICATE FOR ENVIRONMENTAL MONITORING WATER BORES INSTALLATION EP117 EP76 AND EP98

I refer to your application for Authority Certificate received on the 10th October 2018 for the above location. Accordingly, under the powers delegated to me under Section 19 of the *Northern Territory Aboriginal Sacred Sites Act 1989* I am pleased to issue the attached Authority Certificate.

Please read carefully the conditions outlined in the Certificate. In particular, you should note that it has been issued for an indefinite period of time, providing that the works covered by the Certificate start within the period stipulated in condition 3.

The Northern Land Council (NLC) requested we bring to your attention custodian concerns about the proximity of an existing gravel borrow pit in the immediate vicinity of Sacred Site Bamarrnganja waterhole (5664-3). Custodians assert that this pit has been constructed too close to the Sacred Site and are keen to see its use discontinued. We encourage you to discuss this matter with the Northern Land Council.

The NLC also identified an Archaeological object being a spear point, which is referenced as (Other Site 5663-51) on the map that is Annexure 'A' to the enclosed Authority Certificate. I am aware that Origin is aware of this object and the custodian request that it remain in situ. Given that the field survey was conducted by helicopter, the custodians asked the consultant to convey that further on ground investigations should be taken within the boundary associated with this other site, to establish whether there are more archaeological artefacts to be protected in this area. Archaeological sites and objects are protected in accordance with the *Northern Territory Heritage Act.*

There is also the possibility of burial sites being located within the subject land for the attached Certificate. Under the Northern Territory Criminal Code it in an offence to interfere with remains of a deceased person. Under the *Northern Territory Heritage Act* it is an offence to interfere with the remains of a deceased Aboriginal person without authorization under that Act.

In the event that any skeletal remains are unearthed it is your responsibility in law to stop works and report immediately such disturbance to the NT Police, and to the Director Heritage Branch, Department of Tourism and Culture, if you have reason to believe the remains are those of an Aboriginal burial. For further information on burial and archaeological sites please contact the Director Heritage Branch, Department of Tourism and Culture on (08) 8999 5039 (Darwin office) or (08) 8951 9247 (Alice Springs office) or email heritage@nt.gov.au.

Darwin
P: +61 (08) 8999 5511
F: +61 (08) 8999 4334
www.aapant.org.au
enquiries.aapa@nt.gov.au
4th Floor, R.C.G Centre,
47 Mitchell Street DARWIN NT
GPO Box 1890, Darwin NT 0801

Alice Springs
P: +61 (08) 8999 5511
F: +61 (08) 8952 2824
www.aapant.org.au
enquiries.aapa@nt.gov.au
Ground Floor, Belvedere House
Cnr Bath & Parsons Streets Alice Springs NT
All mail to Darwin GPO

You should also note that the Authority has issued you with two identical copies of digitised maps attached. One copy should be retained with your original Certificate. The second is supplied for use by contractors to avoid unnecessary photocopying of a colour coded document.

Please note that the cost of this Authority Certificate will be $14,235 inclusive of GST and an invoice will be issued to you by the Department of Corporate and Information Services. An application fee of 57 revenue units ($67) will also apply. The terms and conditions of the invoice will require you to make payment within 30 days of receipt.

If you have any further queries regarding this Authority Certificate please email enquiries.aapa@nt.gov.au or contact Virginie Branchut on (08) 89994343.

Yours faithfully

DR. BEN SCAMBARY
Chief Executive Officer

30th November 2018

ABORIGINAL AREAS PROTECTION AUTHORITY
AUTHORITY CERTIFICATE

Issued in accordance with Section 22 of the *Northern Territory Aboriginal Sacred Sites Act 1989*.

REFERENCE: **2018/651** **(Doc: 201808625)** **C2018/103**

APPLICANT: Origin Energy Limited
PO Box 4095
Darwin NT 0801

SUBJECT LAND: EP117 EP76 and EP98 within Part NT Portions: 701, 702, 1077, 1079, 1513, 5416, 7027 and 7026, as shown on the map which is Annexure 'A' hereto.

PROPOSED WORK OR USE: Installation and ongoing use of up to 10 water monitoring bores at nine water monitoring bore locations; including the use, maintenance and upgrade of access tracks; and resource extraction at 8 gravel pits being 250 meter x 250 meter areas; and ongoing repair and maintenance.

PREAMBLE: This Authority Certificate is issued in accordance with s22(1)(b) of the Northern Territory Aboriginal Sacred Sites Act where an agreement has been reached between the custodians and the applicant. The agreements forming the basis of this Authority Certificate are: Exploration Agreement: Exploration Permit Application 117 - Borroloola Barkley Region, Northern Territory between Sweetpea Corporation Pty. Ltd. and the Local Aboriginal Groups and the Northern Land Council, as executed by tripartite deed on 23 November 2005; Exploration Agreement: Exploration Permit Applications 98 & 99 and Exploration Permit 76 - Borroloola Barkley Region, Northern Territory between Sweetpea Corporation Pty. Ltd. and the Local Aboriginal Groups and the Northern Land Council; as executed by tripartite deed on 24 November 2003. This Authority Certificate shall expire in accordance with any terms of expiry stated in the aforementioned agreements and/or deeds.

CONDITIONS:

1. The applicant shall ensure that the conditions of this Certificate are included in any subsequent contract or tender documents for the works or use described herein.
2. The applicant shall ensure any agent, contractor or employee is aware of the conditions of this Certificate and the obligations of all persons (who enter on, or carry out works or use land on which there is a sacred site) under Part IV of the *Northern Territory Aboriginal Sacred Sites Act 1989*.
3. This Certificate shall lapse and be null and void if the works in question or the proposed use is not commenced within 24 months of this Certificate.
4. The applicant shall ensure any agent, contractor or employee is aware of the content of section 40(1) of the *Northern Territory Aboriginal Sacred Sites Act 1989* which provides that this Certificate does not negate the need for consent, approval or permission for the subject works or use of the land which may be required under another statute.
5. Within the areas marked Restricted Works Area 1 (RWA1) on Annexure 'A', associated with sacred site 5665-1, no work shall take place or no damage shall occur.

   RWA 1 commences at a point 12 metres beyond the centreline of the existing track, parallel to the existing track and extends for the extent of the remainder of the subject land on both sides of the road. And further, the available road corridor between the RWA 1 areas is comprised of 3 metres either side of the centreline of the existing track for

use, upgrade and maintenance of the existing track. There is an additional 9 metres beyond this for the road shoulder activities only. The total available road corridor for use and maintenance of the existing track is 24 metres across.

The features of sacred site 5665-1 include: a waterhole otherwise known as Junmaru/Dunmarra waterhole.

6. Within the area marked Restricted Works Area 2 (RWA2) on Annexure 'A', associated with sacred site 5665-8, no work shall take place or no damage shall occur.

RWA 2 commences at a point 12 metres beyond the centreline of the existing track, parallel to the existing track and extends for the extent of the remainder of the subject land on one side of the road (east and south of the existing tracks).

The features of sacred site 5665-8 include: a waterhole.

7. Within the area marked Restricted Works Area 3 (RWA3) on Annexure 'A', associated with sacred sites 5665-3,5664-2,5664-6, 5664-7 and 5664-3 no work shall take place or no damage shall occur.

RWA 3 commences at a point 3 metres beyond the centreline of the existing track, parallel to the existing track and extends for the extent of the remainder of the subject land on one side of the road (west of the existing track).

The sacred site complex associated with RWA 3 includes the following sacred sites and features:
The features of sacred site 5665-3 include: sinkhole
The features of sacred site 5664-2 include: waterhole
The features of sacred site 5664-6 include: extensive blue bush and swamp area
The features of sacred site 5664-7 include: waterhole / sinkhole / claypan
The features of sacred site 5664-3 include: waterhole

8. Within the areas marked Restricted Works Area 4 (RWA4) on Annexure 'A', associated with sacred sites 5764-9, 5764-7, 5764-6, 5764-8, 5764-5, 5664-9, 5664-8, and 5664-1, no work shall take place or no damage shall occur.

RWA 4 commences at a point 12 metres beyond the centreline of the existing track, parallel to the existing track and extends for the extent of the remainder of the subject land on both sides of the road. And further, the available road corridor between the RWA 4 areas is comprised of 3 metres either side of the centreline of the existing track for construction, use, upgrade and maintenance of the existing track. There is an additional 9 metres beyond this for the road shoulder activities only. The total available road corridor for use and maintenance of the existing track is 24 metres across.

The sacred site complex associated with RWA 4 includes waterholes in a chain along a tributary of Newcastle Creek including Sandy Lagoon including the following sacred sites and features:
The features of sacred site 5764-9 include: a waterhole / swamp / claypan
The features of sacred site 5764-7 include: waterholes
The features of sacred site 5764-6 include: waterhole
The features of other site 5764-8 include: area of rocks / stones
The features of sacred site 5764-5 include: waterhole / swamp
The features of sacred site 5664-9 include: waterhole
The features of sacred site 5664-8 include:waterhole
The features of sacred site 5664-1 include: waterholes

9. Within the area marked Restricted Works Area 5 (RWA5) on Annexure 'A', associated with sacred site 5663-45 no work shall take place or no damage shall occur.

RWA 5 commences at a point 12 metres beyond the centreline of the existing track, parallel to the existing track and extends for the extent of the remainder of the subject land on both sides of the road (north and south of the existing track). And further, the available road corridor between the RWA 5 areas is comprised of 3 metres either side of the centreline of the existing track for construction, use, upgrade and maintenance of the existing track. There is an additional 9 metres beyond this for the road shoulder activities only. The total available road corridor for use and maintenance of the existing track is 24 metres across.

The COMMON SEAL of the
ABORIGINAL AREAS PROTECTION AUTHORITY

was hereto affixed on the 30th day

of November 2018

DR. BEN SCAMBARY
Chief Executive Officer

Attachments: Appendices, List of known burial and Aboriginal Heritage Places

Appendix 1

Archaeological places or objects exist within or in the vicinity of the subject land. All such materials are protected under the *Northern Territory Heritage Act*. Those that could be identified at the time this Certificate was issued are described in this Appendix, and have been shown as blue squares on the attached map (Annexure A).

For further information please contact the Director Heritage Branch, Department of Tourism and Culture on (08) 8999 5039 (Darwin office) or (08) 8951 9247 (Alice Springs office) or email heritage@nt.gov.au.

