Jemena Northern Gas Pipeline Pty Ltd

Northern Gas Pipeline

Draft Environmental Impact Statement

CHAPTER 6 – BIODIVERSITY

Public

August 2016

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6. BIODIVERSITY

This chapter describes the biodiversity and threatened species that characterise the existing environment within and surrounding the NGP Project footprint, and then assesses the potential impacts to biodiversity and threatened species from Project activities. Risks associated with these potential impacts are analysed and evaluated using the environmental risk assessment process described in Chapter 5 of this EIS. The controls are described that will minimise these potential impacts and reduce the residual risk to biodiversity and threatened species to As Low As Reasonably Practicable (ALARP).

The purpose of this chapter is to demonstrate that Jemena has fully considered all risks to biodiversity and threatened species, and has effective management strategies in place to ensure that the control of these risks is properly addressed through each Project phase. The content of this chapter has been developed specifically to address Section 5.4 of the *Terms of Reference (ToR) for the preparation of an EIS for the Jemena NGP*; though other risks to biodiversity and threatened species identified through the NGP environmental risk assessment process are also discussed.

The information presented in this chapter is informed by the technical content from the Threatened Species Survey Report (Appendix G) and the controls outlined in both the Biodiversity Management Plan (Appendix H) and the Environmental Management Plan (EMP) (Chapter 13). Where relevant, other management plans are also referenced for specific controls to reduce impacts to biodiversity and threatened species. All surveys and management plans have been developed by professionals with experience and qualifications relevant to the environmental aspect being assessed. Details of personnel involved, their experience and qualifications, are provided in Appendix D.

Relevant Matters of National Environmental Significance (MNES) – specifically nationally-listed threatened species – protected under the Commonwealth Environment Protection and Biodiversity Conservation Act (1999) *(Cth)* (EPBC Act) are discussed separately in Chapter 12. Some of these threatened species are listed under both Northern Territory and Commonwealth legislation; consequently, there is some duplication of information between this chapter and Chapter 12.

The abbreviations, acronyms and terminology used throughout this chapter are defined in the Contents, Acronyms and Glossary component of this EIS.

6.1 EXISTING BIODIVERSITY – GENERAL BIODIVERSITY

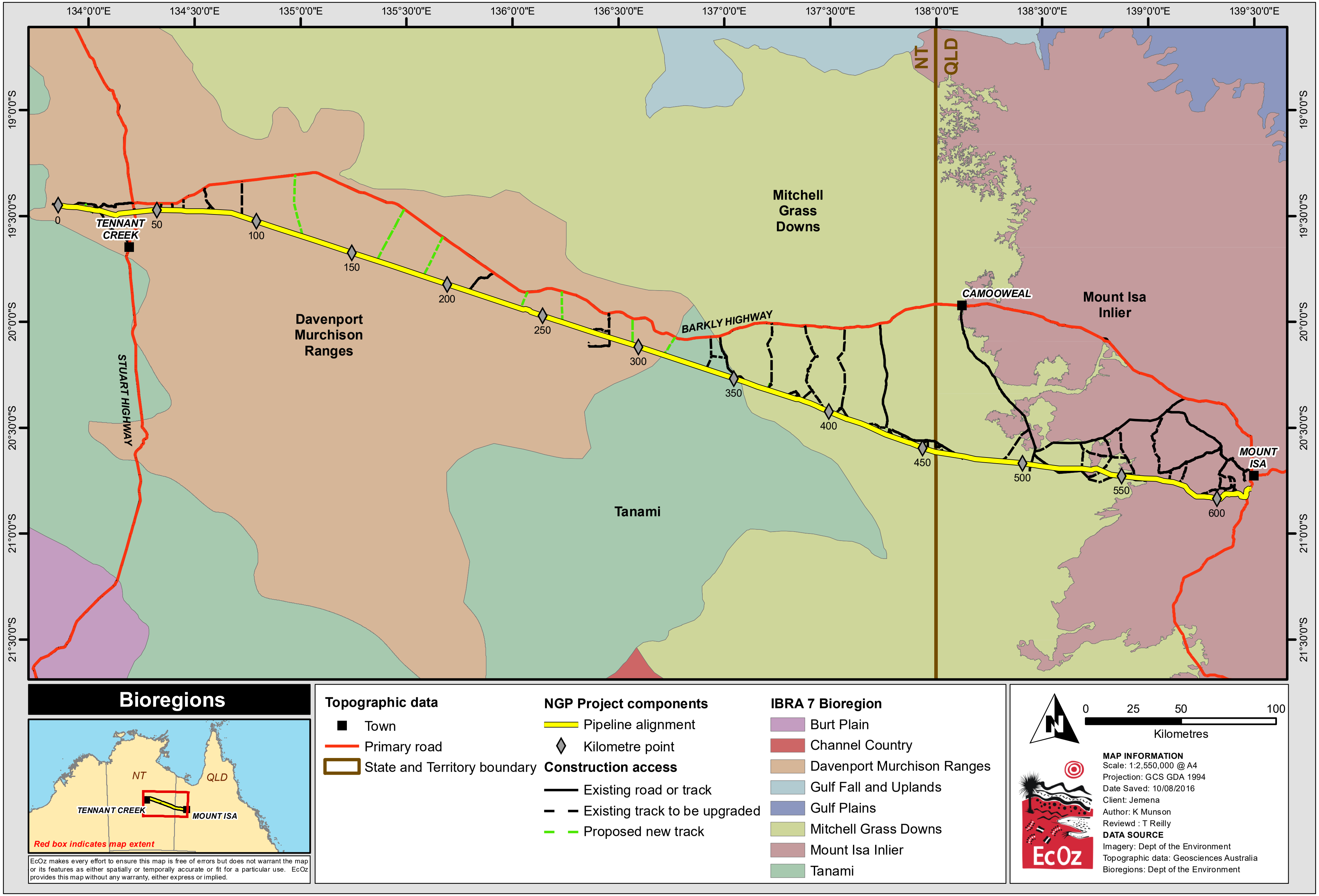
This section establishes the environmental context for assessment of potential impacts and risks to biodiversity. It describes the existing biodiversity-related characteristics of the environment in the Project footprint and surrounds.

6.1.1 BIOREGIONS

A bioregion is an area of land with common climate, geology, landform, native vegetation and species (DOE 2009). The Project footprint passes through four bioregions (accorded to most recent bioregion dataset – IBRA version 7). These are shown and Figure 6-1 described in Table 6-1.

Table 6-1. Bioregions intersected by the Project footprint

Section of NGP	Bioregion	Sub-bioregions	Characteristics
KP 0 – 313	Davenport and Murchison Ranges	• Ashburton Range • Barkly	Low, rugged rocky hills with hummock grasslands and low open woodland dominated by Acacia species.
KP 313 – 353	Tanami	• Sandover	Sand plains bisected by hills and rocky ranges with hummock grasslands and Acacia shrub lands on the rocky ranges.
KP 353 – 561	Mitchell Grass Downs	• Barkly Tableland	Grassland plains on cracking clay soils, with some intermittent lakes. Vegetation includes a variety of grasslands dominated by Mitchell Grasses (Astrebla species).
KP 561 – 622	Mount Isa Inlier	• South-western Plateaus and Flood-outs	Rugged hills and ranges bisected by undulating valleys. Vegetation is primarily open woodland with a spinifex hummock grassland understory.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-1. Map showing the bioregions intersected by the Project footprint.mxd

Figure 6-1. Map showing the bioregions intersected by the Project footprint

6.1.2 LANDFORMS

Seven major landforms and 15 land systems are traversed by the Project footprint as depicted in Figure 6-2 and described in Table 6-2.

Table 6-2. Description of major landforms and land systems within Project footprint

Major landform & component land systems	General description (based on Land Survey of the Barkly Region, Christian et al. 1954)
ALLUVIAL FLOODPLAINS	River plains, swamps and alluvial fans formed on Quaternary alluvium
Georgina	Gently undulating 'black-soil' plains cut by braided streamlines; heavy grey pedocals; *Astrebla pectinata* grassland (Mitchell Grass).
Gosse	Flats; soils of the 'Desert' distributary complex; *Eucalyptus dichromophloia* Woodland, *E. pruinosa* or *E. argillacea – E. terminalis* shrub woodland.
Bundella	Undulating; 'Bundella' soils; *Eucalyptus argillacea – E. terminalis* shrub woodland.
CLAY PLAINS	Broad level plains (black soil) plains; cracking clay soils
Austral	Very gently undulating; heavy grey pedocals and heavy brown pedocals; *Astrebla pectinata* grassland (Mitchell Grass) and *Acacia georginae – Astrebla pectinata* woodland.
Barkly	Very gently undulating; heavy grey pedocals; *Astrebla pectinata* grassland.
Kallala	Very gently undulating 'black-soil' plains; heavy brown pedocals; *Astrebla pectinata* grassland (Mitchell Grass) and *Acacia georginae – Astrebla pectinata* woodland.
Wonardo	'Black-soil' plains; heavy grey pedocals or heavy brown pedocals; *Astrebla pectinata* grassland (Mitchell Grass).
LATERITIC PLAINS & RISES	Plains and rises on weathered sedimentary rocks; red clayey sands, red earths and texture contrast soils
Prentice	Gently undulating, with low limestone rises; calcified lateritic soils; *Eucalyptus argillacea – E. terminalis* shrub woodland.
Wonorah	Gently undulating; lateritic red earths; *Eucalyptus brevifolia* woodland or *Eucalyptus* spp. (low Mallee) – *Acacia* spp. shrubland.
LIMESTONE PLAINS & RISES	Plains, rises and plateaux on dolomite, limestone, chalcedony, shale and sandstone; red clay sand, calcareous earth and outcrop with shallow stony soil
Camil	Gently undulating; tertiary non-lateritic soils; *Triodia pungens* shrub grassland.
Camilrock	Gently undulating; tertiary non-lateritic soils and many limestone outcrops; *Triodia pungens* shrub grassland.
SANDSTONE PLAINS & RISES	Plateaux, plains and rises on sandstone, claystone, shale and limestone; outcrop with shallow stony soils
Tennant Creek	Flat-topped hills and broad valleys; skeletal and alluvial soils; *Eucalyptus brevifolia* woodland.
Yelvertoft	Undulating; mostly skeletal soils or truncated gravelly lateritic red earths; *Eucalyptus brevifolia* or *Eucalyptus dichromophloia* woodlands.
SANDSTONE HILLS	Stony plateaux, tablelands and hills on sandstone, quartzite, siltstone and conglomerate (deeply weathered in places); outcrop with shallow stony soils
Mount Isa	Rugged, hilly country with north-south ridges; mostly rock outcrops or skeletal soils;

Major landform & component land systems	General description (based on Land Survey of the Barkly Region, Christian et al. 1954)
	Eucalyptus brevifolia woodland.
GRANITE HILLS	Hills with plains on granite and gneiss with some schist; outcrop with shallow gritty or stony soils
Waverley	Undulating to low hilly granite country; mostly skeletal soils; *Eucalyptus brevifolia* woodland.

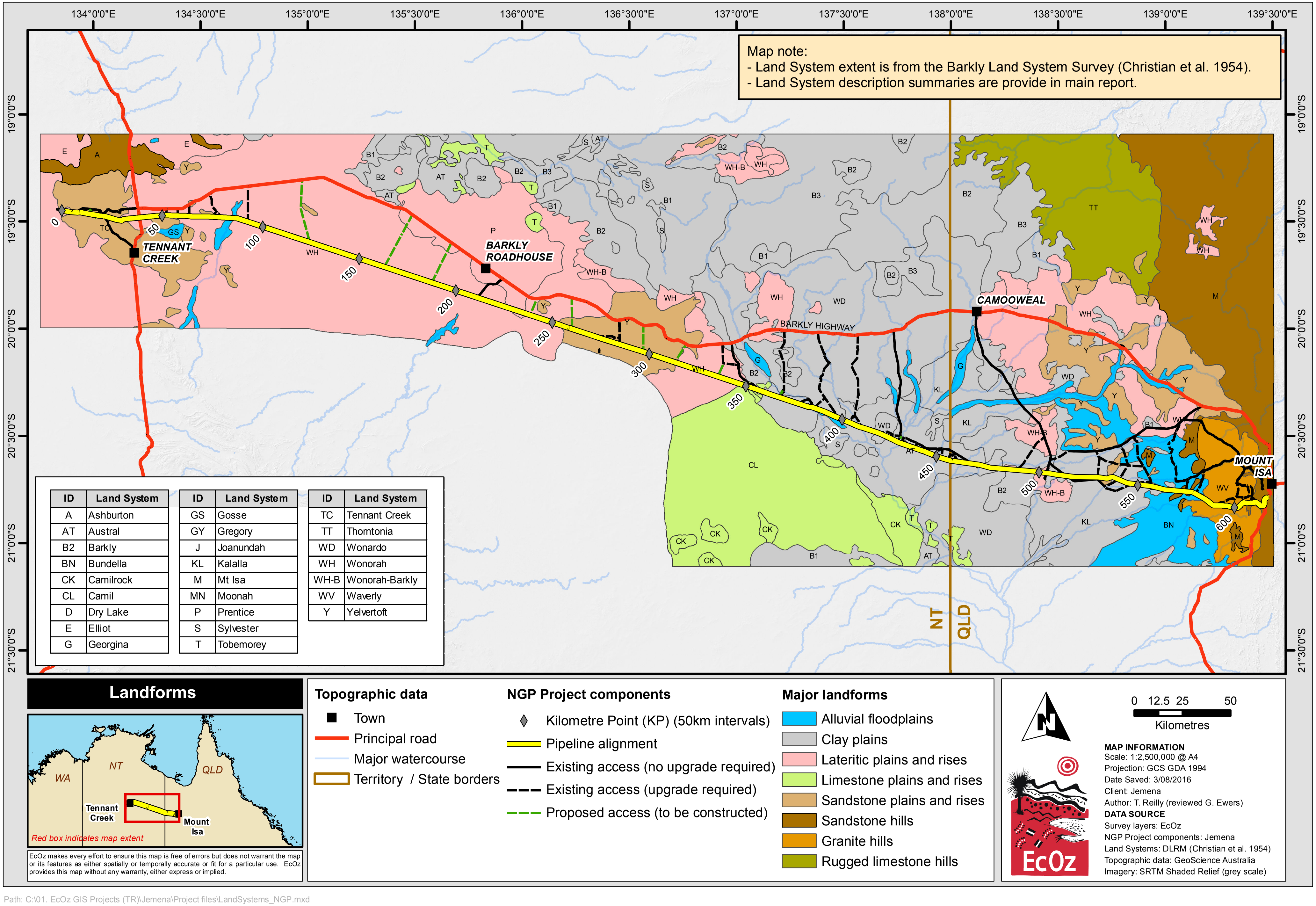


Figure 6-2. Map of major landforms within the region of the Project footprint

6.1.3 VEGETATION COMMUNITIES

Vegetation within the Project footprint has been characterised through analysis of the *Native Vegetation Information System (4.2) Major Vegetation Subgroups (MVS)*. This is the most detailed (and standardised) vegetation dataset available for the study area.

The Project footprint traverses 15 MVS – seven in Northern Territory and 13 in Queensland (Table 6-3). MVS have been mapped for Northern Territory and Queensland, these are provided in Figure 6-3 and Figure 6-4, respectively. The dominant vegetation groups within the Project footprint are *Eucalyptus* low open woodlands with hummock grass (MVS 18), Mitchell Grass tussock grassland (MVS 34), and *Acacia* (+/- low) open woodlands and sparse shrublands +/- tussock grass (MVS 24). These three groups cumulatively cover nearly 90 per cent of the Project footprint.

Table 6-3. MVS descriptions and lengths intersected by the Project footprint

MVS No.	Major Vegetation Subgroup (MVS) descriptions	Project footprint (ha)
Northern Territory		**1753.0**
18	*Eucalyptus* low open woodlands with hummock grass	1191.6
34	Mitchell grass (*Astrebla sp.*) tussock grassland	267.3
24	Acacia (+/- low) open woodlands and sparse shrublands +/- tussock grass	156.3
52	Mulga (*Acacia aneura*) open woodlands and sparse shrublands with hummock grass	67.5
20	Mulga (*Acacia aneura*) woodlands and shrublands +/- tussock grass +/- forbs	26.4
33	Hummock grasslands	25.0
19	*Eucalyptus* low open woodlands with tussock grass	17.5
Queensland		**717.0**
34	Mitchell grass (*Astrebla sp.*) tussock grassland	330.3
18	*Eucalyptus* low open woodlands with hummock grass	216.7
76	Regrowth or modified shrublands	50.5
24	Acacia (+/- low) open woodlands and sparse shrublands +/- tussock grass	20.3
37	Other tussock grasslands	12.1
33	Hummock grasslands	8.6
48	*Eucalyptus* open woodlands with a grassy understorey	14.5
19	*Eucalyptus* low open woodlands with tussock grass	15.5
8	*Eucalyptus* woodlands with a shrubby understorey	10.1
45	Mulga (*Acacia aneura*) open woodlands and sparse shrublands +/- tussock grass	28.3
31	Saltbush and/or Bluebush shrublands	2.7
9	*Eucalyptus* woodlands with a tussock grass understorey	4.6
14	Other *Acacia* forests / woodlands	1.7

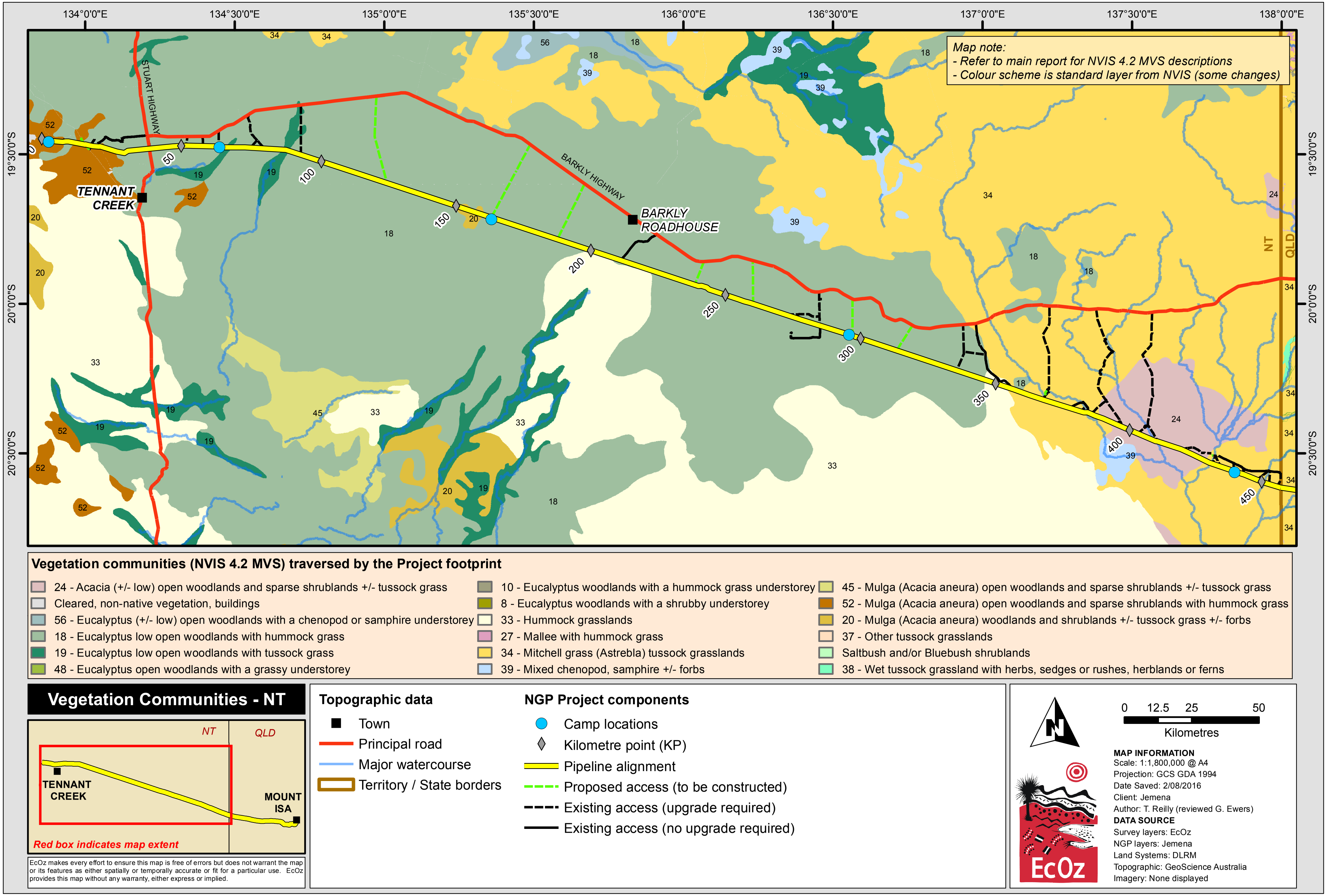


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Figure 6-3. Map showing vegetation communities in the region of the Project footprint (Northern Territory)