List of known Aboriginal heritage places within the subject land:

1 [redacted]

REDACTED

Environmental Monitoring Water Bores Installation EP117 EP76 and EP98

ANNEXURE "A" MAP 1 of 4 FORMING PART OF

AUTHORITY CERTIFICATE C2018/103

ISSUED TO:
Origin Energy Limited

AUTHORISED COPY: NUMBER 1 OF 4

CHECKED BY: ..... DATE 29/11/2018

X.LI - SENIOR LAND INFORMATION OFFICER

J2018-0466

0 30

kilometres

Scale 1:500,000

Coordinate system: GDA94

KEY

- Subject Land
- Extent of Recorded Sacred Site
- Extent of Other Site
- Restricted Works Area
- Registered Sacred Site
- Recorded Sacred Site
- Other Site

** The Sacred Site point is not indicative of the specific site location and does not represent the location of any features of the site.*

Prepared and produced by Aboriginal Areas Protection Authority (AAPA), Darwin, Northern Territory of Australia
© Northern Territory of Australia

This map forms part of a Certificate issued by the Authority under section 22 of the *Northern Territory Aboriginal Sacred Sites Act 1989*. No reliance should be put on the accuracy of the information on the map except as it relates to the land the subject of the Certificate and the fact that sites are not shown in other areas shall not be taken as a definitive indication of the existence or lack of existence of sites.

Appendix F Water Bore Drilling Program Risk Assessment and Level of Effectiveness

Ref	Activity	Aspect	Potential Impacts	Pre-Mitigation Risk Assessment			Additional Mitigation	Post-Mitigation Risk Assessment			Effectiveness of Treatment
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
1	Groundwater Monitoring Bore Design	Protection of groundwater resources	• Connectivity between aquifers resulting in change to groundwater conditions. • Uncontrolled flowing of artesian causing wastage of groundwater resource. • Contamination of groundwater from surface. • Potential for multiple aquifers to be encountered. • Cross flow of groundwater between shallow aquifers results in deterioration of water quality in utilised aquifer. • Potential that drilling method are incorrect impacting on the reliability of the data collected in the future.	3	4	M	• Minimum Construction Requirements for Water bores in Australia 3rd Edition • Monitoring bore designed and drilled as per requirements and suit the hydrogeological conditions on the site, be appropriate to protect aquifer and suitable for intended purpose as a monitoring bore. • Licensed drilling to be engaged. • A buffer of 2 km will be maintained between operations and stock water bores. • Surface water will not be used for any purpose. • No discharges to watercourses. • Agreements to be reached with land holders and/or Department of Transport for the use of groundwater resources • Sustainable use of groundwater measures will be implemented including the monitoring and recording of water use for operations.	3	1	L	E

Ref	Activity	Aspect	Potential Impacts	Pre-Mitigation Risk Assessment			Additional Mitigation	Post-Mitigation Risk Assessment			Effectiveness of Treatment
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
2	Location of monitoring bores	Damage to newly installed monitoring bores and Interaction with underground and/or above ground services.	• Impact on monitoring bore from fire, vehicle traffic, flooding, vegetation (i.e. roots) and surface water. • Although located in remote area, incorrect placement of monitoring bores could interact with utilities and infrastructure. This could include Station water, power, communication utilities.	1	4	M	• Bores should be positioned so that the headworks can be protected from damage from fire, vehicles, frequent flooding and surface water drainage. • Borehead protection should be installed around each monitoring bore. • Prior to installation of monitoring bores, ensure the area has been cleared for any potential underground and overhead services, including Pastoral Properties water supply network for homestead and stock. • Dial before your dig and consultation with land holders.	1	1	L	E

Ref	Activity	Aspect	Potential Impacts	Pre-Mitigation Risk Assessment			Additional Mitigation	Post-Mitigation Risk Assessment			Effectiveness of Treatment
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
3	Water Bore Drilling	Groundwater contamination	• Potential contamination of groundwater from drilling fluid additives. • Chemicals and other drilling fluid additives could leave residual toxicity in monitoring bore.	3	3	M	• Fluids to be used under the Australian guidelines • Chemicals or other substances that could leave a residual will not be added to drilling fluids • MSDS and manufacturer's recommendations to be made available to the DPIR and on the drill sites for all drilling fluid products • Drilling fluids considered acceptable for water bore drilling include water-based drilling fluids and air-based drilling fluids • The makeup water shall be fresh non-polluted water for all water bore drilling fluid preparations. • Mud tanks will be utilised, instead of pits. • Waste (excluding muds and cuttings) to be removed off site for appropriate disposal at licensed landfill facility. • Site to be restored, as close as reasonably practicable, to pre-drilling conditions	3	1	L	E
4	Water Bore Drilling	Drilling can inadvertently transfer microbiological organisms between sites	• Introduction of microbiological organisms (bacteria) can impact on water quality (i.e. iron bacteria cause clogging of screens and water delivery equipment).	2	2	L	• NT Licensed Driller to be used • Driller to ensure good hygiene practices are implemented • Driller to ensure drilling tools are cleaned and disinfected (as required) before commencing at a new site.	2	1	L	E

Ref	Activity	Aspect	Potential Impacts	Pre-Mitigation Risk Assessment			Additional Mitigation	Post-Mitigation Risk Assessment			Effectiveness of Treatment
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
5	Water resource use	Not utilising water in accordance with ESD principles.	• Wasting of water for operations.	1	3	L	• A buffer of 2 km will be maintained between operations and stock water bores. • Surface water will not be used for activities. • Agreements to be reached with land holders and/or Department of Transport for the use of groundwater resources. • Sustainable use of groundwater measures will be implemented including recording of all groundwater use for monitoring bore installation activities .	1	1	L	E

Ref	Activity	Aspect	Potential Impacts	Pre-Mitigation Risk Assessment			Additional Mitigation	Post-Mitigation Risk Assessment			Effectiveness of Treatment
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
6	Groundwater resource use and land contamination	All bores proposed are in greenfield areas that will have low potential to contain contamination. Anticipated water quality will be suitable for discharge to surface and volumes likely to be ~500-1000L per bore depending on depth.	• During the development of groundwater bores for monitoring purposes, waters will discharged to nearby surface to ensure all residual drilling muds and solids are removed from the well bore.	1	3	L	• All purged water will be discharged in a manner to minimise impacts on the environment and land users. • Water will be of good quality (i.e. low salinity) and suitable for discharge to surface. • Drilling muds will be bentonite based	1	1	L	E

7	Civil Construction	Management of Land - Soil and Erosion	• Soil instability or movement as a result of exploration activities or vegetation loss • Soil compaction as a result of civil construction and water bore drilling • Disturbance of creek and stream banks.	2	3	M	• Erosion control measure to be implemented and maintained as per erosion and sediment control plan. Contour drains, retention of natural vegetation, provision of buffer strips of vegetation, short slopes and low gradients help keep runoff velocities low and therefore reduce erosion. • Regular inspections will be conducted to identify erosion and repair where observed. • No off lease or off road driving. • Following completion of works, disturbed areas to be restored and/or rehabilitated. • Gravel borrow pits to have topsoil returned and re-profiled. • Avoid creating windrows. • Avoid steep terrain in dissected upland areas. • Minimise disturbance to creek banks – leave vegetation, deviate to more suitable crossing point such as a naturally clear area. Construct all crossings as per bed level crossings as provided in section 2.2 • Inspect and maintain control measures on a regular basis, particularly before and after heavy rainfall. • All compacted areas will be ripped to promote regeneration of vegetation. • Disturbed areas to be restored will be monitored for weed infestation, and progress towards specified rehabilitation goals.	2	1	L	E
8	Water bore drilling activities, storage and transportation of wastes, sewerage treatment and disposal, disposal of drill cuttings and muds, fuel and	Localised soil contamination and impact on nearby surface water quality	• Soil contamination as a result of civil construction activities and water bore drilling	3	4	M	• Dangerous goods will be stored, handled, separated and signed as required by the Flammable and Combustible Liquids Regulations and AS1940. • Spill response measures shall be implemented for spills or leaks. Spills of dangerous goods will be collected for treatment and disposal at an approved facility.	3	1	L	E

Ref	Activity	Aspect	Potential Impacts	Pre-Mitigation Risk Assessment			Additional Mitigation	Post-Mitigation Risk Assessment			Effectiveness of Treatment
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
	chemical handling and storage						• Designated waste storage and handling area to be provided onsite. • All solid and regulated waste to be removed offsite. • Hazardous goods will be stored in bunded areas away from watercourses. • Refuelling of equipment will not occur within 100m of a water course. • Plant and equipment shall be inspected and maintained regularly to detect and prevent leakage of liquid contaminants				

9	Civil Construction	Surface Water Flow	• Access tracks and site pads altering natural surface water flow, creating ponding and or erosion	3	3	M	• Clearing and design and construction stages of earthworks should take account of seasonal site conditions (e.g. seasonally wet areas, steep slopes or nearby waterbodies). • Fit the development to the seasonal site conditions, including short-term weather forecasts. • Rely on advice of Site Operational Staff in relation to local weather and climate information to make decision regarding site operations (i.e. Cyclone on the coast that could potential increase risk of wet weather in the Basin) • Stage activities to occur during the dry season where possible. • Minimise disturbance close to natural drainage lines, whether ephemeral or permanent. Disturbance can cause changes in drainage patterns, such as sheet flow rather than channel flow. The retention of vegetation buffers, as outlined in the NTG Land Clearing Guidelines 2010, as they relate to stream order should be considered in the planning of tracks and roads. If clearing unavoidable, appropriate stabilisation to occur on creek crossings and maintained to ensure minimal interruption of surface water regimens. • Inspect and maintain control measures on a regular basis, particularly before and after heavy rainfall.	3	1	L	E
10	Access track and drilling operations	Air Quality – Dust and Emissions	• Dust impacts on built-up areas (camp site, homesteads, Aboriginal Communities), vegetation and amenity as a result of civil construction works, drilling operations and travel to the sites. • Potential for an increase in exhaust emissions from contractors' vehicles and generators resulting in localised effect on air	2	2	L	• Reducing the speed of vehicles on dirt tracks • Monitor road conditions to ensure deterioration with possible increase in dust creation, does not occur and undertake road rehabilitation as required. • Watering of roads when appropriate and agreed with landholders.	2	1	L	E

Ref	Activity	Aspect	Potential Impacts	Pre-Mitigation Risk Assessment			Additional Mitigation	Post-Mitigation Risk Assessment			Effectiveness of Treatment
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
			quality and global contribution to greenhouse gases.				• All equipment and machinery to be in good working order to minimise vehicle exhaust emissions				
11	Access track and drilling operations	Lighting, Noise, Vibration and Visual Amenity	• Noise generation causing and environmental nuisance • Interference with pastoral activities if noise, vibration and lighting affects behaviour of stock. • Light pollution impacting sensitive receptors • Visual amenity impacts on tourism	1	1	L	• Low impact water bore drilling activity surrounded by vegetated areas. • Drill sites selected to minimise noise and visual amenity impacts on sensitive receptors/ local community. • 6am to 7pm work, with no night time drilling anticipates. • Complaints shall be recorded in OCIS, investigated and responded to appropriately.	1	1	L	E

12	Access track and drilling operations	Waste Management	• Contamination of soil or water through generation of or use of hazardous materials, domestic, industrial and drilling wastes and sewage. • Encouragement of pest species to waste sites.	2	4	M	• Designated waste storage and handling area to be provided onsite. • Consider recycling capabilities when awarding waste contract for civil construction and drilling program. • Removal and disposal of hazardous wastes to be in accordance with NT hazardous waste disposal requirements. • Undertake inspection of waste storage areas regularly, or after significant rainfall event (greater than 20 mm in 24-hour period). • All waste bins should be covered. • Grey water from kitchen and showering facilities will be managed in accordance with Part 6 of the DoH Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent, 2014. • Domestic refuse to be disposed of in accordance with NT waste guidelines. No incineration of wastes on site. • Identify and remediate the affected area where applicable in accordance with the National Environmental Protection Measure (NEPM) requirements. • Waste Contractors to be used to be listed on the NT EPA waste handling contractors register (http://www.ntepa.nt.gov.au/waste-pollution/approvals-licences/ep-licences).	2	1	L	E
13	Vehicle and water bore Rig movements, Clearing of vegetation and Rehabilitation	Natural Environment – Vegetation, Flora, Fauna and Habitat	• Disturbance to environmentally sensitive areas and/or flora and fauna species • Loss or endangerment of Threatened species • Loss of habitat • Vehicle collisions with fauna – fauna mortality	1	4	M	• Ecological assessment to be undertaken to identify environmentally sensitive areas (flora and fauna habitat). • Clearing to avoid large habitat trees. • Spotter catcher or equivalent to be present when clearing vegetation. • No off lease driving, stay to approved access tracks. • Personnel will be prohibited from bringing firearms or traps into the lease areas.	1	2	L	E

Ref	Activity	Aspect	Potential Impacts	Pre-Mitigation Risk Assessment			Additional Mitigation	Post-Mitigation Risk Assessment			Effectiveness of Treatment
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
							• Water bore leases will be fenced. • Personnel will be prohibited from interfering with wildlife. • Personnel will be prohibited from bringing domestic pets onto the Program area. • Adequate fire breaks shall be maintained around Monitoring bores to protect asset • Appropriate fuel and chemical handling and storage measures will be implemented • Fire extinguishers and firefighting equipment will be provided at each site and for vehicles. • Fire bans will be complied with. • Driving at dawn and dusk to be avoided in accordance with Origin Travel Management Plan • Rehabilitate back to sites natural state once activities are completed (if required). Monitoring post-disturbance.				

14	Civil construction activities, vehicle and water bore Rig movements	Introduction and Spread of Weeds	• Transport of weeds or other exotic species and plant diseases between regions through transport operations that may compromise existing habitats or vegetation and impacton pastoral or cultural activities in the area. If possible locally sourced machinery and Transport will be used to reduce the risk of pests being transported and introduced from other regions • Biosecurity impacts causing harmful effects of some weed species on livestock or native fauna	3	4	H	• Activities will adhere to the guidelines within the NT Weed Management Handbook (2018). • Weed desktop and field based surveys to be undertaken to identify existing weed areas. • Weed management and control measures to be implemented in alignment with existing landholder biosecurity procedures. • All equipment will have certified equipment wash-down completed prior to entry to the field. • New activities will be planned to address prevention of weed or non-indigenous plant spread. • Machinery to be preferentially sourced locally, with machinery sourced from surrounding areas or Queensland being the 2nd and 3rd preferred option respectively. • Pre and post wet (February to May) inspections and periodic audits will be conducted to identify and report weed outbreaks. • Weeds will be actively controlled in cleared/ hardstand areas. • Major equipment moves will be planned from weed-free areas to infested areas and not the other way around. • Staff members responsible for preventing, identifying and managing weeds to be appropriately trained. • Ensuring all material imported to or between sites is free of weeds.	3	3	M	E
15	Operations	Feral Animals and other Pest Species	• Introduction of feral and pest species may impact upon livestock • Introduction of feral animals and pest species may compromise existing habitats, vegetation or native fauna through predatory behaviour or competition • Biosecurity impacts from introduction of diseases associated with feral and pest	2	4	M	• No domestic animals brought to site. • No rubbish (i.e. food packaging) to be left on drill sites. all refuse should be taken back to camp where It will be disposed of appropriately. • Solid domestic waste storage areas will need lids or protective barriers installed that effectively Restrict Access to pest species, including those species able to dig under or climb over barriers.	2	1	L	E

Ref	Activity	Aspect	Potential Impacts	Pre-Mitigation Risk Assessment			Additional Mitigation	Post-Mitigation Risk Assessment			Effectiveness of Treatment
				Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
			species may impact upon existing habitats, vegetation, native fauna and livestock				in general though, removal of wastes is recommended				
16	Access track construction and drilling operations	Bushfire	• Increased incident and intensity of bushfires can lead to vegetation degradation and habitat modification • Damage to or loss of public infrastructure, private infrastructure and equipment or community lands • Damage to or loss of culturally significant sites	4	4	H	• Fire extinguishers to be fitted to all vehicles. • Fire trailer to be on hand to respond to fire. • Emergency response plan developed and implemented to deal with fire. • Establish firebreaks around water bore infrastructure (4 m fire break in accordance with NT requirements. • Firebreaks around production wells must be maintained for life of the lease area. • Access tracks and roads will serve as firebreaks to limit the spread of fire and the availability of water and firefighting equipment on site will assist in fire control.	3	3	M	E

17	Access track construction and drilling operations	Cultural Heritage and Sacred Sites	• Disturbance to cultural heritage sites	2	1	L	• Cultural Heritage Clearance (and identification of sites of Aboriginal significance in conjunction with NLC and AAPA) will be conducted prior to commencement of disturbance activities or operations • Activities will be conducted in accordance with the NLC Agreement. • Prepare a Code of Conduct for employees and contractors to assist in the prevention of any possible anti-social behaviour that will affect the local residents. • Identify location of culturally sensitive areas and ensure design avoids these areas where applicable. • Where avoidance is not possible, such as in the case of existing access tracks, an artefact collection protocol is to be implemented in collaboration with traditional owners and NLC. • An unexpected heritage finds stops related work activities within the vicinity of the find (within a 500 m radius) for assessment and direction by an NLC representative. • Ensuring appropriate behaviours are employed outside of work hours. • Site inductions are to ensure that all personnel are aware of the Code of Conduct prepared for social interactions with the community.	1	1	L	E
18	Access track construction and drilling operations	Livelihood and well-being of local communities and towns	• Loss of visual amenity- landholder and tourists • Possible danger to health and safety of the community. • Possible increase in traffic from activity	1	1	L	• All areas to be located away from sensitive receptors with lease layouts designed to minimise visual amenity impacts. • Emergency response systems will be in place. • All personnel and site visitors will complete the appropriate inductions. • All activities to be undertaken in accordance with land access agreements. • An approved DIPL Traffic Management Plan or exemption to be provided to DPIR prior to commencement of activities.	1	1	L	E

Effectiveness Rating

Rating	Explanation
Effective (E)	• Controls are well designed and address the root cause/s of the risk • Controls are recognised industry best practice • All controls operate at the required level • All controls are within the power of Origin, with few external factors beyond control • Ongoing monitoring required
Can Be Improved (C)	• Majority of controls are well designed and address the root cause/s of the risk • Majority of controls operate at the required level • Some controls are outside the power of Origin, with multiple external factors beyond control • Ongoing monitoring required • Certain controls can be improved or have elements below industry best practice.
Must Be Improved (M)	• Most controls are not well designed and do not address the root cause/s of the risk. • Most controls are not operating to the required level. • A large number of controls are outside the power of Origin, with multiple external factors • The majority of controls require improvement and are well below industry best practice.

Appendix G Environmental Commitment Register

Obligation Details	Track Construction, Maintenance and Access	Water Bore Drilling
Layout of the site and exact siting of infrastructure will be informed by the environmental sensitivities and mitigation measures identified in this EMP.	x	x
Land clearance will be minimised to avoid disturbance of soils, vegetation and wildlife habitats and avoid interference or blockage of natural drainage patterns.	x	
The tracks are designed to minimise their environmental footprint, with standards allowing only sufficient width to enable the safe ingress/egress of the rig and associated equipment, materials and service vehicles.	x	
erosion and sediment measures as per the erosion and sediment control plan shall be implemented to minimise the effect of rainfall runoff or overland flow on areas of disturbance.	x	
Crossing of waterways and drainage lines will be minimised wherever possible and efforts made to find crossing points with the lowest risk of environmental harm.	x	
Existing gravel borrow pits will be used where possible	x	
All bores will be drilled and constructed by an appropriately NT licensed water bore driller and in accordance with the Minimum Construction Requirements for Water bores in Australia 3rd Edition (National Uniform Drillers Licensing Committee, 2012)		x
Location of the lease areas has considered the minimum offset distance of at least 2 km between site activities and pastoral water supply bores.		x
Each aquifer intersected will be isolated from overlying aquifers with a cemented casing string.		x
Drilling will be undertaken with air or mud rotary techniques. If mud rotary techniques are employed, the circulation fluid will be water based and will utilise standard water bore drilling polymer or bentonite-based density and viscosity modifying additives.		x
Within 28 days of bore completion, a statement of bore (Form 21), with it registered number, will need to be submitted to the Water Resource branch of the Department of Environment and Natural Resources (DENR).		x
All cuttings and drilling mud will be disposed of on site in accordance with normal water bore drilling practices. Any contaminated material not suited for onsite disposal will be removed from site and transferred to a licenced waste management facility.		x
Permission from land holders to utilise the existing water bores in the area of the proposed lease areas or a permit to work within a road reserve would be obtained to gain access	x	x
Surface water will not be used for any activities proposed in this EMP or future operations	x	x
Stormwater flooding across the cleared site will be managed to minimise impacts from erosion and sedimentation.	x	x
Creek and stream crossing to be designed to minimise changes to drainage patterns in accordance with NTG Land Clearing Guidelines 2010		
Origin will implement appropriate controls to prevent the spread of weeds, feral pests and diseases, and ensure biosecurity.	x	x
Records of weed distribution will be maintained within Origin's GIS and if required provided to the Weeds Officer at DENR.	x	x
Origin have committed to comply with conditions as prescribed by AAPA for the duration of the program.	x	x
Cultural Heritage Clearance (and identification of sites of Aboriginal significance in conjunction with NLC) will be conducted prior to commencement of disturbance activities or operations in any area	x	x

Obligation Details	Track Construction, Maintenance and Access	Water Bore Drilling
Origin 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.	x	x
Appropriate housekeeping standards will be maintained, and the site will be maintained free of rubbish	x	x
All civil contractors performing work will be housed in local hotel accommodation avoiding the need for permanent camps.	x	x
Wastewater, sewage and sullage generated by the domestic camp activities will be managed by a Department of Health (DoH) approved sewage treatment system or captured and removed from site.	x	x
For the size of the proposed program, all waste (other than drill cuttings) produced will be backloaded with the crew for appropriate disposal and or recycling.	x	x
At completion, Origin will implement natural regeneration to rehabilitate disturbance areas and monitor annually to assess rehabilitation success.	x	x
Monitor road conditions to ensure deterioration with possible increase in dust creation, does not occur and undertake road rehabilitation as required.	x	x

Appendix H Land Access Agreements

REDACTED

Appendix I Erosion and Sediment Control Plan

BEETALOO BASIN GROUNDWATER MONITORING BORE INSTALLATION PROJECT

Erosion and Sediment Control Plan

EP76, EP98 and EP117

This document outlines the basic principles for Contractors to develop site specific erosion and sediment control plans for Beetaloo Basin Groundwater Monitoring Bore Installation Project. This ESCP should be read in conjunction with Beetaloo Basin Groundwater Monitoring Bore Installation Project Environmental Management Plan.