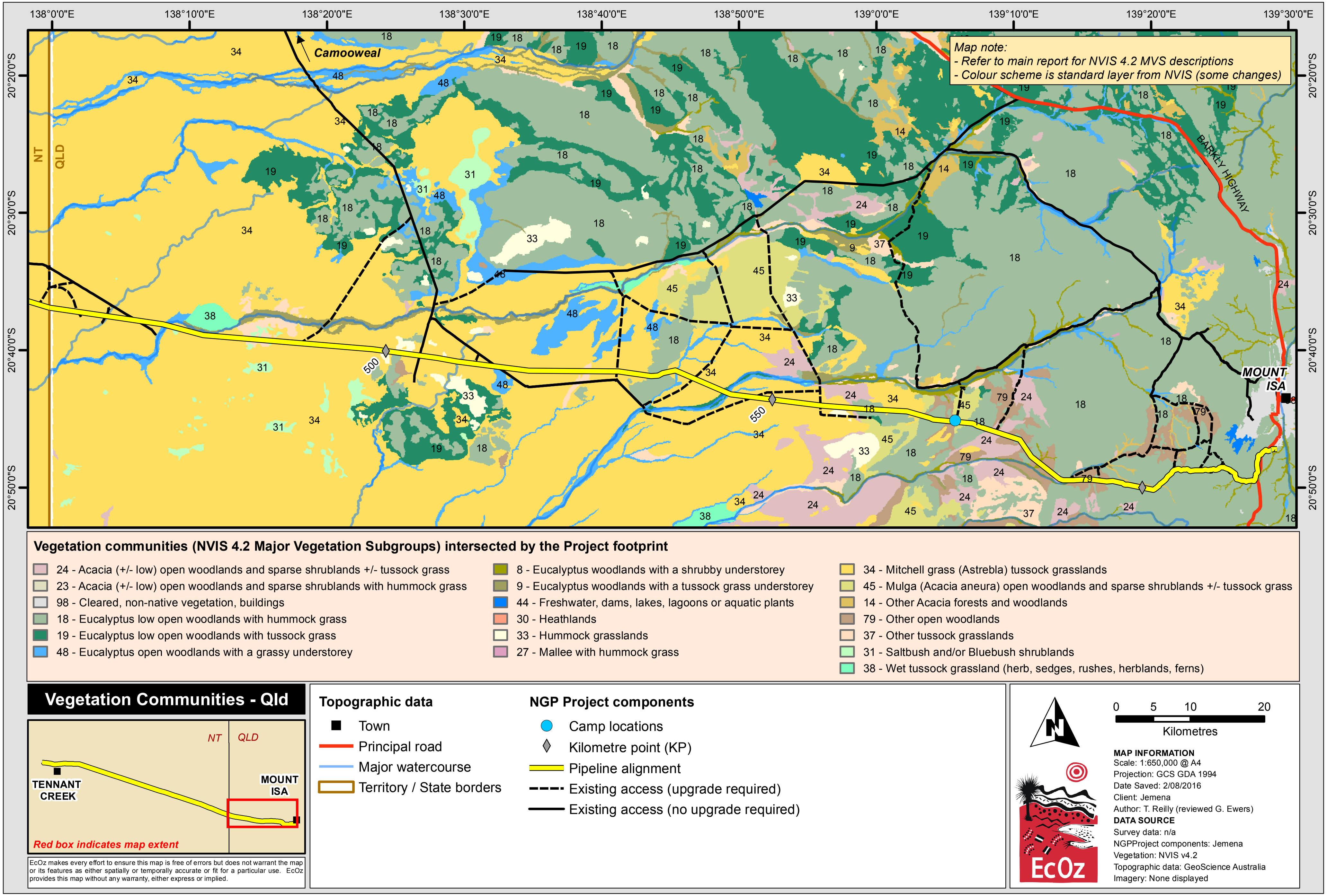

Figure 6-4. Map showing vegetation communities in the region of the Project footprint (Queensland)

6.1.4 SENSITIVE VEGETATION TYPES

There are no Threatened Ecological Communities (listed under Section 18 A of the EPBC Act) within the Project area.

In the Northern Territory, sensitive vegetation types are those considered significant under the *Northern Territory Vegetation Clearing Guidel*ines (DNTRES 2009). These vegetation types are either unique to the region and/or have inherently high biodiversity values.

The region of the Northern Territory in which the Project footprint occurs contains two of these sensitive vegetation types – riparian vegetation and wetlands.

6.1.4.1 Riparian vegetation

Riparian vegetation is 'a distinct forest community occurring on the banks of rivers or streams that directly influences the adjacent water body' (DLRM 2013). When in good condition, riparian vegetation is considered as a sensitive vegetation type as it supports a unique selection of habitat features that are relied upon by a range of flora and fauna species. Riparian vegetation provides refugia habitat, important habitat corridors, improve water quality by filtering terrestrial runoff, stabilise banks and reducing erosion, and support terrestrial and aquatic habitats by maintaining natural light, temperature and oxygen levels within waterways (DLRM 2013). The main threats to riparian vegetation are weed invasion, feral animals, fire, over-grazing, erosion, sedimentation and land clearing (DLRM 2013).

In the Northern Territory section of the Project footprint, riparian vegetation occurs along the larger creeks and rivers, of which all are located within the Mitchell Grass Downs bioregion (i.e. black soil plains). The reconnaissance survey (discussed in Section 3) and subsequent watercourse crossing surveys identified riparian vegetation along the Ranken River, James River, Georgina River and Blue Bush Creek. The Watercourse Crossing Survey Report (Appendix K) presents a preliminary assessment of the extent and type of riparian vegetation at each major river crossing along the construction ROW.

Broad scale vegetation mapping indicates that there is some riparian vegetation along the Ranken, James, Blue Bush and Georgina Rivers (of which approximately 3.7 ha is intersected by the NGP construction ROW). This is mostly comprised of a few reeds on the bank, some with *Eucalyptus coolabah* – see Figure 6-5. The riparian vegetation in the region is heavily impacted by cattle and weeds. There was no evidence of aquatic vegetation, such as lily-pads.

Ranken River, Northern Territory (May 2016)

Georgina River, Northern Territory (March 2016)

Figure 6-5. Photographs of riparian vegetation on the Ranken and Georgina rivers taken following late season rain[1]

[1] The flow conditions shown in these images are not considered to be representative of the conditions that will occur at the time of construction. A detailed risk assessment in relation to watercourse crossings is presented in Chapter 7. The risk assessment assumes that watercourse crossings will be constructed during low or no flow conditions. The photos (taken after late season rains) are for the purpose of showing the riparian vegetation that occurs at the river crossings.

6.1.4.2 Wetlands

Wetlands are considered a sensitive vegetation type as they provide essential habitat for a diverse range of flora and fauna (including threatened and migratory species) and can be easily impacted upon by poor land management and planning (DNRETAS 2010).

Wetlands that occur in arid Northern Territory are defined by Duguid et al. (2005) as:

> *Areas of permanent or temporary surface water or waterlogged soil. They may be dry for decades but inundation or waterlogging must be reoccurring and of sufficient duration to be used by macroscopic plants and animals that require such conditions during their lifecycles. They may be natural or artificial, with still or running water which can be fresh or saline. In the inland they may be of any depth or size.*

Wetlands include waterholes, rivers, swamps, claypans, salt lakes, springs and artificial water sources (such as dams and sewage ponds). They can vary in size and are dry most of the time, but nevertheless, these areas may be important for species conservation. They may support important populations of endemic or threatened species, as well as isolated and relic populations of more widespread species (Duguid et al. 2005) that are important for local biodiversity reasons.

The Project footprint is dry for much of the year and largely includes sandplains with little relief and expansive black soil plains intersected by rivers and creeks. There are temporary swamps and flood-outs proximate to the Project footprint; however none are directly intersected. Two seasonal swamps occur within 300 m of the Project footprint (one proximate to the ROW and one proximate to a proposed access track). Of these, the swamp close to the proposed access track (called Frewena Marsh) is considered to be of regional significance as it is known to support breeding colonies of four water bird species (Fisher et al. 2002).

May 2016

Figure 6-6. Photographs of Frewena Marsh, a wetland of regional significance outside the construction footprint

6.1.5 SPECIES RECORDS

Species likely to occur within the Project footprint were determined from the Atlas of Living Australia database, based on the bioregions through which the NGP passes (see Section 6.1.1), and augmented by the results of field surveys. A summary of the species characteristic of each bioregion is provided in the sections below.

6.1.5.1 Davenport and Murchison Ranges and Tanami Bioregions

The sandplains and low rocky rises of the 'Davenport & Murchison Ranges' and 'Tanami' bioregions are reasonably diverse in all groups of fauna. The area has the highest number of macropods of the three areas and a number of dasyurids and rodents species recorded. The area has also had the most recent Greater Bilby record. The area has the greatest number of reptiles compared to the other two areas.

6.1.5.2 Mitchell Grass Downs Bioregion

The black soil plains of the Mitchell Grass Downs bioregion is the least species diverse of the three bioregions – having fewer species of each grouping (apart from fish species) than both the other areas. Mammals included five species of rodent and four dasyurids. The only macropod recorded is the Red Kangaroo. Reptiles recorded include legless lizards, Central Bearded Dragon, monitors and the Plains Death Adder. The area has the greatest number of reptiles compared to the other two areas. There are fewer records from post-1970 within the area compared to all years; however, this decrease is less than the Tennant Creek Sand-plains region. The bioregion contained half the number of plant species recorded in the Mount Isa Inlier bioregion.

6.1.5.3 Mount Isa Inlier Bioregion

Mount Isa Inlier has the greatest species diversity than the other areas – there are more species of most groupings than both other areas. Mount Isa Inlier bioregion is the only one for which there are bat records. It is also the only area of the three where the purple-necked rock-wallaby has been recorded. Reptile species recorded from the bioregion, include ring-tailed dragon, thorny devil, a number of geckos, king brown snake and northern shovel-nosed snake.

6.1.6 PROTECTED AREAS

There are no conservation reserves intersected by the Project footprint. Camooweal Caves National Park – the closest conservation area to the Project footprint – is located approximately 65 km north (see Figure 6-7).

6.1.7 SITES OF CONSERVATION SIGNIFICANCE

The Northern Territory Government has identified Sites of Conservation Significance (SOCS) areas of important or unique habitat, or areas with significant biodiversity values. SOCS to the north of the Project footprint are Lake Sylvester, Tarrabool Lake and Eva Downs Swamp, which combined are referred to as the Barkly Lakes (DLRM 2016b). Approximately 45 km south of pipeline KP 200 are Frew River flood-out swamps, Davenport and Murchison Ranges and Elkedra River flood-out swamps SOCS (Figure 6-7). With the exception of the Davenport and Murchison Ranges, all SOCS in the vicinity of the Project footprint are associated with wetlands, demonstrating the importance of water in the landscape. The Davenport and Murchison Ranges are low rugged rocky hills which provide diverse habitat and contain permanent and long-lasting waterholes in gorges. Some of the creeks and rivers which flood out to feed the wetlands have their headwaters in the ranges.

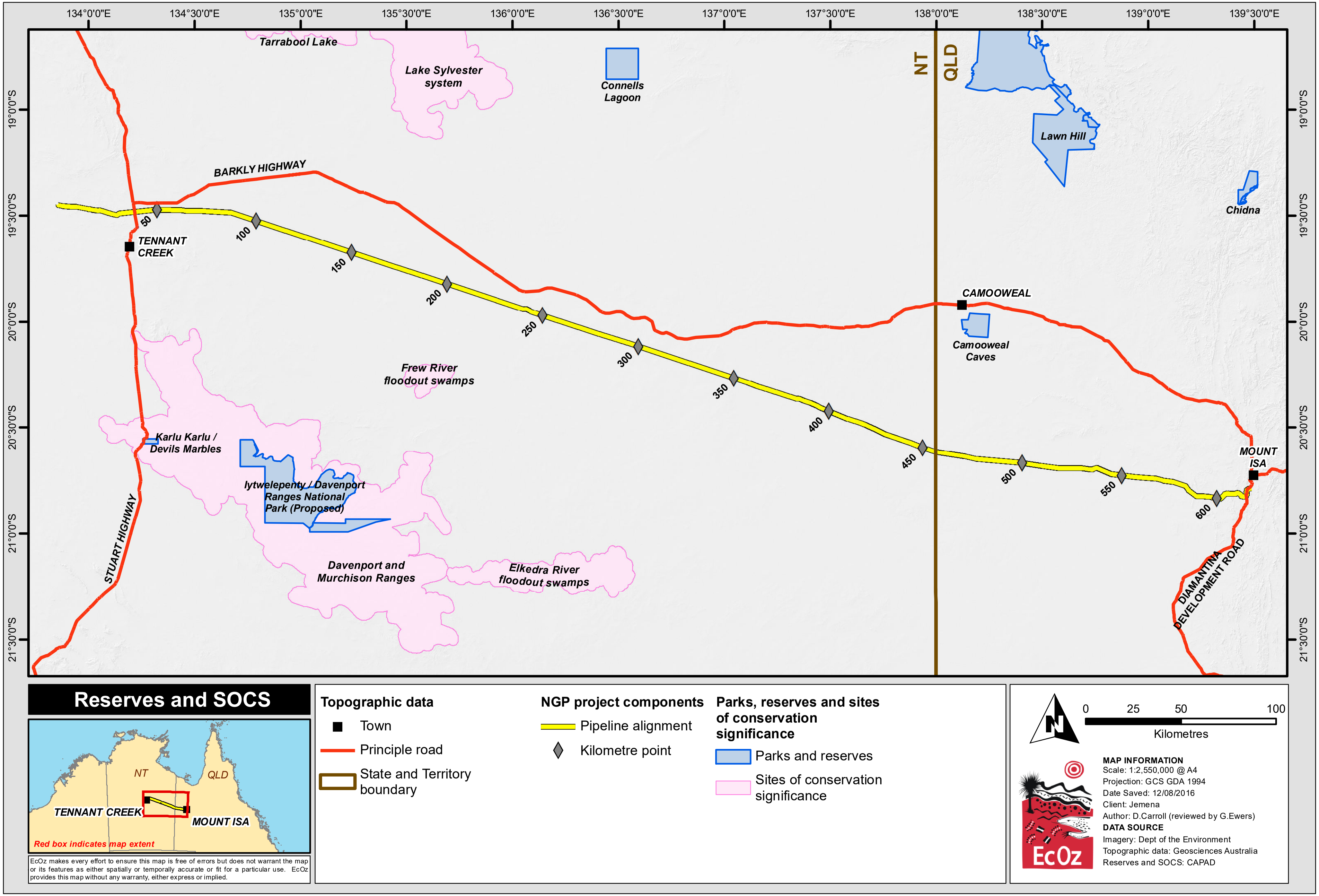

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Figure 6-7. Map showing conservation reserves and SOCS

6.1.8 EXISTING THREATENING PROCESSES

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. Existing threatening processes within the Project area are described in the sections below.

6.1.8.1 Fire

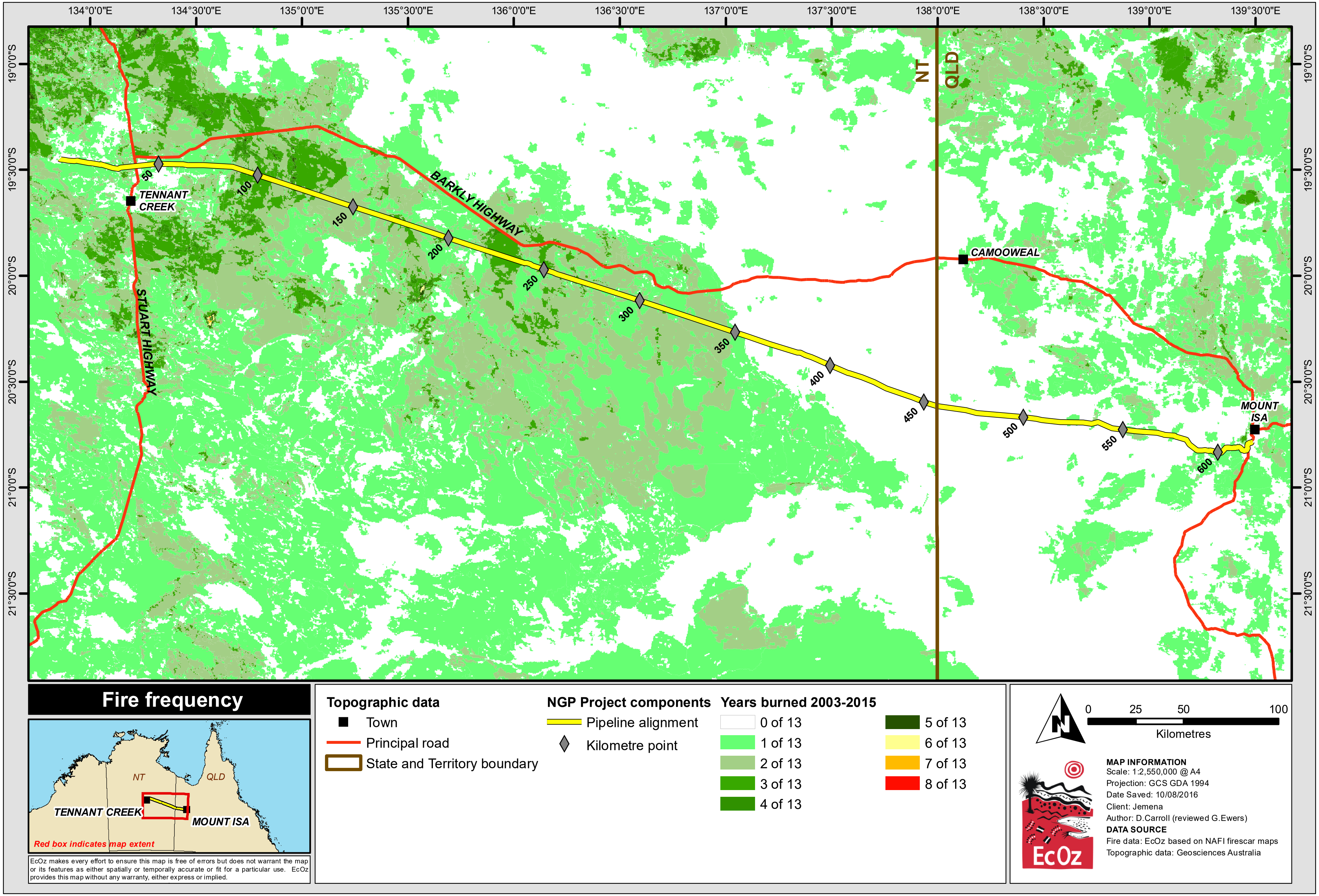
Fire is an essential part of ecosystems within arid and semi-arid Australia (Kershaw et al. 2002) and is caused by natural and anthropogenic sources. It is thought to be a major contributor towards landscape change (Latz 1995; Latz 2007), particularly within the last 130 years where significant changes in land use have led to more frequent, larger scale fires (Edwards et al. 2008). Fire in the region of the Project area is strongly associated with presence and extent of spinifex-dominated landscapes (i.e. hummock grasslands). Spinifex (*Triodia* sp.) is a fire-tolerant species that creates high fuel loads and re-establishes after fire (Latz 1995; Edwards et al. 2008). More frequent, large-scale fires often result in further expansion of spinifex grasslands, which can have negative impacts on many flora and fauna. Introduced grasses – such as Buffel Grass (*Cenchrus ciliaris*) – also play a major role in increasing fire frequency and intensities within central Australia.

Regional fire history and fire scar mapping was obtained through the Northern Australia Fire Information website (NAFI 2015). Fire mapping indicates that approximately half of the Project footprint has burnt two to three times between 2003 and 2015 – as shown in Figure 6-8 (noting that the resolution of this database does not include local, small-scale fires). In general, burnt areas are either located on Aboriginal land or vacant Crown Land. This is on the higher scale of burning frequency for central Australia.

The most significant fire period for the Project region (in recent years) was in 2011, when the majority of the western half (KP 0 – KP 354) of the Project footprint was burnt. In that year, there were several large-scale, spinifex-fuelled fires that swept through the region. These fires burnt significant areas of both long unburnt (> 13 years) and previously burnt (with < 7 years) vegetation communities.

The black soil country between NGP KP 353 and KP 561 generally experienced no fires between 2003 and 2015 – likely due to cattle grazing (fuel-load reduction) and perhaps the lack of spinifex-dominated grasslands (Figure 6-8). Land is predominantly cattle stations within the black soil country. Pastoral management (through active suppression, access tracks, and firebreaks) usually aims to exclude fire from the clay-soil environment, to maintain pasture throughout the dry season (DEWHA 2009b).

Low fire frequencies (i.e. between zero and one burn in the last 13 years) are observed on cattle stations outside of the black soil country. Vegetation communities within these stations have a mix of tussock and spinifex hummock grasses (Figure 6-3); therefore, a higher fuel-load is present (spinifex is generally not grazed upon by cattle). When conditions are suitable, pastoralists periodically burn hummock (spinifex) grasslands to promote green forage for cattle (as palatable tussock grasses, herbs and forbs often emerge after burns in hummock grasslands if weather conditions are suitable).



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-6. Map of fire frequency in the region of the Project footprint between 2006 and 2016.mxd

Figure 6-8. Map of fire frequency in the region of the Project footprint between 2006 and 2016

6.1.8.2 Weeds

In the Northern Territory, weed data are held by the Weeds Management Branch in the Department of Land Resource Management (DLRM). Twenty-two weed species (declared under the Northern Territory Weeds Management Act) have been recorded within 20 km of the construction ROW).

In Queensland, weed data are held by Biosecurity Queensland in the Department of Agriculture and Fisheries. Twenty-eight weed species (as declared under the Land Protection (Pest and Stock Route Management) Act 2002) have been recorded within 20 km of the construction ROW.

Table 6-4 presents a list of known declared weed species per habitat type; Figure 6-9 depicts known records in the region. Although not a declared weed, Buffel Grass (*Cenchrus ciliaris*) is also considered a threat to biodiversity value in the region of the Project footprint, as it can out-compete native tussock and hummock grasses, which often results in more frequent and intense wildfire.

Weed species in the region typically occur within watercourses, alluvial flats, disturbed areas (i.e. roadsides), around infrastructure such as fences and water-points, and on heavy clay and/or loam soils. Incidental and opportunistic weed records were made during fieldwork conducted in April and May and noted that the following weeds were present within (or close to) the Project footprint.

- Noogoora Burr (*Xanthium strumarium*) – dense (but small) infestations recorded on the banks of the Ranken River
- Buffel Grass (*Cenchrus ciliaris*) – recorded along watercourses near Mount Isa, Tennant Creek and Barkly Homestead
- Kapok Bush (*Aerva javanica*) – recorded near Barkly Homestead
- Parkinsonia (*Parkinsonia aculeata*) – low density of saplings on flood-outs of Georgina River
- Mesquite (*Prosopis pallida*) – located along some small drainages within the black soil plains.

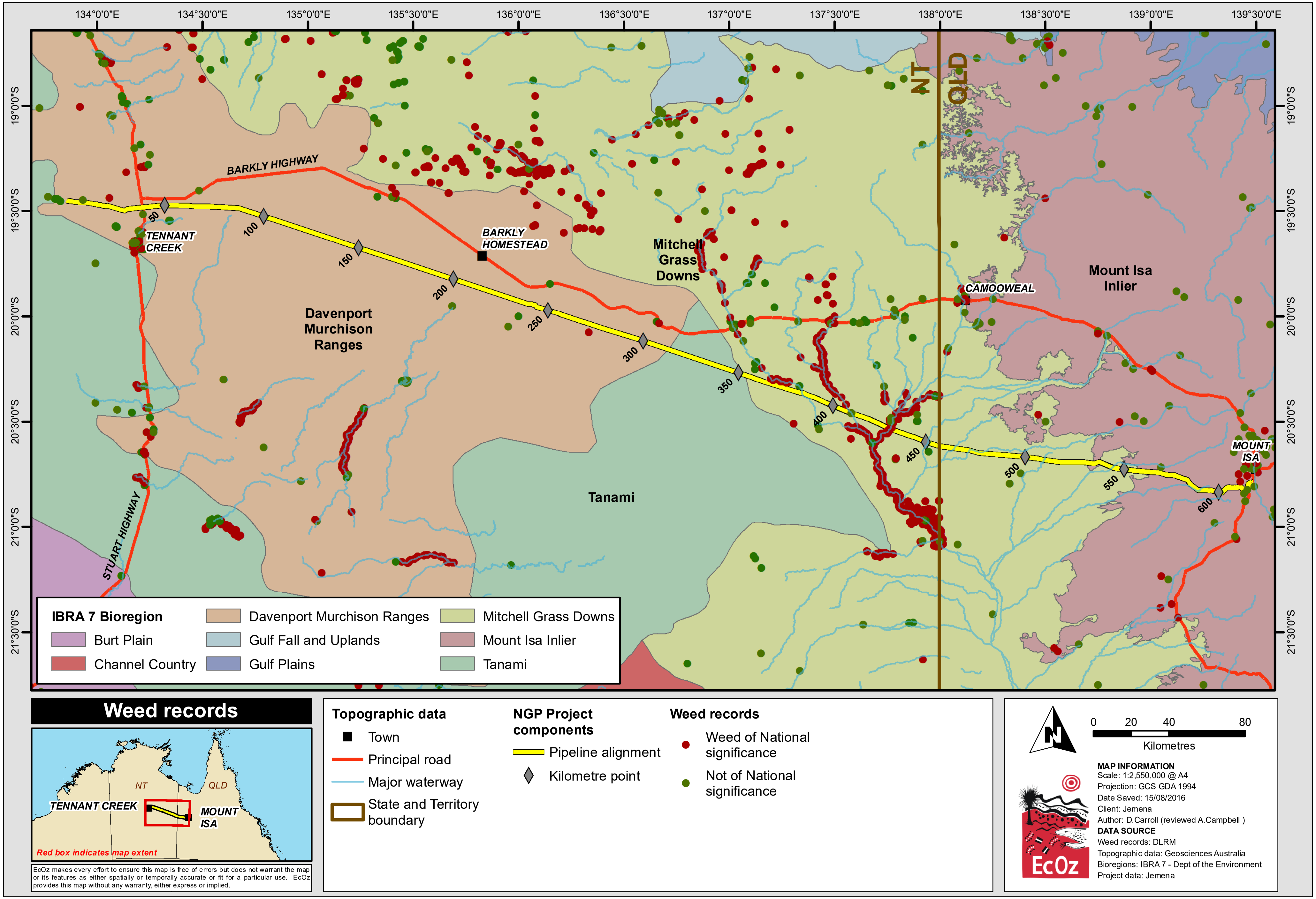
A complete weed survey of the Project footprint will occur prior to construction. Survey methods will be in accordance with Northern Territory and Queensland requirements. Details of the approach to field survey and subsequent refinement of weed management controls are provided in the Weed Management Plan (Appendix J).

Table 6-4. Declared weed species recorded within bioregions intersecting the Project footprint

Family	Common Name	Genus	NT class	Qld class	WoNS
Watercourses and alluvial flats					
ACANTHACEAE	Thunbergia	*Thunbergia annua, T. fragrans & T. laurifolia*	-	1	No
ACANTHACEAE	Thunbergia	*Thunbergia grandiflora*	-	2	No
ANACARDIACEAE	Broadleaved pepper tree	*Schinus terebinthifolius*	-	3	No
APOCYNACEAE	Rubber vine	*Cryptostegia grandiflora*	-	2	Yes
APOCYNACEAE	Rubber bush	*Calotropis procera*	B/C	-	No
ASTERACEAE	Parthenium	*Parthenium hysterophorus*	A/C	2	Yes
ASTERACEAE	Noogoora burr	*Xanthium strumarium*	B/C		No
BIGNONIACEAE	Cat's claw creeper	*Macfadyena unguis-cati*	-	3	Yes
EUPHORBIACEAE	Bellyache bush	*Jatropha gossypiifolia*	A/C	2	Yes
EUPHORBIACEAE	Castor oil plant	*Ricinus communis*	B/C	-	No

Family	Common Name	Genus	NT class	Qld class	WoNS
FABACEAE	Prickly acacia	*Vachellia nilotica*	A/C	-	Yes
FABACEAE	Coffee senna	*Senna occidentalis*	B/C	-	No
FABACEAE	Parkinsonia	*Parkinsonia aculeate*	B/C	2	Yes
FABACEAE	Mesquite	*Prosopis spp.*	A/C	2	Yes
LAMIACEAE	Hyptis	*Hyptis suaveolens*	B/C	-	No
PAPAVERACEAE	Mexican poppy	*Argemone ochroleuca*	B/C	-	No
POACEAE	Mossman river grass	*Cenchrus echinatus*	B/C	-	No
RHAMNACEAE	Chinee apple	*Ziziphus mauritiana*	-	2	No
SALICACEAE	Pencil Willow	*Salix chilensis*	-	3	Yes
SALVINIACEAE	Salvinia	*Salvinia molesta*	-	2	Yes
SOLANACEAE	African boxthorn	*Lycium ferocissimum*	-	2	Yes
SOLANACEAE	Thornapple – Longspine	*Datura ferox*	A/C	-	No
TAMARICACEAE	Athel pine	*Tamarix aphylla*	A/C	3	Yes
Heavy clays and loams					
ASTERACEAE	Parthenium	*Parthenium hysterophorus*	A/C	2	Yes
FABACEAE	Mesquite	*Prosopis spp.*	A/C	2	Yes
FABACEAE	Prickly acacia	*Vachellia nilotica*	A/C	-	Yes
FABACEAE	Parkinsonia	*Parkinsonia aculeate*	B/C	2	Yes
Disturbed areas (i.e. road sides)					
APOCYNACEAE	Rubber bush	*Calotropis procera*	B/C	-	No
ASTERACEAE	Noogoora burr	*Xanthium strumarium*	B/C	-	No
ASTERACEAE	Star burr	*Acanthospermum hispidum*	B/C	-	No
BIGNONIACEAE	Cat's claw creeper	*Macfadyena unguis-cati*	-	3	Yes
BORAGINACEAE	Patterson's curse	*Echium plantagineum*	A/C	-	No
CRASSULACEAE	Mother of millions	*Bryophyllum spp.* and hybrids	-	2	No
EUPHORBIACEAE	Castor oil plant	*Ricinus communis*	B/C	-	No
EUPHORBIACEAE	Bellyache bush	*Jatropha gossypiifolia*	-	2	Yes
FABACEAE	Prickly acacia	*Vachellia nilotica*	A/C	-	Yes
FABACEAE	Coffee senna	*Senna occidentalis*	B/C	-	No
FABACEAE	Parkinsonia	*Parkinsonia aculeate*	B/C	-	Yes
FABACEAE	Sicklepod	*Senna obtusifolia*	B/C	-	No
LAMIACEAE	Hyptis	*Hyptis suaveolens*	B/C	-	No
MALVACEAE	Sida – Spiny head	*Sida acuta*	B/C	-	No
MALVACEAE	Sida – Flannel weed	*Sida cordifolia*	B/C	-	No
MALVACEAE	Sida – Paddy's lucerne	*Sida rhombifolia*	B/C	-	No
POACEAE	Mossman river grass	*Cenchrus echinatus*	B/C	-	No
POACEAE	Mission grass - perennial	*Cenchrus polystachios*	B/C	-	No
SOLANACEAE	African boxthorn	*Lycium ferocissimum*	-	2	Yes
ZYGOPHYLLACEAE	Caltrop	*Tribulus terrestris*	B/C	-	No
Variable habitats					

Family	Common Name	Genus	NT class	Qld class	WoNS
CACTACEAE	Prickly pear	*Opuntia spp.*	-	1	No
CACTACEAE	Harrisia cactus	*Harrisia spp.*	-	1	No
CACTACEAE	Prickly pear	*Opuntia stricta*	-	2	Yes
CACTACEAE	Coral cactus	*Cylindropuntia fulgida var. mamillata*	-	2	Yes
FABACEAE	Prickly acacia	*Vachellia nilotica*	-	2	Yes
VERBENACEAE	Lantana	*Lantana camara, L. montevidensis*	-	3	Yes
Grasslands					
POACEAE	Mexican feather grass	*Nassella tenuissima*	-	1	No
Pasture / agriculture					
ASTERACEA	Fireweed	*Senecio madagascariensis*	-	2	No
POACEAE	Rats tail grass	*Sporobolus spp.*	-	2	No



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-7. Map of declared weed records in the region of the Project footprint.mxd

Figure 6-9. Map of declared weed records in the region of the Project footprint

6.1.8.3 Introduced fauna

The following introduced fauna species are expected within the Project footprint:

Feral Cat (*Felis catus*)

Feral Cats occur throughout the Australian mainland in a wide variety of different habitats – including deserts, forests and grasslands. The species is considered a 'key threatening process' under the EPBC Act. Feral Cats play a significant role in the decline of native fauna – an individual is estimated to kill 5 to 30 native species per day (AWC 2012) – and have been recognised as contributing to the decline of several ground-nesting birds and small to medium-sized mammals.

Previous studies (within the Northern Territory) have recorded Feral Cats in the region of the Project footprint (Gibson et al. 1994; Low Ecological Services 2009), and signs from the species were observed during the EIS field studies for the Greater Bilby (see Section 5.9). According to the Atlas of Living Australia, there are numerous records within the Northern Territory section of the Project footprint and no records within the Queensland section of the Project footprint.

It is likely this species is prevalent across the Project footprint.

Cane Toad (*Rhinella marina*)

Cane Toads are widespread across tropical Queensland and Northern Territory in a wide variety of habitats, moving westward at an estimated 40 to 60 km per year (DEWHA 2010a). The species needs constant access to moisture to survive (which can be water, dew or moist sand).

This species is listed as a 'key threatening process' under the EPBC Act because it is lethal to carnivorous native animals if consumed. Cane Toads are known to be a key factor in the decline of a number of native predatory fauna – including monitors and Northern Quoll – and are poisonous to a wide range of snakes (Phillips et al. 2003).

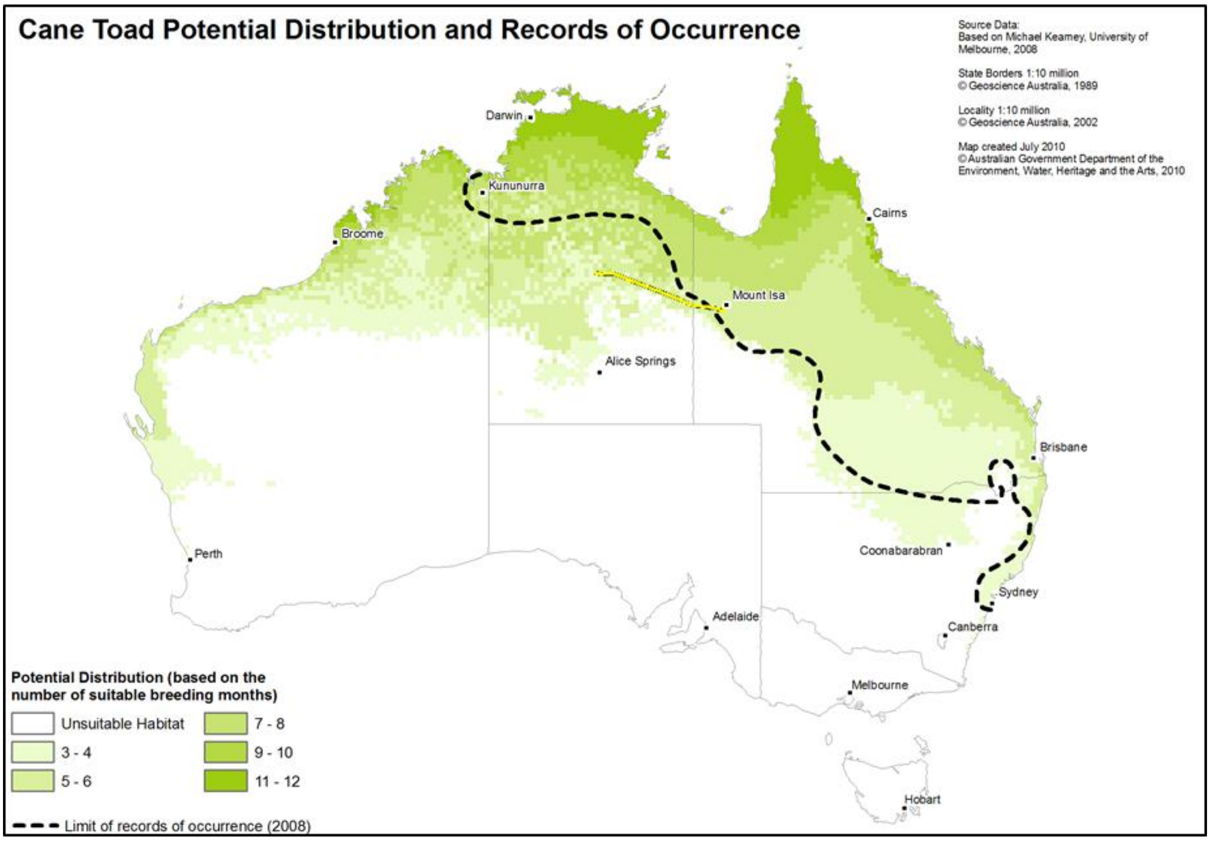
It is unclear to what extent Cane Toads occur within the Project footprint. The most recent distribution modelling of Cane Toads (see Figure 6-10) includes the channel country to the eastern terminus of the pipeline, with a prediction of an eventual distribution of the species westwards along the entire Project footprint. That region is considered marginal habitat for Cane Toads, with a maximum of 3 to 4 months suitable for breeding. During field surveys for this EIS, ecologists noted the species along the roadside near Camooweal – approximately 80 km north of the construction ROW. Camooweal is higher in the catchment than the Project footprint and so it could be assumed that Cane Toads would be present downstream in that catchment. However, there have been no observations of Cane Toads at either Avon Downs or Austral Downs, which are both located in black soil country of that catchment (the latter only 4 km north of the construction ROW).

Two possible conclusions can be drawn from this:

a) Cane Toads have reached the limits of southerly expansion (as dictated by water availability) in the region, and this expansion does not include the construction ROW (except, perhaps, at the Mount Isa end). This seems the likeliest conclusion given the species is present at Camooweal, but not downstream at Austral Downs.

b) Cane Toads yet to spread as far south as the construction ROW (except, perhaps, at the Mount Isa end), but suitable (albeit sub-optimal) habitat occurs, and so expansion into that region is inevitable. This is possible if the species only recently expanded to Camooweal and has not yet had the opportunity to travel downstream.

Where Cane Toads do occur within the footprint, they are likely to be restricted in numbers due to limited water availability.



Construction ROW depicted by yellow line

Figure 6-10. Map of known and potential distribution of the Cane Toad.

Domestic Cattle (*Bos taurus*)

Cattle production is one of the primary economic drivers of the region and so cattle are common throughout the Project footprint. Domestic Cattle can cause land degradation through trampling, soil compaction, erosion, weed spread and decreases in water quality (DLRM 2016b). Additional information on pastoralism is provided in Section 6.1.8.4.

Feral Horse (*Equus caballus*)

Feral Horses occur across the Australian mainland in a wide variety of different habitats. The species prefers grassland and shrubland with plentiful water and pasture (DSEWPaC 2011a). The Feral Horse population is highest in the cattle-raising districts of Queensland and the Northern Territory (IACRC 2015). The species causes erosion of soil and watercourses, weed spread, trampling and consumption of native flora, and sedimentation and increased nutrient levels in watercourses (DSEWPaC 2011a).

Feral Horses were not observed during EIS field studies. Distribution mapping from 2000 indicates that Feral Horses are likely in the Queensland section of the Project footprint (DSEWPaC 2011).