Review record

Rev	Date	Reason for issue	Reviewer/s	Consolidator	Approver
A	05/11/2018	Draft ESCP released for comment	A.Court	M.Kernke	M.Hanson
0	22/11/2018	ESCP final	A.Court	M.Kernke/ M.Pollock	M.Hanson

Review due: 05/11/2019

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1. Introduction

As part of the development of Origin's Groundwater Monitoring Bore Installation Environmental Management Plan (EMP) the pre-mitigated risk for potential impacts associated with soil and erosion was considered a medium risk.

To mitigate the risk of soil and erosion, this Erosion and Sediment Control Plan (ESCP) has been developed to provide directions for the Contractor in erosion and sediment control during construction of access tracks and groundwater monitoring bore pad. As well as ongoing maintenance and monitoring once sites are established.

The design of the pad will comply with Northern Territory and local government statutory laws and regulations and are to be designed to all relevant and applicable codes and standards. This ESCP has been developed in accordance with the following guidelines:

- *Best Practice Erosion and Sediment Control* (IECA, 2008)
- *Land Clearing Guidelines Technical Report No. 20/2009D* (NRETAS, 2010)
- *Erosion and Sediment Control Guidelines for Rural Development Environment* Fact Sheet (DLRM, 2018).

Origin and its Contractors shall implement this ESCP to minimise the impact of the proposed Groundwater Monitoring Bore Installation program on the external environment.

1.1 Objectives

The objectives of this ESCP are to manage Origin's activities within the Permit Area in a manner that minimises the impacts upon soil, vegetation and surface water which may come about as a result of soil disturbance activities including land clearing and monitoring bore pad establishment. This plan is designed to provide guidance for the onsite construction of infrastructure, relying on onsite personnel to deploy the relevant ESC where appropriate.

The ESCP will aim to:

- Address key soil and water management issues, including legislative and client requirements.
- Determine the "Type" of ESC controls to be implemented during and post construction.
- Wherever practical identify, eliminate and reduce hazards and associated risks inherent in specific work activities, which if untreated would lead to a diminished product or create the potential for an accident, dangerous occurrence or environmental incident.

To avoid significant and/or sustained deterioration in downstream water quality this ESCP may be amended as required, in response to the Monitoring and Maintenance Program described herein. Standard drawings are provided as guide, with the Construction Supervisor making final determination on site.

Strategies shall be developed, implemented and reviewed on a regular basis, to ensure all risks are identified, measured and recorded throughout the course of the project. All ESC devices will be design and installed in accordance with the NT *Land Clearance Guidelines Land Technical Report No. 20/2009D* (NRETAS, 2010).

2. 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.

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 have 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 water bore

drilling program. The majority of the proposed groundwater monitoring bore sites were non-dispersive soils and had high gravel content.

- 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 groundwater bore drilling locations were flat 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 1 and Table 2 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 (northern sites) and Newcastle Waters (Kyalla 117 W1-2). The construction activities for the groundwater bore drilling is proposed to be completed prior to the onset of the 2018 wet season. As the program pushes out into November and December, the risk of erosion from rainfall considered moderate to high in the northern sites, and low to moderate in the southern sites.

Table 1 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)*

Table 2 Erosion Risk Rating based on average monthly rainfall at Newcastle Waters

Item	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	125.5	130.9	93.7	24.6	9.3	5.3	3.4	1.0	5.4	20.9	35.7	77.3
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)*

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 with the exception of a record of very minor evidence of scalds caused by sheet erosion at Velkerri 117 E1-1 which is consistent with natural processes.

It is noted that the proposed groundwater bore drilling programming is of short duration, with the aim to be completed prior to onset of the monsoon season. The construction crew will be responsible for monitoring of the weather, using up to date weather data from the Bureau of Meteorology. This will be critical to ensure activities can be completed and sites stabilised prior to the onset of the monsoon season.

2.1.1 Soil Loss Estimate

IECA 2008 includes a soil loss estimation methodology to determine the type of controls a project should adopt to limit soil loss during construction when soils are exposed to rainfall. Long term average soil loss resulting from sheet and rill flow can be predicted using the Revised Universal Soil Loss Equation (RUSLE).

Soil loss calculated using RUSLE for the project area was calculated as follows:

A = R . K . LS . C . P

Where A = annual soil loss due to erosion [tonnes/hectare/year (t/ha/yr)]

R = rainfall erosivity factor based on 2-year ARI, 6-hour rainfall event of 10.1mm/hr = **2249**)

K = soil erodibility factor of **0.04** for silty, clay loam)

LS = topographic factor derived from slope length and slope gradient (**0.44**)

C = cover and management factor (**1**)

P = erosion control practice factor (**1.3**)

The 2 year 6 hour ARI rainfall intensities were sourced for each set of coordinates in Table 2 and the maximum rainfall intensity of 10.1mm/hr was chosen. The 2-year rainfall intensities varied between 9.41mm/hr to 10.1mm/hr, causing the R-factor to vary between 1990 and 2249.

Based on the RUSLE soil loss methodology, the Project was estimated to have a soil loss of 51 t/ha/yr.

2.1.2 Erosion Risk and Determination of ESC Controls

Erosion risk ratings for the Project area has been determined based on the average monthly erosivity (R-factor of 2627), average monthly rainfall depth (mm) (refer Table 1 and Table 2) and soil loss (estimated at 51t/ha/yr). As indicated in Table 3, the Project has an erosion risk rating of "very low" to "high".

Table 3 Erosion Risk Rating (adapted from IECA, 2008, Tables 4.4.1, 4.4.2 and 4.4.3)

Erosion Risk Rating	R-Factor	Average Monthly Rainfall Depth (mm)	Soil Loss (t/ha/yr)
Very Low	0 to 60	0 to 30	0 to 150
Low	60+ to 100	30+ to 45	150+ to 225
Moderate	100+ to 285	45+ to 100	225+ to 500
High	285+ to 1500	100+ to 225	500+ to 1500
Extreme	>1500	>225	>1500

Table 4, provides an indication of the "Type" of erosion and sediment controls that should be deployed during construction depending on annual soil loss. The Project triggers the use of Type 3 erosion and sediment controls.

Table 4 Sediment Control Standard (adapted from IECA, 2008, Table 4.5.1)

Catchment Area (m^2)	Soil Loss Rate Limit (t/ha/yr)		
	Type 1	Type 2	Type 3
250	N/A	N/A	All Cases
1000	N/A	N/A	All Cases
2500	N/A	>75	75
>2500	>150	150	75

Table 5 provides a range of erosion and sediment controls that can be deployed on the Project for each 'Erosion and Sediment Control Type'.

Table 5 Classifications of Sediment Controls

Type 1	Type 2	Type 3
Sheet Flow		
Buffer Zone Capable of infiltrating 100% of stormwater runoff	Buffer Zone Capable of infiltrating 100% of stormwater runoff Topsoil Berm Filter sock Filter sock drop inlet	Buffer Zone Capable of infiltrating 100% of stormwater runoff Modular sediment trap Topsoil barrier Filter fence Sediment fence
Concentrated Flow		
Sediment basin sized in accordance with design standard	Filter tube dam Rock filter dam Sediment basin smaller than design standard Sediment trench Sediment weir	Coarse sediment trap Modular sediment trap U-shaped sediment trap
Dewatering Sediment Control		
Type F/D Basin	Filter bag or filter tube Filter tube dam Portable sediment tank Settling pond Sump pit	Filter Fence Grass Filter Bed Portable sediment tank Sediment Fence
In-stream sediment control		
Pump sediment laden water to an off-stream Type F/D Basin	Filter bag or filter tube Filter tube dam Portable sediment tank Settling pond Sump pit	Filter Fence Portable sediment tank Sediment filter cage

Standard drawings for erosion and sediment controls are available at:

http://www.austieca.com.au/publications/book-6-standard-drawings.

The proposed ESCP for the groundwater bore well sites are provided in Appendix A. Standard drawings that may be applicable for the Project, including controls for access tracks and stream crossings are provided in Appendix B and Appendix C. The final design of the ESC controls will be dependent on decisions made in the field by the Construction Supervisor.

3. Erosion and Sediment Controls

Error! Reference source not found. summarises the ESCP measures to be considered during the completion of works associated with the construction of access tracks and lease pads.

Activity	Management Controls
Land Clearing	- Selective clearing, using lighter machinery such as graders or smaller bulldozers, taking care not to overwork the site. Overworking the site can lead to the loss of topsoil, compaction, formation and wheel rutting. - Retention of vegetation buffers surrounding streams and creeks, as outlined in the *NTG Land Clearing Guidelines 2010*. - Undertake clearing for each stage in small units over time, keeping the disturbed area small and time of exposure short, in conjunction with progressive re-vegetation. - All reasonable and practicable measures must be taken to minimise the removal of, or disturbance to, trees, shrubs and ground covers (organic or inorganic) that are intended to be retained. - Bulk tree clearing must occur in a manner that minimises disturbance to existing ground cover (organic or inorganic). - Bulk tree clearing and grubbing of the site must be immediately followed by specified temporary stabilisation measures (e.g. gravel, soil berm) prior to commencement of each stage of construction works. - No land clearing shall be undertaken unless preceded by the installation of adequate drainage and sediment control measures, unless such clearing is required for the purpose of installing such measures, in which case, only the minimum clearing required to install such measures shall occur. - Prior to land clearing, areas of protected vegetation, and significant areas of retained vegetation must be clearly identified (e.g. with high-visibility tape, or light fencing) for the purposes of minimising the risk of unnecessary land clearing. - All land clearing must be in accordance with the Federal, Territory and local government vegetation clearing requirements.
Access Track Construction	- Where possible, the use of existing roads and tracks will be utilised to access the groundwater bore lease area, and where new tracks are required, they are to be locate along the most direct and practicable route to groundwater bore lease area. - Minimise track width and surface disturbance (e.g. topsoil, seed and root stock) as far as practicable to allow safe passage of required equipment. - Track formation can reduce or eliminate the need for patch gravelling. Where gravelling is still considered to be warranted, the formation process can remove undesirable material and/or box the imported material where it is required. Track formation will be required for the following reasons: • Drainage control, especially in areas where erosion or sediment influences are evident, any vegetation, topography, wheel rutting or compaction is likely to intercept, concentrate and channel water.