One-humped Camel (*Camelus dromedarius*)

Feral Camels are distributed through much of the Australian rangelands, wandering widely according to conditions. The species utilises most habitats in the arid and semi-arid areas, depending on availability of food and summer shade (DEWHA 2010b). Feral Camels cause environmental damage through trampling and foraging behaviour, suppression of plant recruitment, damage to wetland and riparian areas, and competition with native animals for food and shelter (NRMMC 2010). Feral Camels are expected to occur within the Project footprint – although camels are sparsely distributed through this area (0 – 0.25 per km^2) (NRMMC 2010). This species was observed in the rocky country near Mount Isa during field surveys.

EIS field studies recorded One-humped Camels in the rocky country near Mount Isa (Queensland). Very low numbers of tracks and scats were observed within the desert sandplains in the Northern Territory.

Feral Pig (*Sus scrofa*)

Feral Pigs are a widely-distributed, environmental and agricultural pest. Up to 23.5 million Feral Pigs are spread across about half of the continent – from western Victoria, through New South Wales into Queensland, and across northern Australia (DSEWPaC 2011b).

This species is listed as a 'key threatening process' under the EPBC Act because of native fauna predation, contribution to habitat loss and competition with native fauna. The threats associated with Feral Pig are largely confined to riparian and wetland habitats, where rooting, wallowing, tusking and rubbing impact upon flora and fauna, and water quality.

The distribution of Feral Pig includes most of the Project footprint when water is present – more commonly in the east, with only occasional low numbers and/or localised occurrences in the west (West 2008).

Red Fox (*Vulpes vulpes*)

Red Foxes occur across a variety of habitats in most of Australia. The species is absent from north-western WA, northern Northern Territory (north of Tennant Creek), and northern and north-eastern Queensland (West 2008).

This species is listed as a 'key threatening process' under the EPBC Act due to the species' predation of native fauna. The species is known to prey on ground-nesting birds and small to medium-sized mammals such as the Greater Bilby (DSEWPC 2011b).

The Project footprint is at the northern edge of the species' distribution. One Fox track was recorded in desert sandplains within the Northern Territory during EIS studies. According to the Atlas of Living Australia, there are a few records in sandplains within the Northern Territory section of the Project footprint and no records within the black soil plains or Queensland section of the Project footprint.

The Project footprint is at the very northern edge of the species' distribution. It is assumed that this species is present in low densities throughout the Project footprint, apart from the black soil country.

6.1.8.4 Pastoralism

Pastoral stations cover much of the Project footprint – the ROW crosses pastoral leases for 99 per cent of the Queensland length and 50 per cent of the Northern Territory length. Consequently, environmental impacts typically associated with pastoralism are expected to occur within the Project footprint (i.e. increased weeds, erosion development, soil surface structure/infiltration, water source degradation and altered fire regimes) (DEWHA 2009b). Cumulatively, these impacts often have a negative influence on biodiversity. It is implicated that pastoral impacts have resulted in the decline of some vertebrate species and changes in plant species composition in the Australian rangelands (Fisher et al. 2002; DEWHA 2009). Pastoral impacts have particularly affected larger dasyurids and rodents, bandicoots and smaller macropods (Woinarski et al 2001 – cited in DEWHA 2009b).

The level of impacts from pastoral activities on biodiversity values will be dependent on the management of station (i.e. stocking rates, provision of artificial water points and prescribed burns), and also the sensitivity of vegetation communities to grazing. Information on pastoral impacts within the Project footprint was collected during field studies as part of determining the habitat suitability for targeted threatened species. More detailed assessments of land condition across the Project footprint are required to establish reinstatement acceptance criteria prior to commencement of work, this will occur in late 2016 prior to construction.

6.2 EXISTING ENVIRONMENT – THREATENED SPECIES

The International Union for the Conservation of Nature nominates a set of criteria used to identify species at risk of extinction. These criteria are used to define categories of risk which are used by the Northern Territory Government to determine which threatened species are listed under the Territory Parks & Wildlife Conservation Act (*NT)* (TPWC Act)*,* and by the Commonwealth Government to determine which threatened species are listed under the EPBC Act.

The focus of this section is on species that are listed as threatened under either the TPWC Act or the EPBC Act (or both) (i.e. species that are listed as Vulnerable, Endangered or Critically Endangered). Species that are listed as Threatened in Queensland only are not discussed in this EIS, but will be addressed as part of the biodiversity assessments that will be undertaken later in 2016 as required under the pipeline Environmental Authority issued pursuant to the Environmental Protection Act (*Qld*) (EP Act).

This overview of the threatened species relevant to this Project has been derived from the *Threatened Species Survey Report* (Appendix G).

6.2.1 PRELIMINARY 'LIKELIHOOD OF OCCURRENCE' ASSESSMENT

To determine which threatened species may occur within the Project footprint, a desktop analysis of threatened species databases was undertaken. This resulted in a list of 22 threatened species (Commonwealth and/or Northern Territory-listed) that have the potential to occur in the region of the Project footprint. Records of these species are depicted in Figure 6-11.

For each species, the likelihood of occurrence within the Project footprint was assessed based on the species documented habitat requirements, distribution, and the number and dates of nearby records. The purpose of such an assessment was to identify those species that required further consideration through the risk assessment process, and those that can be reasonably excluded from further assessment because they can be assessed as unlikely to occur within the Project footprint with a high degree of certainty.

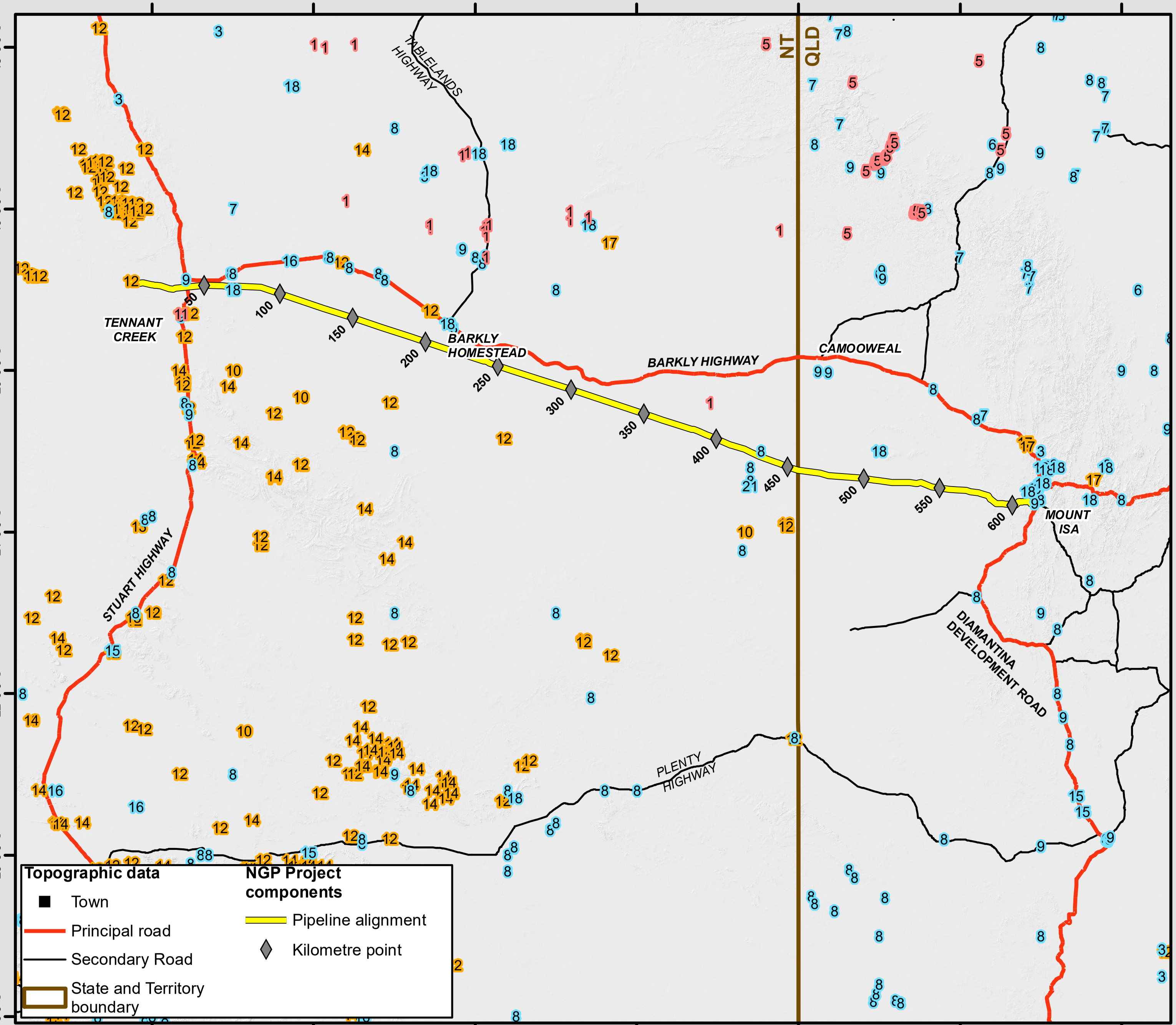
The results of the desktop 'likelihood of occurrence' assessment are presented in Table 6-5 and can be summarised as follows:

- nine species were ranked as having a 'high' or 'medium' chance of occurring within the Project footprint. Therefore, these species were the focus of field studies (some targeted to detect presence/absence and some to quantify areas of suitable habitat within the Project footprint – refer Appendix G).
- five species were ranked as having a 'low' chance of occurring within the Project footprint and so no specific surveys were carried out.
- eight species were considered to not occur within the Project footprint as it does not support important habitat features for these species, the records may be incorrect or they are considered to be locally extinct.

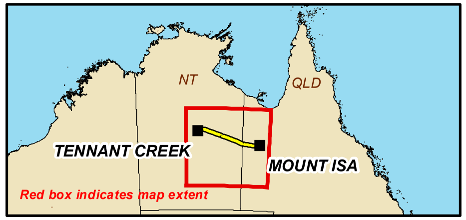
Table 6-5. Desktop 'likelihood-of-occurrence' assessment for threatened species

Likelihood	Common name	Scientific name	*EPBC* status	*TPWC* status
High	Carpentarian Antechinus*	*Pseudantechinus mimulus*	VU	VU
	Plains Death Adder	*Acanthophis hawkei*	VU	VU
	Tobermorey Melon	*Austrobryonia argillicola*	-	VU
	Grey Falcon	*Falco hypoleucos*	-	VU
	Painted Honeyeater†	*Grantiella picta*	VU	VU
Medium	Gouldian Finch*	*Erythrura gouldiae*	EN	VU
	a grass	*Sporobolus latzii*	-	VU
	Brush-tailed Mulgara	*Dasycercus blythi*	-	VU
	Greater Bilby**	*Macrotis lagotis*	VU	VU
Low	Red Goshawk	*Erythrotriorchis radiata*	VU	VU
	Australian Painted Snipe	*Rostratula australis*	EN	VU
	Curlew Sandpiper	*Calidris ferruginea*	CE	VU
	Black-footed Rock-wallaby (MacDonnell Ranges race)	*Petrogale lateralis*	VU	VU
	Night Parrot	*Pezoporus occidentalis*	EN	CE
	Princess Parrot	*Polytelis alexandrae*	VU	VU
None	Masked Owl (Northern)	*Tyto novaehollandiae kimberli*	VU	VU
	Southern Marsupial Mole	*Notoryctes typhlops*	-	EN
	Golden Bandicoot	*Isoodon auratus*	VU	EN
	Common Brushtail Possum (Southern Northern Territory)	*Trichosurus vulpecula vulpecula*	-	EN
	Great Desert Skink	*Liopholis kintorei*	VU	VU
	Gulf Snapping Turtle	*Elseya lavarockorum*	EN	-
	Spencer's Land Snail	*Bothriembryon spenceri*	-	VU

*† In Queensland only (likelihood is 'Low' in Northern Territory), * In Queensland only (likelihood is 'None' in Northern Territory), ** In Northern Territory only (likelihood is 'None' in Queensland)*



Threatened species records



EcOz makes every effort to ensure this map is free of errors but does not warrant the map or its features as either spatially or temporally accurate or fit for a particular use. EcOz provides this map without any warranty, either express or implied.

ID	Common name	Scientific name	EPBC	TWPC
Birds				
3	Curlew Sandpiper	*Calidris ferruginea*	CE	VU
6	Red Goshawk	*Erythrotriorchis radiatus*	VU	VU
7	Gouldian Finch	*Erythrura gouldiae*	EN	VU
8	Grey Falcon	*Falco hypoleucos*	-	VU
9	Painted Honeyeater	*Grantiella picta*	VU	VU
15	Night Parrot	*Pezoporus occidentalis*	EN	CE
16	Princess Parrot	*Polytelis alexandrae*	VU	VU
18	Australian Painted Snipe	*Rostratula australis*	EN	VU
21	Masked Owl (Northern)	*Tyto novaehollandiae kimberli*	VU	VU
Plants				
2	Tobermorey Melon	*Austrobryonia argillicola*	-	VU
19	Latz's Grass	*Sporobolus latzii*	-	VU
Mammals				
4	Brush-tailed Mulgara	*Dasycercus blythi*	-	VU
10	Golden Bandicoot	*Isoodon auratus*	VU	EN
12	Greater Bilby	*Macrotis lagotis*	VU	VU
13	Southern Marsupial Mole	*Notoryctes typhlops*	-	EN
14	Black-footed Rock-wallaby (MacDonnell Ranges race)	*Petrogale lateralis*	VU	VU
17	Carpentarian Antechinus	*Pseudantechinus mimulus*	VU	VU
20	Common Brushtail Possum (Southern NT)	*Trichosurus vulpecula vulpecula*	-	EN
Reptiles				
1	Plains Death Adder	*Acanthophis hawkei*	VU	VU
5	Gulf Snapping Turtle	*Elseya lavarackorum*	EN	-
11	Great Desert Skink	*Liopholis kintorei*	VU	VU

Map notes:
- *Data has been presented to show species presence, not abundance.*
- *TPWC threatened shorebirds have not been presented (Greater Sand Plover, Lesser Sand Plover, Bar-tailed Godwit, Eastern Curlew)*
- *Status: VU Vulnerable; EN Endangered; CE Critically Endangered;*
- *Records shown include pre-1970 records.*

0 25 50 100
Kilometres

MAP INFORMATION
Scale: 1:4,000,000 @ A4
Projection: GCS GDA 1994
Date Saved: 15/08/2016
Client: Jemena
Author: D.Carroll (reviewed G.Ewers)

DATA SOURCE
Threatened species records: ALA
Topographic data: Geosciences Australia
Project data: Jemena

Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6‐11.2 Map of historic threatened species records.mxd

Figure 6-11. Map of historic threatened species database records

6.2.2 TARGETED HABITAT ASSESSMENTS AND FIELD SURVEYS

In April, May and June of 2016, habitat assessments and/or field surveys were undertaken for the threatened species considered to have a 'high or 'medium' likelihood of occurrence within the Project footprint. These assessments are comprehensively documented in the Threatened Species Survey Report (Appendix G) and summarised below.

The species assessed and the surveys and/or habitat assessments applied are summarised in Table 6-6. Where species-specific survey guidelines exist and were appropriate for this form of development, they were used. In other instances, alternative methods were developed in concert with threatened species' experts, whose qualifications and experience are provided in Appendix D.

Table 6-6. Summary of threatened species survey methods

Species name	Summary of survey methods
Carpentarian Antechinus (*Pseudantechinus mimulus*)	Field habitat assessment between KP 510 and KP 622. Elliot trapping at potential sites as per Commonwealth mammal survey guidelines for this species. Camera trapping as per Northern Territory survey guidelines (in the absence of Commonwealth camera trapping guidelines).
Tobermorey Melon (*Austrobryonia argillicola*)	Habitat assessment between KP 355 and KP 457 along the construction ROW. Targeted surveys within potential habitat areas. In the absence of a survey guideline, a method was developed in consultation with Dr Catherine Nano (DLRM), Peter Jobson (Alice Springs Herbarium) and Peter Latz (freelance botanist).
Painted Honeyeater (*Grantiella picta*)	Field identification of potentially-suitable habitat based on regional ecosystem mapping. Field assessment of potential riparian habitat between KP 590 and KP 622. There are no federal survey guidelines for the species, consequently the Queensland survey guidelines (Roland 2012) were used; this method requires transect surveys within selected areas of potential habitat along the construction ROW. These were undertaken in May and again in June.
Grey Falcon (*Falco hypoleucos*)	Desktop habitat assessment to identify suitable nesting locations, cross-checked with high resolution aerial footage and ground-truthed. Bird surveys at multiple locations along the construction ROW, including at watercourse crossings (areas with highest likelihood of providing potential nesting habitat).
Plains Death Adder (*Acanthophis hawkei*)	Following consultation with DLRM, desktop habitat mapping was undertaken along the construction ROW, focussing on areas between KP 355 and KP 561, which was validated with aerial footage and ground-truthed. Targeted surveys not undertaken due to low detection probability.
Gouldian Finch (*Erythrura gouldiae*)	Existing survey guidelines not deemed appropriate for the linear nature of the impact by this project. Alternative method for breeding and foraging habitat assessment developed by Associate Professor Sarah Legge. Results reviewed by Legge.
Greater Bilby (*Macrotis lagotis*)	Existing survey guidelines not deemed appropriate for the linear nature of the impact and vast area of possible habitat traversed by this project. Alternative method developed based on Commonwealth mammal survey guidelines and other landscape-scale surveys with endorsement by Dr Rick Southgate. Aerial transects between KP 0 and KP 350, and along the seven access tracks within potential Greater Bilby area. Track plot surveys

Species name	Summary of survey methods
	over 2 ha at 53 aerially-identified sites.
Brush-tailed Mulgara (*Dasycercus blythi*)	Existing survey guidelines not deemed appropriate for the linear nature of the impact and vast area of possible habitat traversed by this project. Aerial transects between KP 0 and KP 350, and seven access tracks searching for signs and suitable habitat. Track-plot surveys and habitat suitability assessment over 2 ha areas at 53 aerially-identified sites.
Latz's Grass (*Sporobolus latzii*)	Habitat assessment between KP 150 and KP 350. Targeted searches for the species at 41 sites (either seasonal swamps or drainage depressions) identified from reconnaissance surveys. In the absence of a survey guideline, a method was developed in consultation with Dr Catherine Nano (DLRM), Peter Jobson (Alice Springs Herbarium) and Peter Latz (freelance botanist).

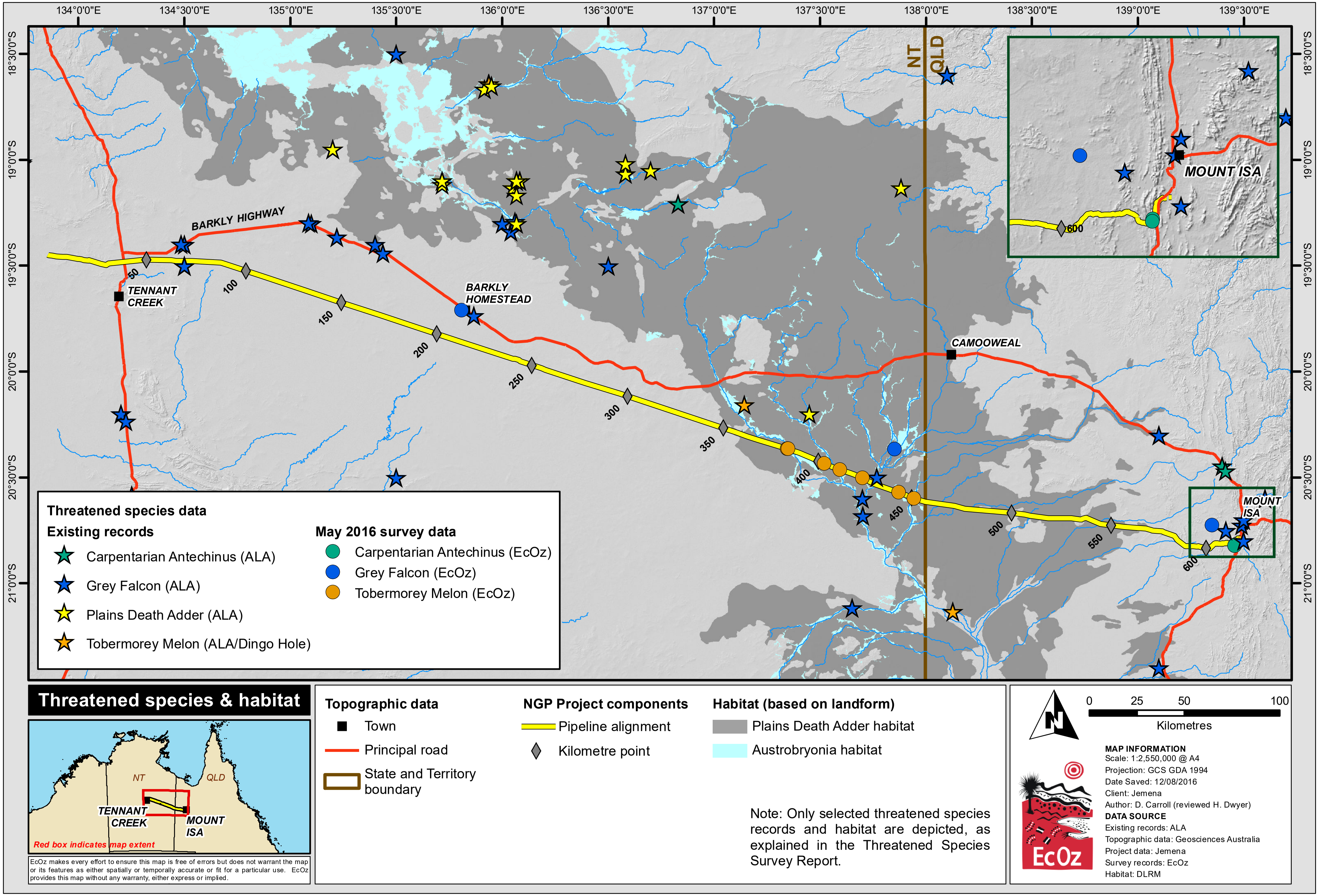
The results of the targeted field surveys were that:

- two threatened species – Carpentarian Antechinus (a carnivorous marsupial) and the Tobermorey Melon (a creeping herb) – were recorded within the Project footprint (see Figure 6-12). The 'likelihood of occurrence' for these species was revised to 'known'.
- three threatened species – Painted Honeyeater (a mistletoe-eating bird), Grey Falcon (a small bird of prey) and Plains Death Adder (a snake) – were not recorded during the surveys. However, based on habitat assessment, it was considered that there is a high chance they could occur at some locations within the Project footprint at some time. The species 'likelihoods of occurrence' were revised to 'likely'.
- four threatened species – Gouldian Finch, Brush-tailed Mulgara, Latz's Grass and Greater Bilby – were not recorded during the surveys and, based on field habitat assessment, there is a low chance they occur. The species 'likelihoods of occurrence' were revised to 'unlikely'.

For each threatened species that is 'known' or 'likely' to occur within the Project footprint, the following sections provide more detail in relation to the species ecology and habitat requirements, existing threatening processes, survey results and discussion.

Each section concludes with a determination of whether or not, for that species, there is likely to be an 'important' population as defined in *EPBC Significant Impact Guidelines 1.1* (DOE 2013) within the Project footprint. All the threatened species that are 'known' or 'likely' to occur within the Project footprint are listed as Vulnerable under Northern Territory and/or Commonwealth legislation. In accordance with the guidelines, for Vulnerable species, an 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity
- populations that are near the limit of the species' range.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-X. Map of records and habitat for species considered as 'known' or 'likely' to occur within the Project footprint.mxd

Figure 6-12. Map of records and habitat for threatened species of significance to the NGP Project

6.2.3 PLAINS DEATH ADDER (*ACANTHOPHIS HAWKEI*)

This species is listed as Vulnerable under the TPWC Act and under the EPBC Act.

The Plains Death Adder is a snake with a short, stout body, with a head that is triangular and distinct from the neck. The species' coloration varies but usually has wide, lighter bands across the body. The end of its tail tapers rapidly – becoming thin and worm-like – and is used to lure prey within striking distance (Hagman et al. 2008). Adults grow to a maximum length of approximately 1.2 m (Wells and Wellington 1985).

The nocturnal Plains Death Adder occurs on floodplains and cracking soil plains (Webb et al. 2002). According to Ward and Phillips (2012):

> *During the Wet season, individuals move every three to ten days, in apparently random directions, distances ranging from a few metres to a kilometre (Phillips and Webb, unpublished data). When it floods, they simply float in debris or rest on emergent vegetation. During the Dry season, movement is less frequent and they often retreat into deep soil cracks. Radio-tracking suggests that they are nomadic and do not have definable home ranges.*

Plains Death Adder generally breeds from October to November, and produces live young from February to March (TSSC 2012).

The exact distribution of Plains Death Adder is unclear. Based on documented field experience and encounter rates across its range, the species can be locally common (in the absence of Cane Toads) on the highly productive floodplains of northern Australian rivers. On the Barkly Tableland and Mitchell Grass Downs (where the NGP Project is located); however, the species is less-commonly encountered and can probably be considered scarce in this habitat (TSSC 2012).

There are many records for this species in similar habitat to the north of the Barkly Highway, but only one record south of the Barkly Highway. This 1978 record is approximately 22 km north of the construction ROW (Figure 6-14). According to TSSC (2012), the Plains Death Adder extent of occurrence is estimated to be approximately 720,000 km^2 and its area of occupancy is estimated to be approximately 233,480 km^2.

The main identified threat to the Plains Death Adder is death by ingestion of the introduced Cane Toad (TSSC 2012). Other potential threats to the Plains Death Adder are habitat modification due to over-grazing by cattle and inappropriate fire regimes.

The potential Plains Death Adder habitat within the Project footprint comprises five land systems (four of which are black soil clay plains), as shown in Figure 6-14. A selection of photographs that represent black soil plains along the construction ROW are provided in Figure 6-13. Habitat mapping conducted at a scale of 1:10,000 indicates that the Project footprint intersects approximately 820.1 ha of suitable habitat for Plains Death Adder (see Table 6-7 and Table 6-8 for breakdown of habitat types specific to Plains Death Adder in the Northern Territory and Queensland, respectively).

Table 6-7. Potential habitat extent for Plains Death Adder within the Project footprint (Northern Territory)

Landscape & landform class	Disturbance area (ha)			Total (ha)
	ROW	Access tracks	Other	
ALLUVIAL FLOODPLAINS	**64.5**	**13.7**	**28.6**	**106.7**
Alluvial Plains	*(61.6)*	*(12.8)*	*(28.6)*	*(103.0)*
Drainage Systems	*(2.9)*	*(0.8)*	*(0.0)*	*(3.7)*
CLAY PLAINS	**243.5**	**71.3**	**29.2**	**344.0**
Downs Plains	*(200.0)*	*(33.3)*	*(29.2)*	*(262.5)*
Plains	*(35.9)*	*(37.4)*	*(0.0)*	*(73.3)*
Inland Wetlands	*(7.7)*	*(0.6)*	*(0.0)*	*(8.3)*
TOTAL	**308.0**	**85.0**	**57.8**	**450.7**

Table 6-8. Potential habitat extent for Plains Death Adder within the Project footprint (Queensland)

Land zone	Disturbance area (ha)			Total (ha)
	ROW	Access tracks	Other	
Alluvium (river and creek flats)	34.4	11.4	23.2	**69.0**
Clay plains not associated with current alluvium	246.5	44.6	9.2	**300.4**
TOTAL	**280.9**	**56**	**32.4**	**369.4**

There are no records of Plains Death Adder within the Project footprint. Field surveys confirmed that there are 206 km of potential Plains Death Adder habitat within the construction ROW between KP 355 and KP 561. This is part of a continuous band of potentially-suitable habitat for the species which continues for many hundreds of kilometres to the north-west (see Figure 6-14). Within that habitat, there is one record (from 1978) approximately 22 km north of the construction ROW from the Wonardo land system, the only record from that land system. There are also many records 100+ km to the north-west of where the construction footprint intersects with suitable Plains Death Adder habitat. A high proportion of these records occur within the Barkly land system which is relatively uncommon in the construction footprint.

The presence – within the Project footprint – of suitable habitat to that known to support Plains Death Adder indicates a reasonable likelihood that the species occurs. This would represent an extension (to the south-west) of the known range of an existing population of this species. It seems reasonable to infer that such an occurrence would be part of the same population as that containing the record proximate to the construction footprint.

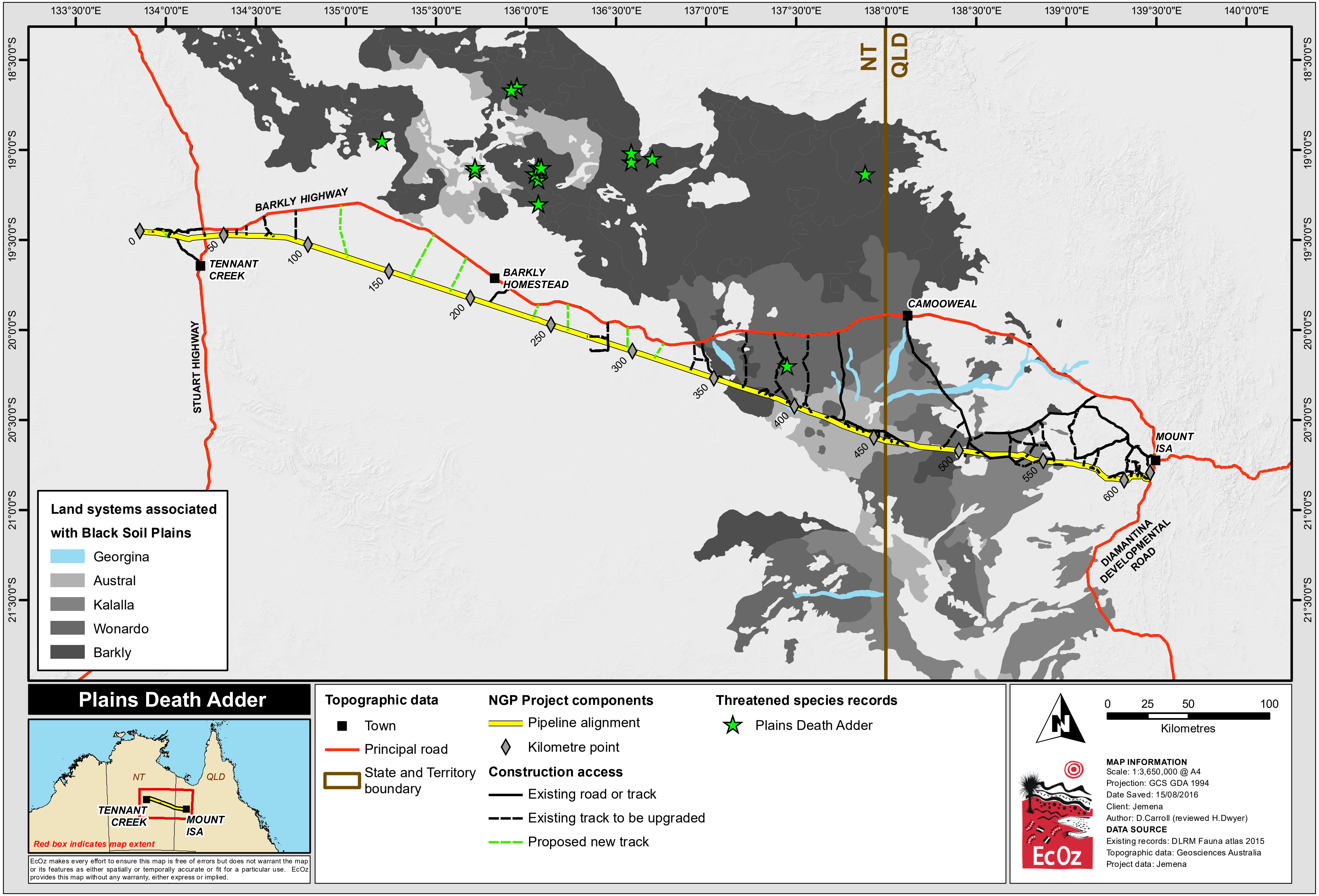
What is unclear is whether that population is contiguous with the population that hosts the occurrence records from 100+ km further north in a different land system. Applying the precautionary principle, it is assumed that, if extant, occurrences of Plains Death Adder within the construction footprint would constitute a separate population (i.e. no gene flow) to that containing the multiple records of the species 100+ km to the north. A population of Plains Death Adder within the Project footprint can therefore be

considered near the limit of the species' known range and, as such, necessary for maintaining the species genetic diversity.

For these reasons, a population of this species within the Project footprint would be considered 'important' (as defined in *EPBC Significant Impact Guidelines 1.1*).

Acknowledging the many uncertainties associated with determining the area of occupancy of this population, a conservative estimate of suitable habitat is 1.6 million ha (16,000 km^2). This is based on the area of habitat containing the Wonardo land system and all other suitable black soil country to the south of that land system, as per Figure 6-14.

Figure 6-13. Photographs of potential habitat (clay plains) for Plains Death Adder within the Project footprint



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6 14. Map of Plains Death Adder habitat and records.mxd

Figure 6-14. Map of Plains Death Adder habitat and records in the greater region

6.2.4 CARPENTARIAN ANTECHINUS (*PSEUDANTECHINUS MIMULUS*)

The eastern end of the construction ROW (between KP 522 and KP 622) falls within the *expert distribution (likely)* of the Carpentarian Antechinus (Commonwealth of Australia 2016). There are records of Carpentarian Antechinus to the north and east of the Mount Isa end of the Project footprint (see Figure 6-11), but none proximate. This species is not expected to occur in the Northern Territory portion of the Project footprint as the area falls outside of the known Northern Territory distribution, and no suitable habitat is traversed. The closest known population of the species in the Northern Territory is approximately 420 km to the north.

Field surveys identified Carpentarian Antechinus in rocky ridges north and south of Mica Creek (KP 617) in Queensland, and in a granite boulder outcrop to the west of those ridges (KP 610). Based on this evidence – and the ecology of the species – it is likely that Carpentarian Antechinus occupy any suitable rocky outcrops, boulder piles and rocky ridges/hills occurring with some regularity between KP 606 and KP 620 of the construction ROW.

Because the Carpentarian Antechinus only occurs within the Queensland section of the Project footprint, the risk of Project activities impacting upon that species needs only be assessed under the EPBC Act, not the EA Act. Consequently, it is further discussed in Chapter 12-MNES.

6.2.5 PAINTED HONEYEATER (*GRANTIELLA PICTA*)

This species is listed as Vulnerable under the TPWC Act and under the EPBC Act.

Painted Honeyeater is a medium-sized honeyeater (approximately 16 cm in length) with black upper parts, underparts with black spots on its flanks, and yellow outer edges to the wing primaries, secondaries and coverts and tail feathers. The species has a distinctive pink bill.

Painted Honeyeater inhabits Eucalypt forests/woodlands, riparian woodlands of Black Box and River Red Gum, Box Ironbark / Yellow Gum woodlands, Acacia-dominated woodlands, paperbarks, Casuarinas, Callitris and trees on farmland or gardens (TSSC 2015b). The species prefers mature trees and is more common in blocks of remnant vegetation rather than narrow strips (Garnett et al. 2011). Unlike other honeyeaters, the species is dependent on mistletoe berries during the breeding season (Barea & Herrera 2009; Watson 2012), although insects and nectar are also taken. The diet relies less on mistletoe and more on other food sources (especially arthropods) during the non-breeding season (Oliver et al. 2003; Garnett et al 2011). Nest selection is concentrated in habitats with high occurrence of mistletoe (Barea 2008); however, nesting success is generally low (Barea and Watson 2013).

Painted Honeyeater occurs through the eastern states, from the eastern Northern Territory through south-west Queensland to northern Victoria. Generally uncommon through its range, concentrations of the species are located on the inland slopes of the Victorian and New South Wales alpine regions, and in Roma, Queensland (Morecombe 2003). The species breeds between Victoria and south-east Queensland southern regions between October and March (BirdLife International 2016; Pizzey and Knight 2012) and migrates to the drier interior outside of these times – including near Mount Isa (Garnett et al 2011). However, the use of habitat in north-west Queensland is becoming increasingly uncommon (TSSC 2015b).

There are three records from the Mount Isa region – from 1932, 2006 and date unknown – including one within the Project footprint at Mica Creek (see Figure 6-16). There is a population of the endemic Kalkadoon Grasswren adjacent to Mica Creek which is well-known to birdwatchers wishing to see the species. As such, there have been 123 documented bird surveys (ALA 2016) at the junction of Mica Creek and the Diamantina Developmental Road, from which there is only a single Painted Honeyeater record. Nevertheless, the Project footprint between KP 570 and the Mica Creek Compressor Station lies within the *expert distribution* of this species (BirdLife International 2016). Records from the Northern

Territory are sparse and uncommon, and are expected to be occasional occurrences of the species moving from the critical habitat for a short period.

The main threat to Painted Honeyeater is habitat loss through the clearing of woodland habitat with the species' preferred mistletoe species (Watson 2012; Garnett et al 2011; TSSC 2015b). Preferred habitat is generally located on rich fertile soils that are also valued as farmland. Habitat loss through continued degradation of woodland by inappropriate fire and grazing regimes also threatens the species. Frequent fires reduce mistletoe densities through woodland – reducing the key food source for the Painted Honeyeater (Watson 2012). Inappropriate grazing regimes prevent recruitment of woodland species, causing a change in woodland structure and leading to a future loss of mistletoe resources (Watson 2012; TSSC 2015).

Painted Honeyeater was not detected during the targeted surveys in Queensland or general bird surveys in the Northern Territory. The survey sites with the highest number of bird species (including other species of honeyeaters) had an established and unburnt understory. Surveys at this site detected four honeyeater species; however, there was no mistletoe, indicating sub-optimal foraging resource availability for the Painted Honeyeater. The site with the greatest concentration of mistletoe was not fruiting at the time of survey (see Figure 6-15). The increased density of mistletoe at this site is likely due to the larger size of the watercourse (and hence larger trees), presence of permanent to semi-permanent water, and the longer time since the last fire.

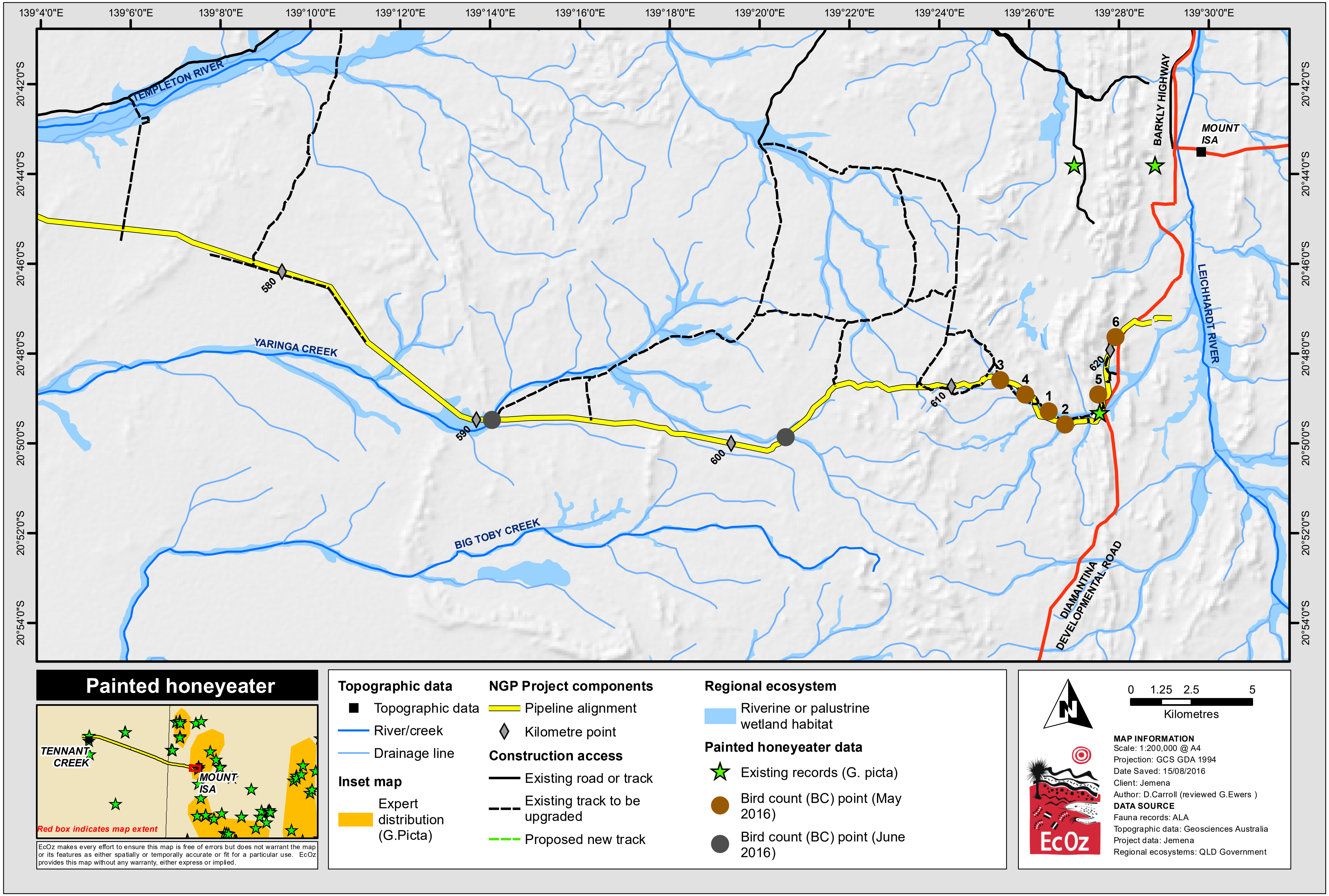
In general, the sites surveyed contained limited numbers of mistletoe. Although Painted Honeyeater utilises alternative food sources (especially outside the breeding season), the reliance on mistletoe as a primary food source, and the paucity of local records despite a high number of surveys, indicates that the woodland through which the construction ROW passes constitutes only marginal habitat used occasionally by the species.