Activity	Management Controls
	• Where the topography of the track location or the drainage characteristics of the soil are likely to hinder access for a protracted time period following rain (e.g. 1 to 2 weeks). • Where natural side-slope pose a safety hazard to potential users of the track (e.g. Contractors, Land Owners) - Place scrub and vegetation cleared from the route adjacent to the route where practical to facilitate its return to the disturbed area. Where this occurs, spread the material out rather than form windrows. - Construct access tracks in a manner best designed to include erosion controls such as table trains and turn-out drains. This may require cross drains discharging into table drains. Cross drains may require rip-rap and/or silt traps. - Due to the flat terrain across the permit area road crowning should be avoided to allow water to naturally cross the road. - Form tracks to allow off-road drainage. Where track intercepts the direction of overland flow and re-directs this flow to a non-natural drainage line, install erosion control works to minimise potential erosion. - The design and position of erosion control measures to be determined in the field by experienced operator and site engineer, based on the site characteristics of the access track location. - Where deemed table drains and cut-out drains to be constructed, they should have a broad flat base at least 1m wide and should not be graded to produce a V. To minimise erosion the slope should be no greater than 0.5% on erodible soils or 1% on stable soils. Refer to Typical Offlet Drain and Table Drain Block for further detail (Appendix B). - Where cut-out drains are required, they should be spaced based on the slope of the area (i.e. 0.5% slope, allow for cut-out draining every 170-180 m or 1 % slope, allow for cut-out drainage every 120-130 m etc) (refer to NT Road Drainage Fact Sheet). It is noted that the recommended distance between turn-out drains is a guide and may not apply to all locations along the access track. - Monitor road conditions to ensure deterioration with possible adverse environmental impacts, does not occur. Assist in the maintenance and repair work on roads and tracks used. - Following completion of activities and within 2 years after the surrender of a lease, the land surrounding or affected by the installation of access tracks shall be restored in accordance with the site-specific rehabilitation plan and final determination of asset (i.e. if transferring asset ownership to landholder).
Pad construction	- Pad construction to be in accordance with the typical erosion and sediment control plan. The Topsoil Berm dimension to be in accordance with the IECA Standard Drawing MB-01 presented in Appendix A. - Surface flows entering the lease from undisturbed areas upslope ('clean' water), and stormwater runoff arising from disturbed areas ('dirty' water) are to be managed by diverting the upslope runoff around the site and unstable slopes to avoid or minimise soil erosion and prevent 'clean water' adding to the volume of 'dirty water' to be managed. It is proposed topsoil berms to be utilised to achieve this.

Activity	Management Controls
	- Prior to the commencement of construction, a site inspection is to be undertaken with Construction Supervisor to determine if topsoil stripping is required. The determination will be based on the assessment of the suitability of the existing grass cover, slope and proposed disturbance. If topsoil stripping is not required than an assessment by the Construction Supervisor can be made to remove the clean water and dirty water topsoil berms. It is not expected core logs would be required for the sites. - Where topsoil stripping is required, the stripping depth would be in accordance with Technical Instruction (NT-2050-15-TI-0001) and amelioration rates agreed with the Construction Supervisor. The expected nominal depth of topsoil is 50 to 150 mm. Final strip depth to be confirmed in the field. - For sites that are heavily treed, the felled trees would be stockpiled nearby for future use in rehabilitation. - Maintenance of erosion and sediment control devices will be required. The following would be undertaken: • Inspection of erosion and sediment control devices to be completed in accordance with Section 5 Maintenance schedule. • The Contractor shall inspect all environmental devices on a regular basis. Any rectification of damage to the environmental control devices or cleaning out of devices is to be carried out by Contractor/Origin as required. • Regular maintenance to be undertaken until sufficient ground cover is established to provide stabilisation to disturbed areas. - Following completion of activities and within 2 years after the surrender of a lease, the land surrounding or affected by the groundwater monitoring bores shall be restored in accordance with the site-specific rehabilitation plan and final determination of asset (i.e. if transferring asset ownership to landholder).
Stream and Creek Crossings	Where a crossing is required to be upgraded, a bed level crossing as detailed in Appendix B, will be installed in accordance with the following: - Crossings will be aligned perpendicular to the water flow. - Crossing is to be constructed from clean rocks (minimal fine material) that are an equivalent or larger size than the natural bed material at the crossing. - The surface is to be left rough and not to be over compacted (e.g. track-rolled finish or rougher). - The lowest point of the bed level crossing must be installed at the level of the lowest point of the natural stream bed (preconstruction), within the footprint of the proposed crossing. - There must be a height difference of at least 100 mm from the lowest point of the crossing to the edges of the low flow section of the crossing. Where scour protection is required: - Scour protection must abut the surface edge of the crossing at the same level (this is to ensure that there is no drop in elevation at the join). - If the crossing is set below bed level then the surface of the scour protection must also be below bed level. - The stream bed must abut the scour protection at the same level (this is to ensure that there is no drop in elevation at the join). - The scour protection is installed at a gradient no steeper than 1 in 20 or the natural channel gradient, whichever is steeper. - Scour protection must incorporate a low flow channel. Use clean rocks (minimal fine material), at least 100 mm diameter.

Activity	Management Controls
	- Ensure the rock armouring is not over compacted but left proud and uneven (track-rolled finish or rougher). - Use clean rocks (minimal fine material), at least 100 mm diameter. - The retention of vegetation buffers, as outlined in the NTG Land Clearing Guidelines – Northern Territory Planning Scheme 2010, as they relate to stream order has been considered for the siting of proposed access tracks and pads.
Soil and Stockpile Management	- All reasonable and practicable measures must be taken to obtain the maximum benefit from existing topsoil and can be reused back on the site for erosion and sediment control and future rehabilitation at completion of project. - Stockpiles of erodible material that has the potential to cause environmental harm if displaced, must be: (i) Appropriately protected from wind, rain, concentrated surface flow and excessive up-slope stormwater surface flows. (ii) Located at least 2m from any hazardous area, retained vegetation, or concentrated drainage line. (iii) Located up-slope of an appropriate sediment control system. (iv) Provided with an appropriate protective cover (synthetic vegetative) if the materials are likely to be stockpiled for more than 28 days. (v) Provided with an appropriate protective cover (synthetic or vegetative) if the materials are likely to be stockpiled for more than 10 days during those months that have a high erosion risk. - A suitable flow diversion system must be established immediately up-slope of a stockpile of erodible material that has the potential to cause environmental harm if displaced, if the up-slope catchment area draining to the stockpile exceeds 1500m^2 - Avoid creating windrows – do not create windrows across creeks, use rollers when putting in tracks in preference to dozers, or walk the dozer with the blade raised off the ground.
Site Management	- Ongoing maintenance and repair work as required on tracks utilised for the program. - No off lease or off-road driving. - The construction schedule must aim to minimise the duration that any and all areas of soil are exposed to the erosive effects of wind, rain and surface water flow. - Land-disturbing activities must be undertaken in such a manner that allows all reasonable and practicable measures to be undertaken to: (i) allow stormwater to pass through the site in a controlled manner and at non-erosive flow velocities. (ii) minimise soil erosion resulting from rain, water flow and/or wind. (iii) minimise adverse effects of sediment runoff, including safety issues. (iv) prevent, or at least minimise, environmental harm resulting from work-related soil erosion and sediment runoff. (v) ensure that the value and use of land/properties adjacent to the site (including access roads) are not diminished as a result of the adopted ESC measures.

Activity	Management Controls
	- Additional and/or alternative ESC measures must be implemented in the event that site inspections, the site's Monitoring and Maintenance Program, or the regulatory authority, identifies that unacceptable offsite sedimentation is occurring as a result of the work activities. - Tracks to be regularly inspected for early signs of compaction, erosion, soil degradation (generation of bulldust) and maintenance implemented. - Sediment (including clay, silt, sand, gravel, soil, mud and cement waste) deposited off the site as a direct result of an on-site activity, must be collected and the area appropriately cleaned/rehabilitated as soon as reasonable and practicable, and in a manner that gives appropriate consideration to the safety and environmental risks associated with the sediment deposition.
Drainage Control	- Wherever reasonable and practicable, stormwater runoff entering the site from external areas, and non-sediment laden (clean) stormwater runoff entering a work area or area of soil disturbance, must be diverted around or through that area in a manner that minimises soil erosion and the contamination of that water for all discharges. - During the construction period, all reasonable and practicable measures must be implemented to control flow velocities in such a manner than prevents soil erosion along drainage paths and at the entrance and exit of all drains and drainage pipes during all storms up to the relevant design storm discharge. - To the maximum degree reasonable and practicable, all waters discharged during the construction must discharge onto stable land, in a non-erosive manner.
Erosion Control	- Synthetic reinforced erosion control mats and blankets (if required) must not be placed within, or adjacent to, riparian zones and watercourses if such materials are likely to cause environmental harm to wildlife or wildlife habitats. - A minimum 60% ground cover must be achieved on all non-completed earthworks exposed to accelerated soil erosion if further construction activities or soil disturbances are likely to be suspended for more than 30 days during those months when the expected rainfall erosivity is less than 60; minimum 70% cover within 30 days if between 60 and 100; minimum 70% cover within 20 days if between 100 and 285; minimum 75% cover within 10 days if between 285 and 1500; and minimum 80% cover within 5 days if greater than 1500.
Sediment Control	- Optimum benefit must be made of every opportunity to trap sediment within the work site, and as close as practicable to its source. - Sediment traps must be installed and operated to both collect and retain sediment. - The potential safety risk of a proposed sediment trap to site workers and the public must be given appropriate consideration, especially those devices located within publicly accessible areas (i.e. in close proximity to Stuart and Carpentaria Highway). - All reasonable and practicable measures must be taken to prevent, or at least minimise, the release of sediment from the site. - Sediment control devices must be de-silted and made fully operational as soon as reasonable and practicable after a sediment-producing event, whether natural or artificial, if the device's sediment retention capacity falls below 75% of its design retention capacity. - Materials, whether liquid or solid, removed from sediment control devices during maintenance or decommissioning, must be disposed of in a manner that does not cause ongoing soil erosion or environmental harm.