Figure 6-15. Photograph of site surveyed for potential Painted Honeyeater habitat

Given the presence of suitable habitat (although sub-optimal), and the existence of nearby historical records, it has to be assumed that the Painted Honeyeater may be an irregular, non-breeding visitor in riparian woodland within the Project footprint. Considering its dispersive habits, the species is considered to have a single population (Garnett et al. 2011).

None of the criteria for a Vulnerable species population to be considered 'important' (as defined in *EPBC Significant Impact Guidelines 1.1*) apply to the irregular individuals of this species that may occur in the Project footprint because they should be considered to constitute a sub-set of a single population that has dispersed post-breeding. Those individuals are no more necessary for maintaining genetic diversity than any other Painted Honeyeater, nor are they a key source population for breeding or dispersal. Although the occurrence of this species in the Project footprint is near the limit of the species' range, it is a dispersive range within which those individuals will return to breeding habitat in south-eastern Australia, and so is no more significant than Painted Honeyeaters which disperse much closer to their south-eastern Australia breeding areas.

For these reasons, the individual members of the population of this species that may occur within the Project footprint during the non-breeding dispersal of this species is not considered an 'important population' (as defined in *EPBC Significant Impact Guidelines 1.1*).



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6□21. Map of Painted Honeyeater habitat and records.mxd

Figure 6-16. Map of Painted Honeyeater habitat and records

6.2.6 GREY FALCON (*FALCO HYPOLEUCOS*)

This species is listed as Vulnerable under the TPWC Act and is not listed under the EPBC Act.

The Grey Falcon is a medium-sized, compact, pale falcon. It is known to occur in areas of lightly-timbered lowland plains, typically on inland drainage systems, where the average annual rainfall is less than 500 mm (Ward 2012). This species occupies nests (often built by other bird species) in the tallest trees along watercourses (Garnett et al. 2011), as well as on telecommunications towers. Nesting is normally between June to November (Ward 2012). The Grey Falcon is generally a solitary bird, sometimes found in pairs or family groups (Debus 2012).

The Grey Falcon is always found in low densities (Garnett et al. 2011), primarily throughout arid and semi-arid areas (Ward 2012), including the Northern Territory and Queensland. Most records are in the Tanami Desert and in the lower third of the Northern Territory (Northern Territory Fauna Atlas database 2015).

There are six known records nearby to the Northern Territory section of the Project footprint (see Figure 6-19) as well as many others in the Queensland section (mostly concentrated around Mount Isa) and the region in general. Many records are from the Barkly Highway, along which there are many telecommunications towers suitable for Grey Falcon nests.

According to Ward (2012), threats to the Grey Falcon are not clearly defined. In the Northern Territory, landscape-scale changes in fire-regimes or grazing by feral or domestic herbivores may, in the long-term, reduce the availability of nesting trees and appropriate prey species.

The following points summarise the main results from the Grey Falcon survey:

- no Grey Falcon or nests were recorded within the parts of the Project footprint visited during field surveys.
- a Grey Falcon was opportunistically recorded during the survey at Barkly Homestead approximately 17 km north of the construction ROW. Another record was made on May Downs Station approximately 10 km north of the construction ROW. See Figure 6-19 for records.
- the entire Project footprint constitutes suitable habitat for Grey Falcon.
- given the species requirement for tall trees, Ranken River, James River, Georgina River, Mingera Creek, Templeton River, Yaringa Creek and Mica Creek are the most likely locations within the Project footprint where Grey Falcon may nest (see Figure 6-17 and Figure 6-18 for representative habitat).
- throughout the region there are also many telecommunications towers which present suitable nesting structures for Grey Falcon.

There are many records of Grey Falcon in the region and the entire Project footprint constitutes suitable foraging habitat. However, Grey Falcon is a solitary bird (only occasionally found in pairs or family groups) occurring in low densities throughout its broad distribution. As such, it is likely that only a few individuals of this species have home ranges over the Project footprint.

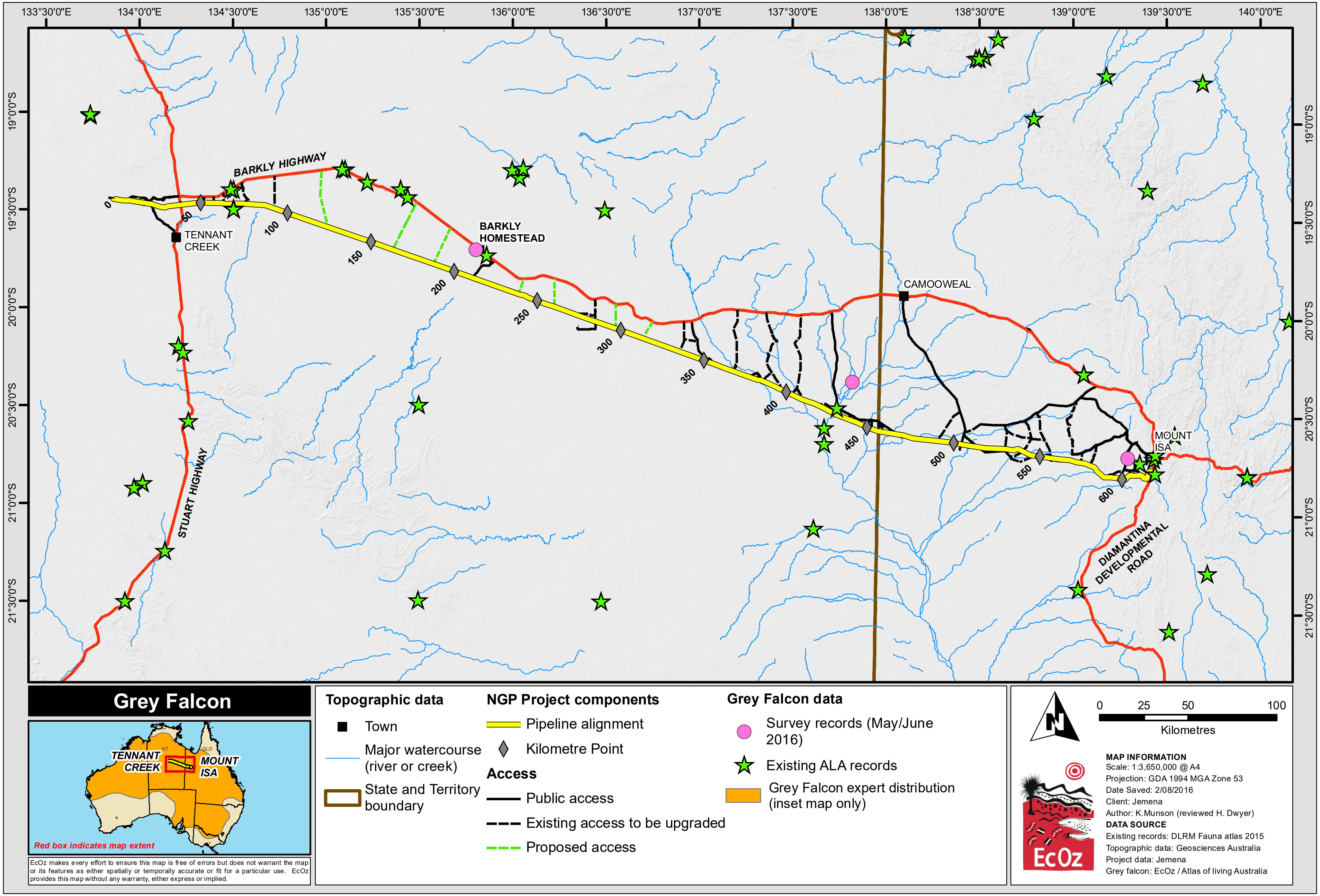
Grey Falcon could conceivably nest within the Project footprint; however, its preference for tall trees means that – regionally – suitable habitat will be restricted to watercourses. The limited number of watercourse crossings, relatively narrow construction ROW and short construction timeframe, all combine to suggest there is a low likelihood that a nest site would occur directly in the construction ROW during construction.

General occurrence of a Vulnerable species in a region does not meet the definition of an 'important' population of a Vulnerable species as per the *EPBC Significant Impact Guidelines 1.1*. The Project footprint is well within the expert distribution range of Grey Falcon, but there is no evidence that individual Grey Falcon in central-eastern Northern Territory and/or central-western Queensland constitute a key source population, or one that is necessary for maintaining genetic diversity.

For these reasons, the occurrence of a few individuals of this species within the Project footprint is not considered 'important' (as defined in *EPBC Significant Impact Guidelines 1.1*).

Figure 6-17. Photograph of Ranken River crossing lined by Coolabah

Figure 6-18. Photograph of Templeton River lined by Red River Gum



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-24. Map of Grey Falcon habitat and records.mxd

Figure 6-19. Map of Grey Falcon habitat and records

6.2.7 TOBERMOREY MELON (*AUSTROBRYONIA ARGILLICOLA*)

This species is listed as Vulnerable under the TPWC Act and was previously listed as Endangered under the EPBC Act. The Commonwealth Threatened Species Scientific Committee (TTSC) (in 2010) determined that this species was eligible for delisting due to recent information that better defines its taxonomic status, and consequently establishes a much larger known range and number of populations. Furthermore, the TSSC stated that there are no listed threatening factors known to affect this species. *A. argillicola* was subsequently de-listed as an *EPBC*-listed threatened species in December 2013.

Tobermorey Melon is a prostrate herb with a thickened, perennial rootstock and annual stems to 1 m long (Nano et al. 2012). It occurs along creeks and poorly-drained areas, mainly Mitchell Grass Downs on cracking clays (dominated by *Astrebla* spp.) (Schaefer et al. 2008). It is most abundant in seasonal swamps, clay pans and run-on areas. It has been recorded from Bluebush (*Maireana* spp.) swamps, Gidgee (*Acacia cambagei*) shrubland and riparian woodlands dominated by River Red Gum (*Eucalyptus camaldulensis*) (Nano et al. 2012). Figure 6-20 shows photos of suitable habitat within the Project footprint and Figure 6-21 shows photos of the plant taken during field surveys.

This species exhibits natural fluctuations and more individuals are likely to be recorded following the wet season (Queensland Herbarium 2009) because the above-ground parts are seasonal or dependent on weather conditions (Schaefer et al. 2008). According to Nano et al. (2012), this species has been observed flowering in March, May, July and October. Schaefer et al. (2008) describe flowering and fruiting as occurring from February – July.

A. argillicola is endemic to central-western Queensland, extending to the adjoining Barkly Tableland in the Northern Territory (Schaefer et al. 2008). In Queensland, this species occurs in numerous locations south of the Project footprint. In the Northern Territory, this species is currently known from six locations (Nano 2012) – four located adjacent to the Northern Territory/Queensland border (near the Plenty Hwy ~200 km south of Project footprint), one located near Corella Lake (~200 km north of Project footprint), and one located on the Ranken River (discussed below).

See Figure 6-23 for the full extent of *A. argillicola* records. In the Northern Territory, there is one location proximate to the Project footprint where three individual *A. argillicola* were recorded in 2001. This record is located 15 km north of KP 356 on a depression called Dingo Hole that is associated with a tributary of the Ranken River (see Figure 6-22).

The preferred habitat of this species is favoured by stock and feral animals. Pastoral and infrastructure (e.g. road and seismic lines) developments in *A. argillicola* habitat could have a major negative impact on this species (Nano et al. 2012); however, there is no supporting evidence of this to date.

A. argillicola was recorded at 58 per cent of ground survey locations (seven of the 12 sites) along the construction ROW, and was incidentally recorded at the Austral Downs airstrip (during helicopter refueling). The species was observed within drainages, depressions and on the upper banks of creeks or rivers. In all circumstances, there were a low number of plants within the 2 ha search area, with one to three plants being observed at each site. Most plants had senesced foliage; however, the large round-to-oblong fruit was prominent and relatively conspicuous. Records were spread across four surface water sub-catchments of the Ranken River, James River, Georgina River, and Blue Bush Creek. This suggests that the species is likely to be widespread in drainage habitat within the region, but occurs in low densities at each location.

The aerial survey of the construction ROW indicated that suitable habitat is common within the Project footprint and extensive in the broader region. Habitat types of particular importance to *A. argillicola* are:

- upper banks and floodouts of large rivers and creeks
- small creeks and drainage

- seasonally-inundated depressions.

The construction ROW crosses 18 of these habitat types (site descriptions are provided in Appendix G). However, it is also possible the species occurs in low numbers within the extensive clay plains which were not surveyed (pers. comm. Peter Jobson 2016).

As expected, high degrees of pastoral impacts occurred throughout the entire area defined as suitable habitat for *A. argillicola*, with the exception of one site (AA18 – a creek) that showed low level pastoral impacts. The high level of pastoralism may be a reason for the scarcity of *A. argillicola* detected during the surveys; however, current publications only speculate pastoralism as a potential threatening process for the species.

Suitable habitat was common along the proposed access tracks situated within the *A. argillicola* survey extent. Ground-searches did not occur at these sites; consequently, the presence or absence of *A. argillicola* along access tracks cannot be documented (note that all access tracks occur along existing linear disturbances, such as fence lines or station tracks, therefore survey priority was focused on the construction ROW as no existing linear disturbance exists).

The *Commonwealth Listing Advice on Austrobryonia argillicola* (TSSC 2013) states that this species has an extent of occurrence of 800 000 km^2 and an unknown area of occupancy. In 2006, Kerrigan and Albrecht estimated that, in the Northern Territory, *A. argillicola* has an area of occupancy of 20 km^2; however, this was before additional records were found and also seems low because the then known population extent only just overlapped into the Northern Territory (see Figure 6-23).

TSSC (2013) asserts that although this species' known distribution is fragmented, this non-continuous distribution may be an artefact of limited collection effort (Kerrigan & Albrecht 2006). This has been re-affirmed during recent discussions with the Northern Territory Herbarium (Peter Jobson pers. comm. 2016). As such, *A. argillicola* could be a candidate for de-listing as a threatened species in the Northern Territory.

Survey results suggest that *A. argillicola* is likely to be widespread in drainage habitat within the region, but is scarce (i.e. occurs in low densities) at each location. Given the large area of contiguous habitat and apparent abundance of this species when targeted in surveys, it seems reasonable to infer that there is a single population of *A. argillicola* dispersed throughout the river systems in the Mitchell Grass Downs area. Occurrences of this species within the Project footprint are not considered populations of this species, but individual members of a single population. The criteria for being an 'important' population (as defined in the *EPBC Significant Impact Guidelines 1.1*) are not satisfied.

Figure 6-20. Photographs of suitable habitat for the Tobermorey Melon

Figure 6-21. Photographs of the Tobermorey Melon

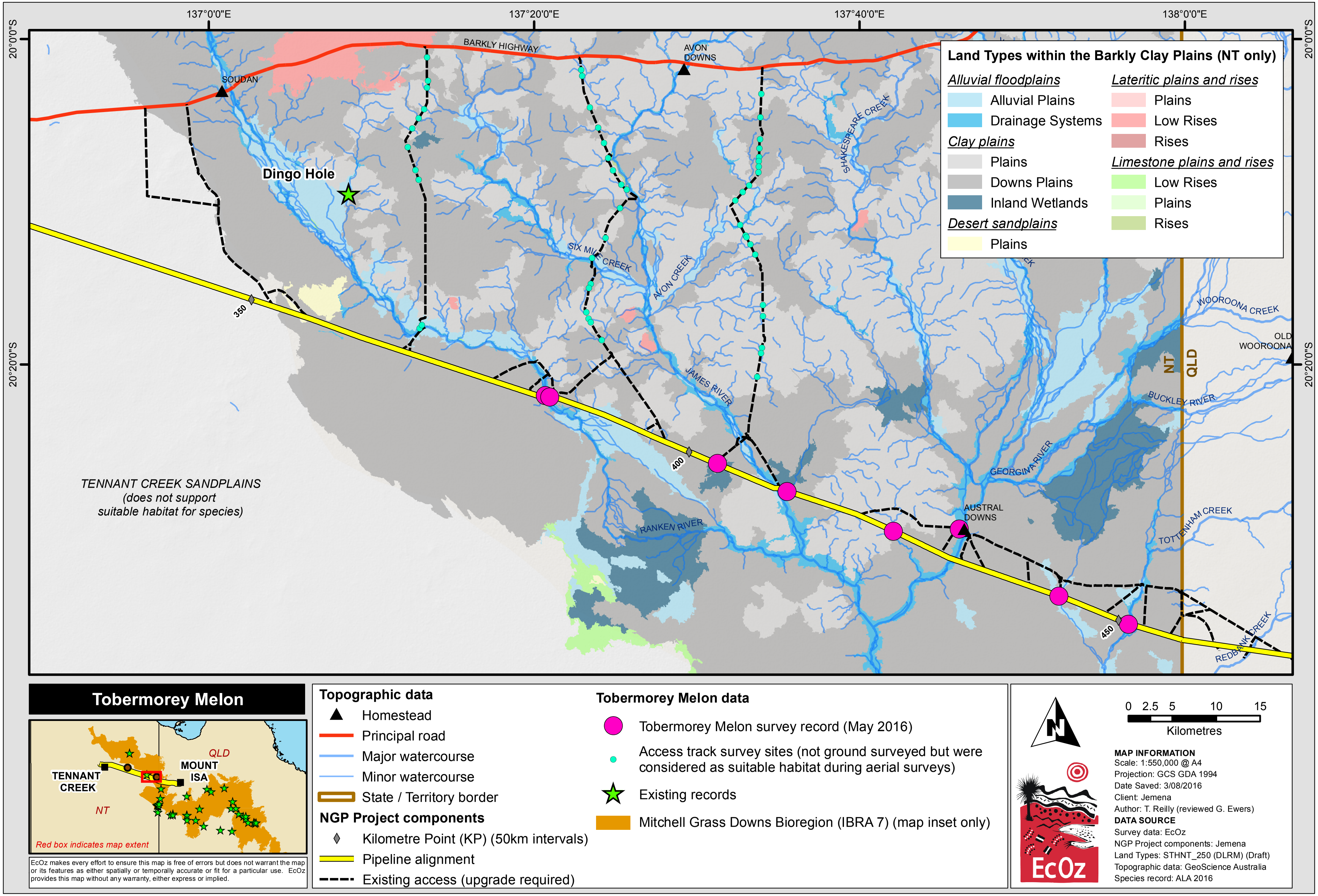
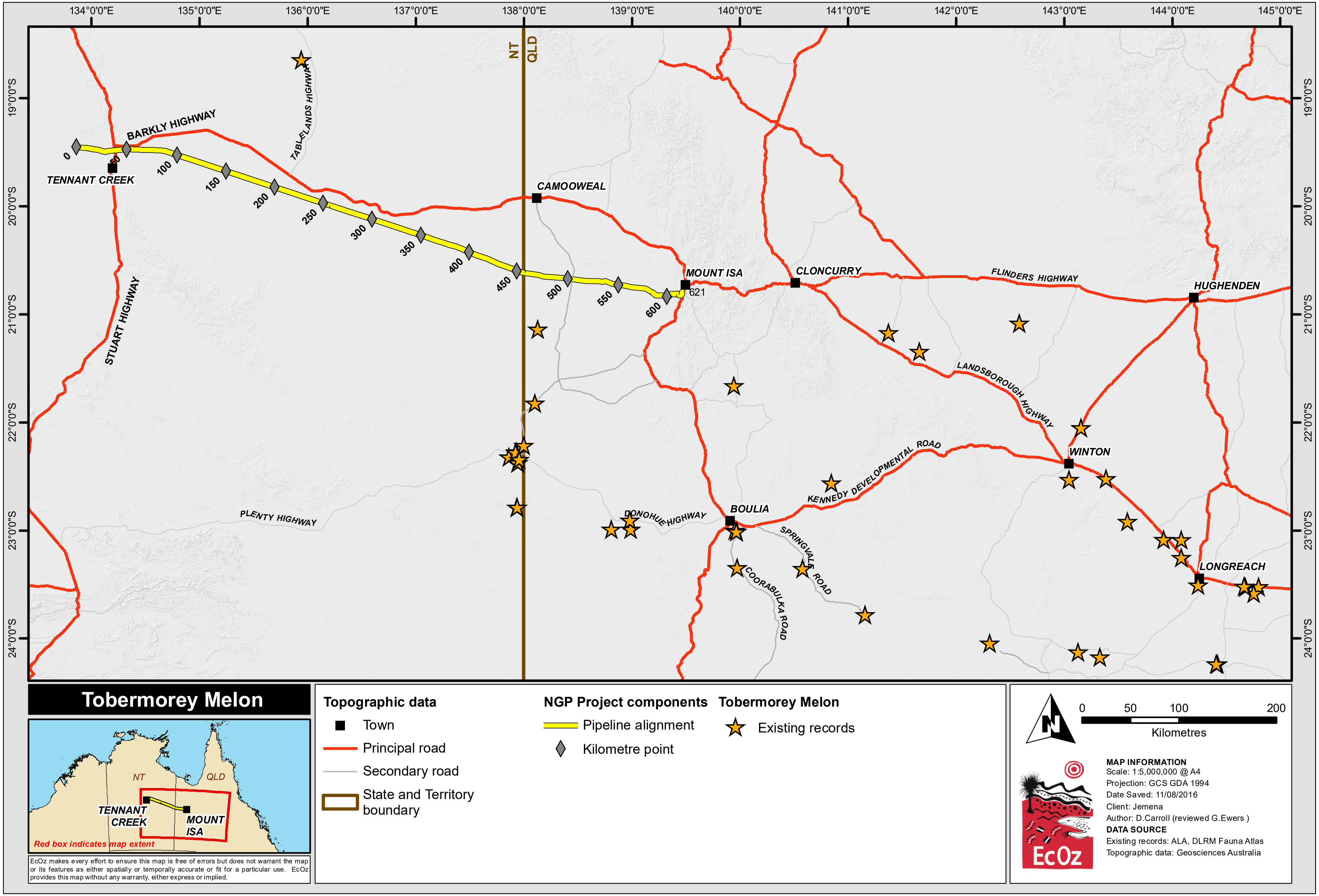


Figure 6-22. Map of Tobermorey Melon habitat and records



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-23. Map of all Tobermorey Melon records.mxd

Figure 6-23. Map of all Tobermorey Melon records

6.2.8 THREATENED SPECIES CONCLUSION

After due assessment based on the above context, important populations of two threatened species are considered to occur, or likely to occur, within the Project footprint:

- Plains Death Adder (*Acanthophis hawkei*) in the black soil country between KP 355 and KP 561
- Carpentarian Antechinus (*Pseudantechinus mimulus*) in the rocky country between KP 609.5 and KP 620.5.

Because the Carpentarian Antechinus only occurs within the Queensland section of the Project footprint, the risk of Project activities impacting upon that species needs only be assessed under the EPBC Act. Consequently, it is further discussed in Chapter 12-MNES.

6.3 BIODIVERSITY RISK ASSESSMENT

Risks associated with each potential impact to biodiversity and threatened species were assessed using the procedures and criteria described in Chapter 5. The complete environmental risk register is documented in Appendix F1, which assesses impacts for biodiversity and threatened species separately. The likelihood and consequences of each potential biodiversity impact were assessed in relation to the following biodiversity objective defined in Section 5.4.1 of the EIS ToR:

> *"Maintain the conservation status, diversity, geographic distribution and productivity of flora and fauna at species and ecosystem levels through the avoidance or management of adverse impacts (on the Project area and on adjacent areas that may be impacted)."*

Based on the above objective and the existing environment context, the biodiversity risk assessment focusses on assessing the risks associated with potential impacts to:

a) ecosystems – using vegetation communities as a surrogate (as described in Section 6.1.3)

b) sensitive vegetation types (in the Northern Territory only)

c) threatened species – specifically the Plains Death Adder – at a population level[2].

These are further discussed in the sections below. The risks associated with potential impacts to EPBC-listed threatened species are further discussed in Chapter 12.

In the instances where the inherent risk for a particular potential impact was assessed as Low or Moderate (i.e. tolerable), no specific controls are required. Consequently, no further analysis is given unless some additional elaboration is required.

6.3.1 POTENTIAL IMPACTS

Assessment of risks to biodiversity and threatened species first involved identifying potential causes of impact associated with the Project activities described in Chapter 2, and subsequent impacts that could occur to ecosystems that are known or expected to occur within the Project footprint and surrounds. The key references used to identify potential impacts were the EIS ToR (Appendix A), Project description (Chapter 2), Threatened Species Survey Report (Appendix G) and the contextual information presented earlier in this chapter.

[2] 'Population' is defined as 'a group of the same species occurring in a geographically-distinct area, and have the capability of interbreeding'. As explained in Section 6.2.3, it is assumed that within the Project footprint there is one Plains Death Adder population.

With respect to existing environmental values, almost the entire construction footprint (apart from existing access tracks that are already cleared) is remnant native vegetation. There are no Threatened Ecological Communities (listed under Section 18 A of the EPBC Act) within the Project footprint; however, there are some occurrences of riparian vegetation and wetlands, which are considered significant under the *Northern Territory Vegetation Clearing Guidelines* (DNTRES 2009). One threatened species is considered to occur, or likely to occur, within the NT section of the Project footprint – Plains Death Adder (*Acanthophis hawkei*) in the black soil country between KP 355 and KP 561. Much of that footprint is pastoral country and so has experienced some degradation in quality typical of that associated with pastoral activities in semi-arid areas, and weed infestations occur.

The NGP Project planning phase has and will continue to involve survey works for the purpose of identifying important flora and fauna habitats, mapping the occurrence of weeds and refining design and construction details. Through this process, potential impacts to biodiversity can be avoided by making changes to the construction approach and/or implementing specific controls in areas potentially more susceptible to impacts. The planning phase surveys did not recommend any further changes to the route required for the purpose of avoiding impacts to biodiversity or threatened species; however, the surveys did identify requirements for site-specific controls to minimise impacts in relation to watercourse crossings, which are further addressed in Chapter 7. Further surveys planned for late 2016 will map weed distribution within the Project area.

The Project construction phase will occur over a period of 12 – 18 months. Construction of the pipeline and facilities will involve removal of approximately 2,449.7 ha of vegetation, of which 2,347.5 ha (95.8 per cent) will be progressively reinstated following completion of construction. During construction there will be earthworks, noise and vibration, dust emissions, which could directly impact fauna, reduce habitat quality and temporarily reduce habitat availability within a localised area. Construction activities also have potential to introduce and spread weeds, and cause erosion and sedimentation, both of which could negatively impact on biodiversity.

Operational activities will not involve any additional disturbance outside of the areas already disturbed during the construction phase. Routine operations and maintenance are not expected to cause air emissions, noise and vibration that would impact on ecological receptors (see Chapter 11, Air, Noise and Vibration). Progressive rehabilitation of the Project construction footprint is expected to reinstate habitat values for most species.

For the purpose of identifying potential impacts associated with decommissioning, it is assumed that the pipeline will be decommissioned in-situ i.e. it will be made safe but left in the ground, and above-ground facilities will be removed; all activities will be in accordance with regulatory requirements applicable at the time.

Based on the above context, Project activities have the potential to impact upon biodiversity and threatened species as follows:

- direct impacts associated with clearing of vegetation and habitat for construction of the NGP, and mortality of fauna in the pipeline trench, from vehicle strikes and bushfires.
- indirect impacts associated with disruption of breeding, and with the effects of noise and vibration, dust, erosion, reduced water quality and quantity, failure of rehab and the introduction of weeds and feral fauna.

These potential impacts are listed below according to the Project phase in which they may occur.

6.3.2 PLANNING

Activities during the planning phase have potential to cause the following impacts to biodiversity and threatened species:

- loss of biodiversity values and/or threatened species due to an inadequate assessment of the existing environment leading to ill-informed risk assessment and lost opportunities for impact avoidance.
- reduction in habitat quality (long-term) for flora and fauna due to weed introduction and/or proliferation caused by pre-construction survey activities.

6.3.3 CONSTRUCTION

Activities during the construction phase have potential to cause the following impacts to biodiversity and threatened species:

- reduction in the quality of ecosystems, loss of threatened species' habitat and loss of sensitive vegetation types due to land clearing.
- temporary reduction in the quality of ecosystems and threatened species' habitats due to:
  - dust
  - noise and vibration
  - bushfire.
- reduction in the quality of ecosystems and threatened species' habitats (both either long term or permanent) due to:
  - inadequate reinstatement causing erosion and/or failure of rehabilitation
  - weed introduction and/or proliferation
  - habitat fragmentation
  - edge effects
  - reduced water quality caused by chemical spill, sedimentation from erosion or uncontrolled release of water.
- loss of threatened species due to disruption of a breeding cycle caused by the construction ROW or trench creating a barrier to dispersal.
- reduction in the quality of ecosystems and loss of threatened species due to:
  - interaction with construction traffic and earth-moving equipment (fauna strike)
  - trench excavation
  - entrapment in the open trench and/or stored pipes
  - the introduction or proliferation of feral fauna species.
- reduction in the quality of ecosystems and loss of threatened species due to bushfire caused by
  - construction activities
  - the proliferation of weeds creating higher fuel loads and therefore more intense fires.
- reduction in the quality of ecosystems, loss of threatened species and loss of sensitive vegetation types due to reduced water availability because of extraction of water for construction activities from natural sources and/or because of altered surface water flows due to construction activities.

6.3.4 OPERATIONS

Activities during the operations phase have potential to cause the following impacts to biodiversity and threatened species:

- reduction in the quality of ecosystems and threatened species' habitats (both either long term or permanent) due to
    - weed introduction and/or proliferation caused by operational usage of vehicles
    - failure of rehabilitation (because of insufficient natural revegetation).
- reduction in the quality of ecosystems and threatened species' habitats (both temporary) due to noise from the compressor stations.
- reduction in the quality of ecosystems and threatened species habitats (both temporary) due to a bushfire caused by pipeline failure.

6.3.5 DECOMMISSIONING

Activities during the decommissioning phase have potential to cause the following impacts to biodiversity and threatened species:

- reduction in the quality of ecosystems and threatened species' habitats (both either long term or permanent) due to disturbance caused by removal of above-ground infrastructure.

These potential impacts are noted; however, no further assessment is undertaken in this chapter. Details of the decommissioning process and legislative requirements that will be applicable at the time (forecast to be in excess of 30 years from now) are not known with enough certainly to inform assessment of risk.

6.4 PLANNING PHASE RISKS

The planning phase for the Project extends across 2016 and the early part of 2017. This phase aims to identify the biodiversity and threatened species values that require protection, establishing the context for assessment of risks. One of the permitted activities during this phase is low-impact ecological, heritage and geotechnical surveying.

6.4.1 ASSESSMENT OF EXISTING BIODIVERSITY VALUES

Context and assumptions

Loss of biodiversity values and/or threatened species could occur due to an inadequate assessment of the existing environment leading ill-informed risk assessment and inadequate impact avoidance.

In calculating an inherent risk for this potential impact, it is assumed that:

a) there are significant biodiversity values and important populations of threatened species within the Project footprint that could be deleteriously impacted by the Project

b) the biodiversity survey work was either incomplete, or the methods used were incorrect, leading to ill-informed assessment of risks from this Project

c) the consequence would be that the assessment of impacts and resultant mitigation approach may not achieve the biodiversity objective defined in Section 5.4.1 of the EIS ToR.

Inherent risk

If ecological surveys are inadequate there is a **SIGNIFICANT** risk that some sensitive vegetation communities and important threatened species populations will not be identified, and therefore will not be adequately protected. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Catastrophic	Inadequate assessment of the existing environment could mean that certain threatened species, significant vegetation types and/or other biodiversity values are not considered, leading to substantial or long-term damage to them.
Likelihood	Rare	Because of the rigorous scrutiny applied to an EIS by the Northern Territory Environment Protection Authority (NT EPA) and Commonwealth Department of Environment (DoE), (in consultation with departmental experts) prior to approval, and the opportunity in the EIS process for further information requests, this impact is expected to occur only in exceptional circumstances.

Controls

To reduce the risk to ALARP the following steps were put in place:

- a desktop analysis of all possible biodiversity values using all available datasets and acceptable analysis methods was undertaken.
- prior to field surveys, the outcomes of the ‘likelihood of occurrence assessment’ for threatened species were discussed with Northern Territory Government scientists to ensure that the appropriate species were being targeted.
- field surveys were undertaken by ecologists with relevant expertise in ecological surveying (see Appendix G).
- for those species that were deemed to require targeted field surveys, and where survey guidelines either did not exist or were not suitable for this type of long-linear development, well-respected experts were engaged to develop survey methods, and review results and interpretation.

Assessment of effectiveness

The desktop review undertaken to characterise the existing environment utilised best-available information, and was compiled by ecologists with appropriate qualifications and experience in undertaking similar assessments across the Northern Territory (refer Appendix D).

The methods adopted for the purpose of surveying threatened species were either established guidelines, or Project-specific methods developed by people with appropriate qualifications and experience in Threatened species surveys. The effectiveness of the surveys will be subject to further assessment by DLRM and DoE, and clearances/approvals will not be issued unless the level of consultation and survey is deemed to have been undertaken in accordance with accepted standards.

That some threatened species were detected during field surveys attests to the proficiency of the surveyors. There is a high degree of confidence that all occurrences of sensitive vegetation communities and threatened species populations have been identified through the field surveys documented in the Threatened Species Survey Report (Appendix G).

Residual risk

The residual risk is assessed as **LOW**. Justification for the reduced risk rating is provided below.

Risk component	Ranking	Justification
Consequence	Minor	By ensuring that the locations of riparian and wetland communities, and threatened species populations are known, they can be protected through implementation of controls. The field surveys therefore reduce potential consequences to minor on-site effects to the identified communities and populations.
Likelihood	Rare	Minor localised impacts to riparian and wetland communities, and individuals of listed threatened species are not expected to cause impacts at the ecosystem level.

6.4.2 WEEDS

Context and assumptions

Reduced habitat quality for flora and fauna could occur due to weed introduction and/or proliferation caused by pre-construction survey activities. Low-impact activities such as threatened species and weed surveys, heritage surveys, geotechnical investigations and land condition assessments will be undertaken during the planning phase. These involve driving on existing tracks and cross-country, as well as the use of helicopters for access. It is possible that, in particular, the use of vehicles during these activities could introduce new weeds or spread existing weeds.

In calculating an inherent risk for this potential impact, it is assumed that there will be low traffic volumes associated with survey work; and that weeds are common within the Project footprint, are easily transported, and that no weed hygiene activities are undertaken prior to, and during, land access. Weeds are not considered a threatening process for Plains Death Adder (TSSC 2012). Therefore, a risk assessment of the potential impact of weeds to threatened species has not been undertaken.

Inherent risk

There is an **EXTREME** risk that, without controls, weeds will be introduced and spread during the Project planning phase surveys. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Major	A weed infestation, especially in a weed-free environment, could have a major consequence at an ecosystem level. Rectification would be difficult, particularly of a weed that naturally spreads on introduction.

Risk component	Ranking	Explanation
Likelihood	Likely	Without controls in place, weeds spread very readily on vehicles driven from infested areas into weed-free areas. A weed infestation impacting at an ecosystem level due to planning phase activities would be a likely occurrence.

Controls

To reduce the risk of weed introduction and proliferation during the planning phase field surveys, interim weed hygiene procedures have been developed. These procedures (presented in Appendix I) contain rules for driving within the Project area during the planning phase, including the requirement for all vehicles before leaving from Tennant Creek or Mount Isa to undergo weed hygiene inspections carried out by a trained Weed Hygiene Inspector in compliance with the Queensland Government Biosecurity Queensland Checklists (in lieu of the Northern Territory Government having equivalent procedures). Vehicles are also required to stay on existing roads and tracks; in situations where this is unavoidable, procedures are described for reducing weed seed transportation and vehicle cleaning. The procedures also apply to surveyors walking off tracks and to helicopters landing.

Assessment of effectiveness

The procedures outlined in Appendix I are known to be effective for weed control for planning phase activities and are consistent with the Australian Pipeline Industry Code for Environmental Practice (APIA 2013).

Residual risk

Subject to effective implementation of the proposed controls the residual risk is assessed as **MODERATE**. Justification for the reduced risk rating is provided below.

Risk component	Ranking	Explanation
Consequence	Severe	Given the controls proposed, a weed infestation due to planning phase activities should be localised. Rectification would be required over the medium term. As such, there would only be a temporary effect at an ecosystem level.
Likelihood	Unlikely	Effective weed hygiene procedures should ensure that a weed infestation impacting at an ecosystem level due to planning phase activities would be an uncommon occurrence.

6.5 CONSTRUCTION PHASE RISKS

The construction phase is when the greatest amount of the Project activities and the largest area of disturbance will occur. Consequently, it is the phase that will have the greatest chance of environmental impact. Most disturbed areas will be reinstated during this phase (except for aboveground facilities, dams and access tracks that landholders have requested are retained).

6.5.1 REMOVAL OF VEGETATION COMMUNITIES AND HABITATS

Context and assumptions

Reduction in the quality of ecosystems, loss of threatened species habitat and loss of sensitive vegetation types could occur due to land clearing. The construction of the pipeline, compressor stations and above-ground facilities will require clearing of approximately 2,470 ha of vegetation – 1,750 ha in the Northern Territory and 717 ha in Queensland (see Chapter 2 – Section 2.6). Of this, over 90 per cent of this is narrow and linear (either the 30 m wide clearing for the ROW or the 5 to 10 m wide clearing required for new or upgraded access tracks). Progressive reinstatement and rehabilitation will be undertaken for over 95 per cent, therefore, only approximately only 102 ha will remain cleared for operational purposes.

The majority of vegetation communities within the Project footprint are regionally common and widespread (see Section 6.1.4). With regards to sensitive vegetation types, it is assumed that the only one occurring within the Project footprint is riparian vegetation (Project design has avoided wetlands). Field surveys have identified that there is some degraded riparian vegetation along the Ranken, James, Blue Bush and Georgina rivers. This is mostly comprised of a few reeds on the bank, some with *Eucalyptus coolabah*. The riparian vegetation in the region is heavily impacted by cattle and weeds.

As the Project will use open trenching techniques at watercourse crossings, riparian habitats within the 30m construction ROW will be directly impacted. No riparian vegetation will remain permanently cleared. Vegetation mapping indicates there are approximately 3.7 ha of riparian habitats occurring within the Project footprint.

The estimated temporary loss of habitat for the Plains Death Adder is 820.1 ha.

There are three consequences associated with land clearing that need to be considered when determining the risk of potential impacts to biodiversity values:

- temporary loss of approximately 2,470 ha during construction – most of which will be progressively reinstated and rehabilitated post-construction.
- permanent loss of 102 ha that will remain cleared for operational purposes.
- permanent reduction in habitat quality if reinstatement and rehabilitation are, to some significant degree, unsuccessful (further discussed in Sections 6.5.15 and 6.6.3).