Activity	Management Controls
Site Rehabilitation	- Following completion of works, disturbed areas to be restored and/or rehabilitated. - Gravel pits to have topsoil returned and re-profiled. - All compacted areas will be ripped and scarified to promote regeneration of vegetation. - All disturbed areas should be allowed to naturally regenerate or be revegetated on completion of use. - Compacted areas should be contour ripped to 0.5m depth where practicable. - At completion of activities, establish vegetation similar to adjacent vegetation, unless agreement with landowner for alternative use. - All disturbed areas identified as very low, low, medium or high erosion risk must be suitably stabilised prior to anticipated rainfall, from the day that soil disturbances on the area have been finalised. - Stabilise disturbed areas quickly to reduce the potential for erosion. Methods of stabilisation will be site specific. - Previously removed vegetation and topsoil will be uniformly re-spread over disturbed area to assist with rehabilitation process through agencies of increased infiltration and return of seed bearing topsoil. - Windrows of debris that cannot be removed should be aligned down the contour or in a manner appropriate to avoid channelling and concentrating runoff. All other windrows are to be removed as soon as practicable. - The type of ground cover applied to completed earthworks is compatible with the anticipated long-term land use, environmental risk, and site rehabilitation measures.

4. Monitoring

Monitoring for soil erosion and related issues is best undertaken at critical stages, such as:

- During siting of access track and water bore areas – this is when there is greatest opportunity to avoid erosion problems.
- After completion of a specific phase of activity all areas disturbed should be inspected for early signs of compaction, erosion and soil degradation (generation of bulldust).
- When accessing the site after the wet season look for signs of erosion. If significant impacts are identified remediation works may need to be conducted prior to continued vehicular access.

Where rehabilitation of a site is undertaken, rehabilitation monitoring will be undertaken annually to assess the rehabilitation success and determine where additional remedial works are required. Success criteria is defined as:

- Safe for humans and wildlife
- Non-polluting
- Stable, with appropriate vegetation cover and erosion and sediment controls in place and functioning
- Land condition suitable for existing pastoral land use.

Photographic records will be maintained over the duration of the activities for documenting soil disturbance.

All environmentally relevant incidents are to be recorded in a field log that must remain accessible to all relevant regulatory authorities.

5. Maintenance

All temporary erosion and sediment control measures, including drainage control measures, must be fully operational and maintained in proper working order at all times during the duration of the project.

When undertaking construction work, erosion and sediment control measures must be inspected:

- at least daily (when work is occurring on-site)
- within 24 hours of expected rainfall (when working onsite)
- within 18 hours (or as soon as practicable) of a rainfall event of sufficient intensity and duration to cause runoff on-site or greater than 20mm in 24 hours.

Sediment removed from sediment traps and places of sediment deposition must be disposed of in a lawful manner that does not cause ongoing soil erosion or environmental harm.

Prior to the completion of activities on the ground, the construction areas will be stabilised to the satisfaction of the Construction Supervisor. Regular inspections would occur throughout the year until the land is handed back.

6. References

Catchment and Creeks Pty Ltd. 2012. *Erosion & Sediment Control – A Field Guide for Construction Site Managers V5.* Catchment and Creeks. Brisbane. QLD.

Department of Natural Resources, Environment, The Arts and Sport (NRETAS) 2010. *Land Clearing Guidelines*. Northern Territory Government.

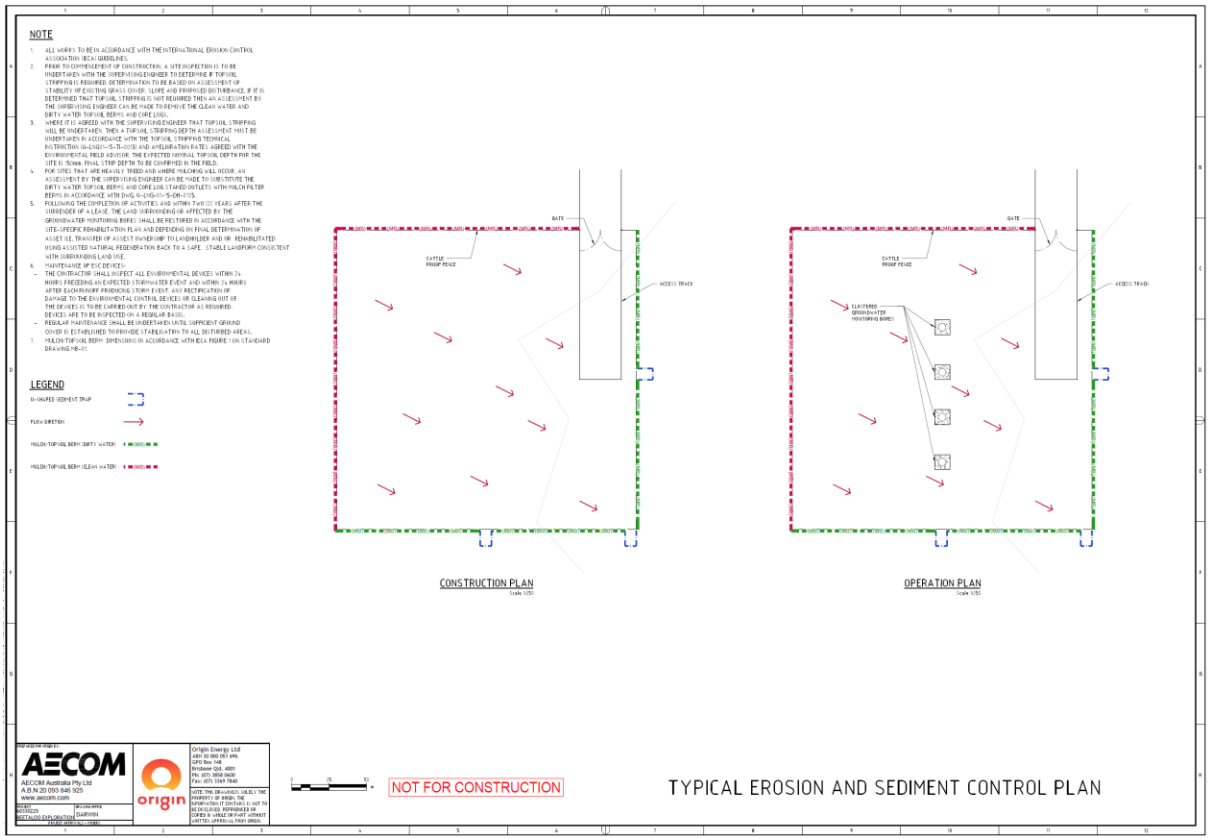
Department of Agriculture, Fisheries and Forestry. 2013. *Code for Self-Assessable Development Minor Waterway Barrier Works Part 4: Bed Level Crossings Code Number WWBW01 April 2013*. State of Queensland, Qld.

IECA. 2008. *Best Practice Erosion and Sediment Control – for building and construction sites*. Picton, NSW: International Erosion Control Association (Australasia).

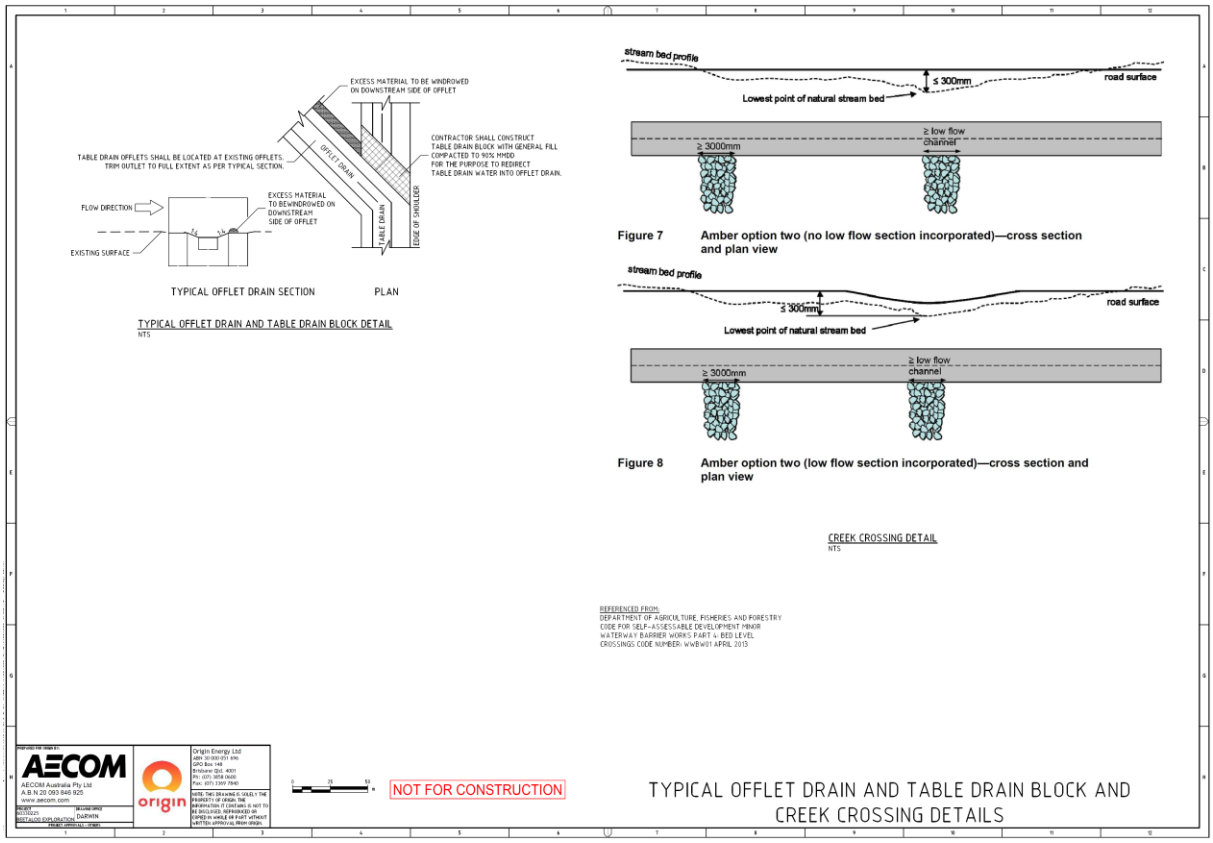
Origin Energy Resources Limited. 2018. *Draft Beetaloo Basin Groundwater Monitoring Bore Installation Program Environmental Management Plan*.

Scientific Inquiry into Hydraulic Fracturing in the Northern Territory. 2018. *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory – Final Report.*

Appendix A Erosion and Sediment Control Plan for Groundwater Bore Site

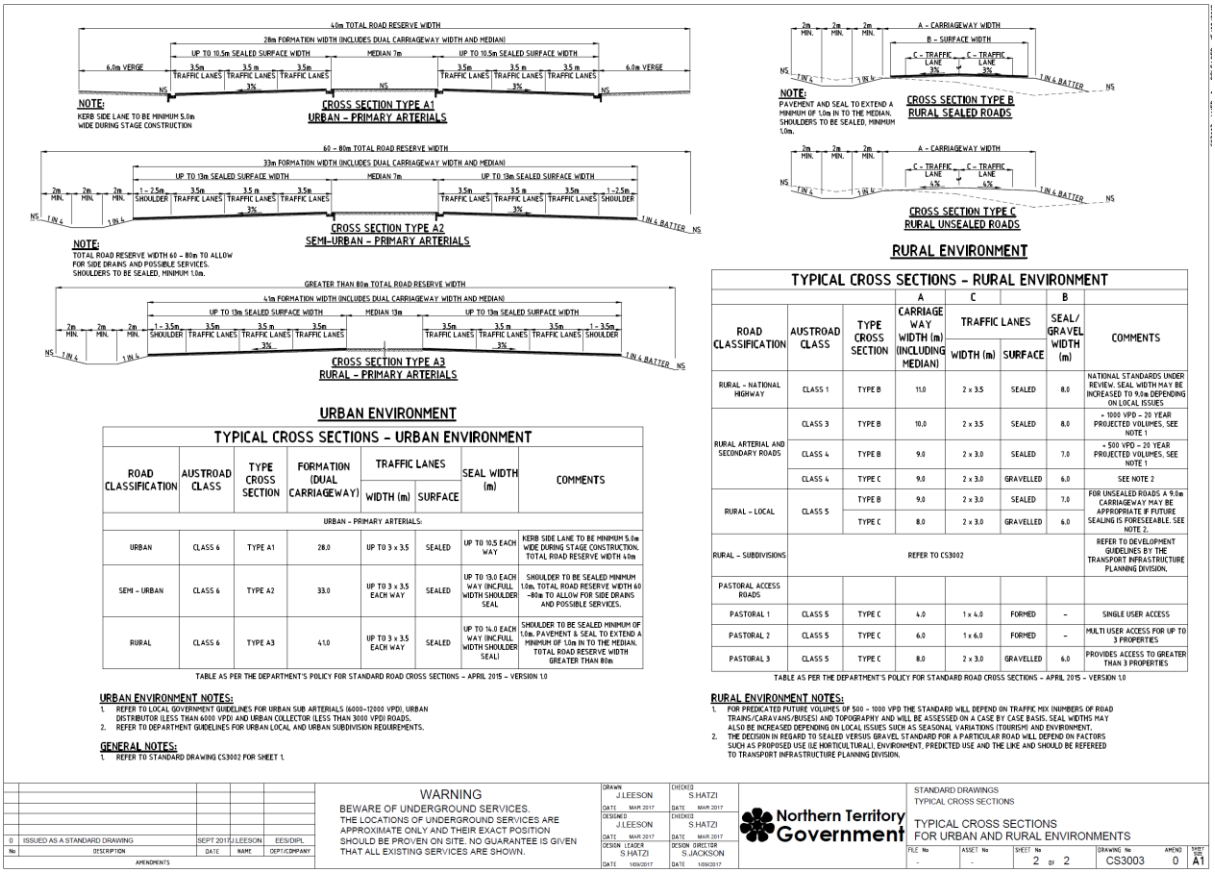


Appendix B Standard Cross Section for Access Tracks



Appendix C Other Standard Specifications that may be applicable to Project

Typical Cross Section for Road Classification – Pastoral 3



URBAN ENVIRONMENT

TYPICAL CROSS SECTIONS – URBAN ENVIRONMENT

ROAD CLASSIFICATION	AUSTROAD CLASS	TYPE CROSS SECTION	FORMATION (DUAL CARRIAGEWAY)	TRAFFIC LANES		SEAL WIDTH (m)	COMMENTS
				WIDTH (m)	SURFACE		
URBAN – PRIMARY ARTERIALS:							
URBAN	CLASS 6	TYPE A1	28.0	UP TO 3 x 3.5	SEALED	UP TO 10.5 EACH WAY	KERB SIDE LANE TO BE MINIMUM 5.0m WIDE DURING STAGE CONSTRUCTION. TOTAL ROAD RESERVE WIDTH 4.0m
SEMI – URBAN	CLASS 6	TYPE A2	33.0	UP TO 3 x 3.5 EACH WAY	SEALED	UP TO 13.0 EACH WAY (INCFULL WIDTH SHOULDER SEAL	SHOULDER TO BE SEALED MINIMUM 1.0m. TOTAL ROAD RESERVE WIDTH 60 –80m TO ALLOW FOR SIDE DRAINS AND POSSIBLE SERVICES.
RURAL	CLASS 6	TYPE A3	41.0	UP TO 3 x 3.5 EACH WAY	SEALED	UP TO 14.0 EACH WAY (INCFULL WIDTH SHOULDER SEAL)	SHOULDER TO BE SEALED MINIMUM OF 1.0m. PAVEMENT & SEAL TO EXTEND A MINIMUM OF 1.0m IN TO THE MEDIAN. TOTAL ROAD RESERVE WIDTH GREATER THAN 80m

TABLE AS PER THE DEPARTMENT'S POLICY FOR STANDARD ROAD CROSS SECTIONS – APRIL 2015 – VERSION 1.0

URBAN ENVIRONMENT NOTES:
1. REFER TO LOCAL GOVERNMENT GUIDELINES FOR URBAN SUB ARTERIALS (6000–12000 VPD), URBAN DISTRIBUTOR (LESS THAN 6000 VPD) AND URBAN COLLECTOR (LESS THAN 3000 VPD) ROADS.
2. REFER TO DEPARTMENT GUIDELINES FOR URBAN LOCAL AND URBAN SUBDIVISION REQUIREMENTS.

GENERAL NOTES:
1. REFER TO STANDARD DRAWING CS3002 FOR SHEET 1.

RURAL ENVIRONMENT

TYPICAL CROSS SECTIONS – RURAL ENVIRONMENT

ROAD CLASSIFICATION	AUSTROAD CLASS	TYPE CROSS SECTION	A CARRIAGE WAY WIDTH (m) (INCLUDING MEDIAN)	C TRAFFIC LANES		B SEAL/ GRAVEL WIDTH (m)	COMMENTS
				WIDTH (m)	SURFACE		
RURAL – NATIONAL HIGHWAY	CLASS 1	TYPE B	11.0	2 x 3.5	SEALED	8.0	NATIONAL STANDARDS UNDER REVIEW. SEAL WIDTH MAY BE INCREASED TO 9.0m DEPENDING ON LOCAL ISSUES
RURAL ARTERIAL AND SECONDARY ROADS	CLASS 3	TYPE B	10.0	2 x 3.5	SEALED	8.0	> 1000 VPD – 20 YEAR PROJECTED VOLUMES, SEE NOTE 1
	CLASS 4	TYPE B	9.0	2 x 3.0	SEALED	7.0	> 500 VPD – 20 YEAR PROJECTED VOLUMES, SEE NOTE 1
	CLASS 4	TYPE C	9.0	2 x 3.0	GRAVELLED	6.0	SEE NOTE 2
RURAL – LOCAL	CLASS 5	TYPE B	9.0	2 x 3.0	SEALED	7.0	FOR UNSEALED ROADS A 9.0m CARRIAGEWAY MAY BE APPROPRIATE IF FUTURE SEALING IS FORESEEABLE. SEE NOTE 2.
		TYPE C	8.0	2 x 3.0	GRAVELLED	6.0	
RURAL – SUBDIVISIONS	REFER TO CS3002						REFER TO DEVELOPMENT GUIDELINES BY THE TRANSPORT INFRASTRUCTURE PLANNING DIVISION.
PASTORAL ACCESS ROADS							
PASTORAL 1	CLASS 5	TYPE C	4.0	1 x 4.0	FORMED	–	SINGLE USER ACCESS
PASTORAL 2	CLASS 5	TYPE C	6.0	1 x 6.0	FORMED	–	MULTI USER ACCESS FOR UP TO 3 PROPERTIES
PASTORAL 3	CLASS 5	TYPE C	8.0	2 x 3.0	GRAVELLED	6.0	PROVIDES ACCESS TO GREATER THAN 3 PROPERTIES

TABLE AS PER THE DEPARTMENT'S POLICY FOR STANDARD ROAD CROSS SECTIONS – APRIL 2015 – VERSION 1.0

RURAL ENVIRONMENT NOTES:
1. FOR PREDICATED FUTURE VOLUMES OF 500 – 1000 VPD THE STANDARD WILL DEPEND ON TRAFFIC MIX (NUMBERS OF ROAD TRAINS/CARAVANS/BUSES) AND TOPOGRAPHY AND WILL BE ASSESSED ON A CASE BY CASE BASIS. SEAL WIDTHS MAY ALSO BE INCREASED DEPENDING ON LOCAL ISSUES SUCH AS SEASONAL VARIATIONS (TOURISM) AND ENVIRONMENT.
2. THE DECISION IN REGARD TO SEALED VERSUS GRAVEL STANDARD FOR A PARTICULAR ROAD WILL DEPEND ON FACTORS SUCH AS PROPOSED USE (IE HORTICULTURAL), ENVIRONMENT, PREDICTED USE AND THE LIKE AND SHOULD BE REFEREED TO TRANSPORT INFRASTRUCTURE PLANNING DIVISION.

No	DESCRIPTION	DATE	NAME	DEPT./COMPANY
0	ISSUED AS A STANDARD DRAWING	SEPT 2017	J.LEESON	EES/DIPL

AMENDMENTS

WARNING
BEWARE OF UNDERGROUND SERVICES.
THE LOCATIONS OF UNDERGROUND SERVICES ARE APPROXIMATE ONLY AND THEIR EXACT POSITION SHOULD BE PROVEN ON SITE. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN.

DRAWN	CHECKED
J.LEESON	S.HATZI
DATE MAR 2017	DATE MAR 2017
DESIGNED	CHECKED
J.LEESON	S.HATZI
DATE MAR 2017	DATE MAR 2017
DESIGN LEADER	DESIGN DIRECTOR
S.HATZI	S.JACKSON
DATE 10/9/2017	DATE 10/9/2017

Northern Territory Government

STANDARD DRAWINGS
TYPICAL CROSS SECTIONS
TYPICAL CROSS SECTIONS FOR URBAN AND RURAL ENVIRONMENTS

FILE No	ASSET No	SHEET No	DRAWING No	AMEND	SHEET SIZE
-	-	2 OF 2	CS3003	0	A1

Review due: 05/11/2019

MATERIALS

(i) MULCH MUST COMPLY WITH THE REQUIREMENTS OF AS4454.

(ii) MAXIMUM SOLUBLE SALT CONCENTRATION OF 5dS/m.

(iii) MOISTURE CONTENT OF 30 TO 50% PRIOR TO APPLICATION.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND EXTENT. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, MATERIAL TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. WHEN SELECTING THE LOCATION OF A MULCH FILTER BERM, TO THE MAXIMUM DEGREE PRACTICAL, ENSURE THE BERM IS LOCATED:

(i) TOTALLY WITHIN THE PROPERTY BOUNDARIES;

(ii) ALONG A LINE OF CONSTANT ELEVATION (PREFERRED, BUT NOT ALWAYS PRACTICAL);

(iii) AT LEAST 1m, IDEALLY 3m, FROM THE TOE OF A FILL EMBANKMENT.

(iv) AWAY FROM AREAS OF CONCENTRATED FLOW.

3. ENSURE THE BERM IS INSTALLED IN A MANNER THAT AVOIDS THE CONCENTRATION OF FLOW ALONG THE BERM, OR THE UNDESIRABLE DISCHARGE OF WATER AROUND THE END OF THE BERM.

4. ENSURE THE BERM HAS BEEN PLACED SUCH THAT PONDING UP-SLOPE OF THE BERM IS MAXIMISED.

5. ENSURE BOTH ENDS OF THE BERM ARE ADEQUATELY TURNED UP THE SLOPE TO PREVENT FLOW BYPASSING PRIOR TO WATER PASSING OVER THE BERM.

6. ENSURE 100% CONTACT WITH THE SOIL SURFACE.

7. WHERE SPECIFIED, TAKE APPROPRIATE STEPS TO VEGETATE THE BERM.

MAINTENANCE

1. DURING THE CONSTRUCTION PERIOD, INSPECT ALL BERMS AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR OR REPLACE ANY DAMAGED SECTIONS.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.

4. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 100mm OR 1/3 THE HEIGHT OF THE BERM.

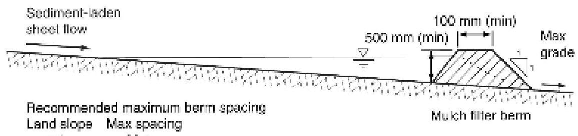
5. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL (IF REQUIRED)

1. WHEN DISTURBED AREAS UP-SLOPE OF THE BERM ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE BERM MAYBE REMOVED.

2. REMOVE ANY COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.



Recommended maximum berm spacing

Land slope	Max spacing
< 2%	30 m
5%	25 m
10%	15 m
20%	8 m

Figure 1 - Typical placement of mulch filter berm

Drawn:	Date:		
GMW	Apr-10	Mulch Filter Berms	MB-01

Review due: 05/11/2019

MATERIALS

ROCK: HARD, ANGULAR, DURABLE, WEATHER RESISTANT AND EVENLY GRADED WITH 50% BY WEIGHT LARGER THAN THE SPECIFIED NOMINAL ROCK SIZE AND SUFFICIENT SMALL ROCK TO FILL THE VOIDS BETWEEN THE LARGER ROCK. THE DIAMETER OF THE LARGEST ROCK SIZE SHOULD BE NO LARGER THAN 1.5 TIMES THE NOMINAL ROCK SIZE. SPECIFIC GRAVITY TO BE AT LEAST 2.5.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH, MINIMUM BIDIM A24 OR EQUIVALENT.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT AND INSTALLATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE PROPOSED CHANNEL AREA OF TREES, STUMPS, ROOTS, LOOSE ROCK, AND OTHER OBJECTIONABLE MATERIALS.

3. EXCAVATE THE CHANNEL TO THE LINES AND GRADES AS SHOWN ON THE PLANS. OVER-CUT THE CHANNEL TO A DEPTH EQUAL TO THE SPECIFIED DEPTH OF ROCK PLACEMENT SUCH THAT THE FINISHED ROCK SURFACE WILL BE AT THE ELEVATION OF THE SURROUNDING LAND.

4. ROCK MUST BE PLACED WITHIN THE CHANNEL AS SPECIFIED WITHIN THE APPROVED PLANS, INCLUDING THE PLACEMENT OF ANY SPECIFIED FILTER LAYER.

5. IF DETAILS ARE NOT PROVIDED ON THE ROCK PLACEMENT, THEN THE PRIMARY ARMOUR ROCK MUST BE EITHER PLACED ON:

(i) A FILTER BED FORMED FROM A LAYER OF SPECIFIED SMALLER ROCK (ROCK FILTER LAYER).

(ii) AN EARTH BED LINED WITH FILTER CLOTH;

(iii) AN EARTH BED NOT LINED IN FILTER CLOTH, BUT ONLY IF ALL VOIDS BETWEEN THE ARMOUR ROCK ARE TO BE FILLED WITH SOIL AND POCKET PLANTED IMMEDIATELY AFTER PLACEMENT OF THE ROCK.

6. IF A ROCK/AGGREGATE FILTER LAYER IS SPECIFIED, THEN PLACE THE FILTER LAYER IMMEDIATELY AFTER THE FOUNDATIONS ARE PREPARED. SPREAD THE FILTER ROCK IN A UNIFORM LAYER TO THE SPECIFIED DEPTH BUT A MINIMUM OF 150mm. WHERE MORE THAN ONE LAYER OF FILTER MATERIAL HAS BEEN SPECIFIED, SPREAD EACH LAYER SUCH THAT MINIMAL MIXING OCCURS BETWEEN EACH LAYER OF ROCK.

7. IF A GEOTEXTILE (FILTER CLOTH) UNDERLAY IS SPECIFIED, PLACE THE FABRIC DIRECTLY ON THE PREPARED FOUNDATION. IF MORE THAN ONE SHEET OF FABRIC IS REQUIRED TO OVER THE AREA, OVERLAP THE EDGE OF EACH SHEET AT LEAST 300mm AND PLACE ANCHOR PINS AT MINIMUM 1m SPACING ALONG THE OVERLAP.

8. ENSURE THE GEOTEXTILE FABRIC IS PROTECTED FROM PUNCHING OR TEARING DURING INSTALLATION OF THE FABRIC AND THE ROCK. REPAIR ANY DAMAGE BY REMOVING THE ROCK AND PLACING WITH ANOTHER PIECE OF FILTER CLOTH OVER THE DAMAGED AREA OVERLAPPING THE EXISTING FABRIC A MINIMUM OF 300mm.

9. WHERE NECESSARY, A MINIMUM 100mm LAYER OF FINE GRAVEL, AGGREGATE OR SAND SHOULD BE PLACED OVER THE FABRIC TO PROTECT IT FROM DAMAGE.

10. PLACEMENT OF ROCK SHOULD FOLLOW IMMEDIATELY AFTER PLACEMENT OF THE FILTER LAYER. PLACE ROCK SO THAT IT FORMS A DENSE, WELL GRADED MASS OF ROCK WITH A MINIMUM OF VOIDS.

11. PLACE ROCK TO ITS FULL THICKNESS IN ONE OPERATION. DO NOT PLACE ROCK BY DUMPING THROUGH CHUTES OR OTHER METHODS THAT CAUSE SEGREGATION OF ROCK SIZES.

12. THE FINISHED SURFACE SHOULD BE FREE OF POCKETS OF SMALL ROCK OR CLUSTERS OF LARGE ROCKS. HAND PLACING MAY BE NECESSARY TO ACHIEVE THE PROPER DISTRIBUTION OF ROCK SIZES TO PRODUCE A RELATIVELY SMOOTH, UNIFORM SURFACE. THE FINISHED GRADE OF THE ROCK SHOULD BLEND WITH THE SURROUNDING AREA. NO OVERFALL OR PROTRUSION OF ROCK SHOULD BE APPARENT.

13. IMMEDIATELY UPON COMPLETION OF THE CHANNEL, VEGETATE ALL DISTURBED AREAS OR OTHERWISE PROTECT THEM AGAINST SOIL EROSION.

14. WHERE SPECIFIED, FILL ALL VOIDS WITH SOIL AND VEGETATE THE ROCK SURFACE IN ACCORDANCE WITH THE APPROVED PLAN.

MAINTENANCE

1. ROCK-LINED CHANNELS SHOULD BE INSPECTED PERIODICALLY AND AFTER SIGNIFICANT STORM EVENTS. CHECK FOR SCOUR OR DISLODGED ROCK. REPAIR DAMAGED AREAS IMMEDIATELY.

2. CLOSELY INSPECT THE OUTER EDGES OF THE ROCK PROTECTION. ENSURE WATER ENTRY INTO THE CHANNEL OR CHUTE IS NOT CAUSING EROSION ALONG THE EDGE OF THE ROCK PROTECTION.

3. CAREFULLY CHECK THE STABILITY OF THE ROCK LOOKING FOR INDICATIONS OF PIPING, SCOUR HOLES, OR BANK FAILURES.

4. REPLACE ANY DISPLACED ROCK WITH ROCK OF A SIGNIFICANTLY (MINIMUM 110%) LARGER SIZE THAN THE DISPLACED ROCK.

Drawn	Date		
GMW	May-10	Rock Linings	RR-02

APPLICATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND APPLICATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF APPLICATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. FILL OR SUITABLY CONTOUR ANY EXISTING RUTTING, RILLING OR GULLIES.

3. SUITABLY DIVERT UP-SLOPE STORMWATER RUNOFF AROUND TREATED AREA AS DIRECTED WITHIN THE APPROVED PLANS, OR OTHERWISE AS DIRECTED BY THE SITE ENGINEER.

4. APPLY TREATMENT TO THE AREA TO THE DEPTH AND FREQUENCY (SPACING) SPECIFIED ON THE APPROVED PLANS, OR OTHERWISE AS DIRECTED BY THE SITE ENGINEER.

5. IMMEDIATELY SEED AND MULCH ROUGHENED AREAS TO OPTIMISE SEED GERMINATION AND GROWING CONDITIONS.

MAINTENANCE

1. DURING THE CONSTRUCTION PERIOD, INSPECT THE TREATED AREA PRIOR TO FORECAST RAINFALL, DAILY DURING EXTENDED PERIODS OF RAINFALL, AFTER SIGNIFICANT RUNOFF PRODUCING RAINFALL, OR OTHERWISE ON A WEEKLY BASIS.

2. FILL EROSION RILLS SLIGHTLY ABOVE THE ORIGINAL GRADE, OR REGRADE THE SLOPE AS DIRECTED TO REMOVE THE RILLS.

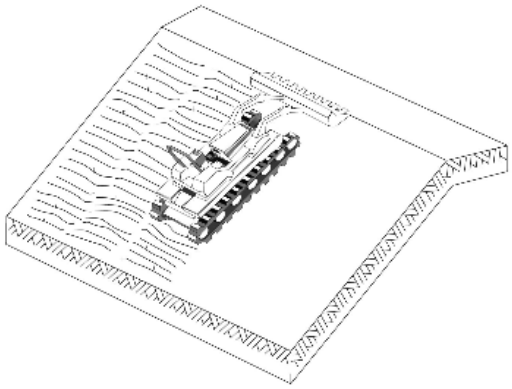


Figure 1 - Application of surface roughening on slope

Drawn	Date		
GMW	Dec-09	Surface Roughening	SR-01