For the purpose of assessing the inherent risk (without controls) it is assumed that:

- reinstatement and rehabilitation will be effective in returning habitats to close to pre-disturbance condition, and therefore the impact would only be temporary.
- land clearing will remove a small proportion of the overall extent of occurrence of each vegetation community within the disturbance footprint (see Table 6-3). This is because most of the disturbance is narrow (30 m wide or less) and linear (ROW and access tracks).
- any fauna currently using the areas to be impacted will move into adjacent habitats of similar quality – but intact – without any adverse impact to the species continued long-term persistence in the local area.

Inherent risk – ecosystems

There is a **LOW** risk that, without controls, land clearing could result in ecosystem level impacts. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Serious	Because of the vegetation communities are regionally common and permanent land clearing associated with this Project is spread across 15 regionally-common and widespread vegetation communities, and constitutes a small fraction of those communities' regional areas of occurrence. Such an impact constitutes a minor impact on regional ecosystems, with the damage recoverable through rehabilitation.
Likelihood	Rare	The narrow, linear nature of the land clearing required for this Project, traversing large areas of contiguous habitats with low levels of previous land clearing, indicates that such temporary habitat loss would only result in impacts at ecosystem levels in exceptional circumstances.

Inherent risk – sensitive vegetation types

There is a **LOW** risk that, without controls, land clearing would cause permanent impacts to riparian habitats that would result impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Serious	The temporary clearing of existing, degraded riparian vegetation associated with this Project constitutes a small fraction of that vegetation types' regional area of occurrence. This constitutes a minor, temporary impact to a sensitive vegetation type, with the damage recoverable through rehabilitation.
Likelihood	Rare	Long term damage to riparian habitat as a consequence of the temporary clearance of small areas of that habitat would only occur in exceptional circumstances i.e. if inadequate erosion and sediment controls lead to impacts to vegetation over a larger area.

Inherent risk – threatened species

There is a **LOW** risk that, without controls, land clearing would cause significant impacts to the Plains Death Adder. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Minor	The estimated temporary loss of critical habitat for the Plains Death Adder is 820.1 ha. The estimated total area of habitat for the populations of this species is 1.6 million ha.

Risk component	Ranking	Explanation
		Therefore, there will be less than 0.01 per cent loss of this species' critical habitat. Damage will be recoverable through rehabilitation.
Likelihood	Rare	Significant harm to Plains Death Adder as consequence of the temporarily clearance of a negligible area of critical habitat would only occur in exceptional circumstances.

Controls

Notwithstanding the low level of inherent risk, a range of routine clearing controls will be implemented in accordance with the *Code of Environmental Practice – Onshore Pipelines* (APIA 2013). In particular, clearing will only be undertaken within the specified construction footprint, and clearing boundaries will be delineated prior to clear and grade activities being undertaken.

These controls are expected to ensure that vegetation clearing is confined to within the designated Project footprint, and habitat loss is therefore minimised.

A Vegetation Clearing Procedure will also be developed prior to commencing construction that describes best practice vegetation clearing procedures to minimise harm to wildlife during land clearing activities.

Assessment of effectiveness

The clearing controls and reinstatement procedures prescribed by the *Code of Environmental Practice – Onshore Pipelines* (APIA 2013) are considered best-practice for pipeline projects in Australia. The NGP Construction Contractor has Standard Operating Procedures that address the code requirements and extensive experience in applying these requirements on pipeline projects. The controls are therefore expected to be effective in maintaining a low level of risk.

Residual risk

Risks to ecosystems, sensitive communities and threatened species are inherently **LOW**, and implementation of standard procedures through the CEMP will further reduce the likelihood of impacts occurring over the construction phase of the Project.

6.5.2 FAUNA STRIKE

Context and assumptions

Reduction in the quality of ecosystems and loss of threatened species could occur due to interaction with construction traffic and earth-moving equipment (fauna strike). Project activities will involve increased movement of vehicles, equipment and plant along highways, access tracks and the pipeline construction ROW. For human health and safety reasons, the Traffic Management Plan (Appendix E) specifies that vehicle movement along the ROW will be ordinarily between the hours of 0600 and 1800. Furthermore, all traffic will be required to adhere to speed limits on public roads. In assessing inherent risks (without controls) it is assumed that these standard controls will be implemented.

Inherent risk – ecosystems

There is a **LOW** risk that, without controls, fauna strike would cause impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Serious	The Project activities may lead to the loss of individual fauna from a variety of species due to vehicle strike. The numbers of animals that would be expected to be killed are low in the context of assessing potential impacts at the ecosystem level.
Likelihood	Rare	It would be an exceptional circumstance in which the loss of individual fauna due to vehicle strike had an impact at an ecosystem level.

Inherent risk – threatened species

There is a **LOW** risk that without controls, that mortality of Plains Death Adder individuals due to fauna strike, would cause a significant impact to the species. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Serious	Plains Death Adder is nocturnal, and so is unlikely to be involved in a vehicle strike given the restricted driving hours mandated in the Traffic Management Plan. Therefore, at worst vehicle strike may cause the mortality of a few individuals with negligible impact to the population.
Likelihood	Rare	It would be an exceptional circumstance in which the mortality of a few individuals due to vehicle strike would have an impact on this species' population.

Controls

As per the Traffic Management Plan (Appendix E), Safe Work Method Statements (SWMS) will be implemented governing the safe use of vehicles within the Project site, including:

- appropriate speed limits when travelling to and from site and within camps
- minimised vehicle activity at night.

Assessment of effectiveness

Large projects such as the NGP have strictly enforced Workplace Health and Safety requirements and so it is expected that adherence to the abovementioned SWMS will be high.

Residual risk

Risks associated with fauna strike are inherently **LOW**, and implementation of standard procedures through the CEMP will further reduce the likelihood of impacts occurring over the construction phase of the Project.

6.5.3 TRENCH EXCAVATION

Context and assumptions

Reduction in the quality of ecosystems and loss of threatened species may occur due to trench excavation. The construction ROW will include a trench with a minimum width of 62.5 cm and an average depth of 125 cm. The progressive excavation of that trench using heavy machinery and, in rocky country, blasting could disturb and/or lead to the mortality of burrowing fauna.

In assessing the inherent risk (without controls), it is assumed that excavating a very narrow, linear trench may impact upon a few individual burrowing fauna, but at such a small scale that impact will be negligible impact at an ecosystem level. Therefore, an inherent risk assessment has only been undertaken for the Plains Death Adder.

In assessing the inherent risk of impacts on the Plains Death Adder, it is assumed that because Plains Death Adders often retreat into deep soil cracks during the Dry season, there is the possibility during that time that individuals may be injured or killed during trench excavation. However, the area of Plains Death Adder habitat that will be excavated is a trench 0.6 m wide extending for 206 km – a total of 12.4 ha. Although the density of Plains Death Adder in suitable habitat is unknown, it seems unlikely that more than one or two individuals of this species will occur within the excavation corridor. Moreover, those individuals may not necessarily be injured if excavated.

Inherent risk – threatened species

There is a **LOW** risk that, without controls, that mortality of Plains Death Adder individuals caused by trenching activities, would cause a significant impact to the species. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Serious	As the trench footprint within the Plains Death Adder's habitat is small, at worst a few individuals may perish during trench excavation, with negligible impact to the population.
Likelihood	Rare	It would be an exceptional circumstance in which a few individuals perishing during trench excavation would have an impact on this species' population.

Controls

No specific controls are implemented due to low inherent risk. If any threatened species are encountered during trench excavation, this risk will be re-assessed and appropriate management measures implemented.

Assessment of effectiveness

Given the low inherent risk, and assessment of effectiveness is not relevant.

Residual risk

Risks associated with fauna mortality during trench excavation are inherently **LOW**, and implementation of standard procedures through the CEMP will further reduce the likelihood of impacts occurring over the construction phase of the Project.

6.5.4 ENTRAPMENT IN TRENCH

Context and assumptions

Reduction in the quality of ecosystems and loss of threatened species may occur due to entrapment in the open trench and/or stored pipes. Trenching and pipe-laying operations include stringing pipe sections on site, welding sections together, and then installing the assembled pipeline into the trench. There is potential for fauna to enter pipe sections, the welded pipeline or fall into the trench; become trapped, and die.

In Daly Waters in the Northern Territory – about 400 km north of the Tennant Creek end of this Project – Woinarski et al. (2000) recorded along 74 km of trench, 349 individual vertebrates from 40 species, with 11 per cent mortality.

In assessing the inherent risk to fauna (without controls), it is assumed that:

- no controls are in place to rescue or manage fauna – i.e. mortality will be approximately 11 per cent as per Woinarski et al. (2000).
- the sides of the trench are vertical, except in rocky country where blasting is required, in which case the sides of the trench will be sloped.
- Plains Death Adders occur within the construction footprint. It is unknown how proficient the species would be at escaping from a trench; however, Phillips (pers. comm. 2016) suggests that the species may have an adversity to falling given his experience in failing to capture Plains Death Adders in pitfall trapping exercises.
- as snakes can generally survive for extended periods without food, trapped Plains Death Adders have a significant time-frame opportunity to escape from the trench.
- trapped Plains Death Adders would be able to defend themselves from predation.

Inherent risk – ecosystems

There is a **LOW** risk that, without controls, that the numbers of animals that perish due to entrapment in the trench, would cause impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Serious	The low level and broadly distributed fauna mortality in an open trench documented by Woinarksi et al. (2000) (i.e. 11 per cent across 40 species) is an impact that would have minimal damage at an ecosystem level.
Likelihood	Unlikely	It would be an uncommon circumstance in which the loss of individual fauna due to entrapment in the trench had an impact at an ecosystem level.

Inherent risk – threatened species

There is a **LOW** risk that, without controls, that mortality of Plains Death Adder individuals caused by entrapment in the trench, would cause a significant impact to the species. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Serious	At worst a few individuals may become trapped in the trench and perish, with negligible impact to the population.
Likelihood	Rare	It would be an exceptional circumstance in which a few individuals becoming trapped in the trench and perishing would have an impact on this species' population.

Controls

Notwithstanding the low level of inherent risk, a range of routine clearing controls from the *Code of Environmental Practice for Onshore Pipelines* (APIA 2013) will be implemented:

- the trench will be progressively backfilled after the pipe is installed.
- to aid fauna that may have fallen into the trench, earth plugs will be installed at a maximum of 5 km apart intervals. An earth plug is a temporary trench crossing point that facilitates movement across the trench for vehicles, people and animals. The sides of the earth plug within the trench are at an angle of $< 45^o$ allowing any fauna fallen within the trench to escape. Additional earth plugs will be installed at property owner requests where cattle are required to access across the trench to reach water sources.
- to give shelter while fauna are within the trench, fauna shelters will be installed at least every 1 km.
- a Trench Inspection Procedure will be developed prior to construction commencing. This will provide for the presence of qualified fauna spotter-catchers (FSC) who will inspect the length of open trench daily to recover and release any fauna that is fallen into the trench overnight.
- to ensure that fauna does not enter the pipe end caps will be fitted to welded pipe strings at the end of each day's construction.

For the Plains Death Adder, it is considered that the general trench procedures outlined above will be sufficient. A Trench Inspection Report will be completed daily. If any threatened species are extracted from the trench, this risk will be re-assessed and, if necessary, additional management measures implemented.

Assessment of effectiveness

The controls outlined above are now standard procedure for pipeline projects in accordance with the *Code of Environmental Practice for Onshore Pipelines* (APIA 2013) and have been shown to reduce to in-trench mortality to <1 per cent (see Swan and Wilson 2012). The Construction Contractor has Standard Operating Procedures for trench inspection and clearance, and experience implementing these procedures on other pipeline projects.

Residual risk

Risks associated with fauna mortality due to entrapment in the trench are inherently **LOW**, and implementation of standard procedures through the CEMP will further reduce the likelihood of impacts occurring over the construction phase of the Project.

6.5.5 EDGE EFFECTS

Context and assumptions

Reduction in the quality of ecosystems and threatened species' habitats (both either long term or permanent) could occur due to edge effects. An 'edge effect' occurs when intact vegetation is disturbed and the newly-created edges between the intact and disturbed areas become lower quality habitat for species occurring in that vegetation – see, e.g., Murcia (1995). Land clearing, especially for the construction ROW, will create such an edge.

In assessing the inherent risk (without controls), it is assumed that reinstatement and rehabilitation will be effective. The risks associated with failure of rehabilitation are discussed in Sections 6.5.15 and 6.6.3.

It is further assumed that because the critical habitat for Plains Death Adder is sparsely-vegetated (see Figure 6-13) vegetation integrity is not an important ecological requirement for this species (as compared with, for instance, a forest-dwelling species). Therefore, the risks associated with edge effects have not been further assessed as they are unlikely to impact on the species.

Inherent risk – ecosystems

There is a **LOW** risk that, without controls, edge effects would cause habitat degradation to an extent that would cause impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Minor	Land clearing will create a temporary, minor on-site effect rectified by reinstatement and rehabilitation with negligible residual impact.
Likelihood	Rare	The impact is not likely to occur in this location. Apart from the increased likelihood of weed infestation, edge effects are more pronounced in forested areas where exposure to wind and sunlight (which change micro-climates, reduce soil moisture and encourage lower canopy plant species), and increased vulnerability to fire (because of more understorey). Therefore, it is assumed that the open, sparsely vegetated habitats within the Project footprint will not experience any significant or substantial edge effects – certainly not such that will impact at an ecosystem level.

Controls

Due to the low level of inherent risk, additional controls are not deemed necessary.

Residual risk

The residual risk without any additional controls is assessed as **LOW**.

6.5.6 HABITAT FRAGMENTATION

Context and assumptions

Reduction in the quality of ecosystems and threatened species' habitats (both either long term or permanent) may occur due to habitat fragmentation. Habitat fragmentation is considered in this context to be the permanent process by which habitat loss results in the division of large, continuous habitats into smaller, more isolated remnants. These remnants are then subject to the complex processes of habitat degradation and island biogeography, leading to loss of species diversity – initially locally, but ultimately at the landscape scale.

In assessing the inherent risk (without controls) for this potential impact, it is assumed that reinstatement and rehabilitation are effective. The risk associated with that not being the case is addressed in Sections 6.5.15 and 6.6.3.

Inherent risk – ecosystems

There is a **LOW** risk that, without controls, habitat fragmentation would cause impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Minor	Land clearing will only create a temporary fragmentation of habitat that are common and widespread in the regional, and hence will have no permanent habitat fragmentation effect.
Likelihood	Rare	The impact is not likely to occur in this location. During construction this Project will divide – temporarily – the vegetation communities the construction footprint intersects. As these vegetation communities are large (section 6.1.3), and as this impact will be temporary, such division cannot reasonably be considered fragmentation. This is also true for the few and narrow strips of riparian vegetation intersected by this project during construction. Long term fragmentation of riparian habitat as a consequence of the narrow, temporarily clearance of negligible areas of that habitat would only occur in exceptional circumstances.

Inherent risk – threatened species

There is a **LOW** risk that, without controls, that habitat fragmentation will cause a significant impact to the Plains Death Adder. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Minor	The Plains Death Adder is not described as a social species and so temporary fragmentation should not result in disrupted social dynamics. The Plains Death Adder has a vast and contiguous area of habitat available. A temporary division of that habitat is akin to a negligible loss of the population's critical habitat.

Risk component	Ranking	Explanation
Likelihood	Rare	It would be an exceptional circumstance in which temporary division of the population's critical habitat would result in habitat fragmentation that has an impact on the Plains Death Adder population.

Controls

Due to the low level of inherent risk, additional controls are not deemed necessary.

Residual risk

The residual risk without any additional controls is assessed as **LOW**.

6.5.7 DISRUPTION TO BREEDING

Context and assumptions

This section examines disruption to breeding due to the installation of the trench. Impacts from noise and dust are discussed in sections 6.5.10 and 6.5.11 respectively.

The temporary presence of the construction ROW and a narrow trench may impact upon the local breeding success of a few individual fauna, but at such a small scale that impact will be negligible impact at an ecosystem level. Loss of threatened species could occur due to disruption of a breeding cycle caused by the construction ROW or trench creating a barrier to dispersal. Therefore, a risk assessment has only been undertaken for the Plains Death Adder.

In assessing the inherent risk (without controls), it is assumed that:

- reinstatement and rehabilitation are effective, and therefore the impact would only be temporary. The risk associated with that not being the case is addressed in Section 6.5.15.
- the Plains Death Adder generally breeds in black soil country from October to November, and produces live young from February to March (TSSC 2012). Because black soil country is usually very boggy during those months it is likely that construction works will not be undertaken during that period. Moreover, the Plains Death Adder has a vast and contiguous area of habitat available, such that a temporary division of that habitat will likely have a negligible impact to the population breeding cycle.

Inherent risk

The inherent risk for impacts to the Plains Death Adder from disruption to breeding is determined to be **LOW.** The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Minor	The Plains Death Adder has a vast and contiguous area of habitat available, such that a temporary division of that habitat will likely have a negligible impact to the population breeding cycle.

Risk component	Ranking	Explanation
Likelihood	Rare	This risk would only be realised under extraordinary circumstances.

Controls

Due to the low level of inherent risk, additional controls are not deemed necessary.

Residual risk

The residual risk without any additional controls is assessed as **LOW**.

6.5.8 WEEDS

Context and assumptions

Reduction in the quality of ecosystems and threatened species' habitats (both either long term or permanent) could occur due to weed introduction and/or proliferation. Impacts may also occur due to bushfire caused by the proliferation of weeds creating higher fuel loads and therefore more intense fires.

There are many weed species within the Project footprint (see Section 6.1.8.2), especially on pastoral properties around watercourses, tracks and previously-disturbed areas. Clearing of native vegetation has the potential to increase the risk of weed spread because the open, disturbed ground is readily colonised and dominated by the fast growing weed species. Movement of personnel and vehicles throughout the Project area also has the potential to increase the likelihood of weed species being introduced into areas previously not recorded. Proliferation of weed species has the potential to lead to displacement of native vegetation, a reduction in habitat quality, reduction in food sources for fauna, and increased frequency and intensity of bushfires. The latter can also negatively impact upon the pastoral productivity of the land.

In assessing the inherent risk (without controls), it is assumed that weeds are common within the Project footprint, are easily transported, and that no weed hygiene activities are undertaken prior to, and during, land access. Weeds are not considered a threatening process for Plains Death Adder (TSSC 2012). Therefore, a risk assessment of the potential impact of weeds to threatened species has not been undertaken.

Inherent risk

There is an **EXTREME** risk that, without controls, weeds could be introduced and spread by the Project activities and subsequently cause impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Major	A weed infestation, especially in a weed-free environment, could have a major consequence at an ecosystem level. Rectification would be difficult, particularly of a weed that naturally spreads on introduction.

Risk component	Ranking	Explanation
Likelihood	Almost certain	Without controls in place, weeds spread very readily on vehicles driven from infested areas into weed-free areas. Weeds are often abundant along the corridor of other linear projects that have been undertaken in Northern Australia.

Controls

The Weed Management Plan (Appendix J) outlines strategies to limit the introduction of new weeds within the Project area and limit the spread of existing weeds during construction activities. The main weed controls are:

- prior to entering the construction site, vehicles, machinery and equipment must undergo weed hygiene inspections carried out by a trained Weed Hygiene Inspector in compliance with the Queensland Government Biosecurity Queensland Checklists (this is in lieu of the Northern Territory Government having equivalent procedures). Transport must be via approved transport routes.
- the introduction of soil or fill material must be accompanied by a Weed Hygiene Declaration form.
- prior to construction, the Project footprint will be surveyed to map existing weeds within the Project footprint or immediate surrounds. The information from the weed survey, combined with the desktop search results, will be used to map and categorise weed management zones (‘weed zones’). Weed zones will be determined based on:
  - weed species and density recorded during the weed survey
  - weed classes according to Northern Territory and Queensland legislation
  - location of state, territory and property boundaries
  - likely construction activities within each zone
  - proximity to watercourses.
- the weed zones will inform weed control and weed hygiene requirements. The weed zones will only apply to initial land clearing and topsoil removal works, and reinstatement and reinstatement works – i.e. those works undertaken in ‘dirty’ areas (see below). The method for determining weed zones, and specific controls required for each zone, will be confirmed with the Weeds Branch of DLRM following the weed survey, and this weed management plan will be updated with the additional information.

All vehicles and machinery working with topsoil or vegetation will be considered to be working in a ‘dirty’ area, in that there is the potential for these activities and vehicles to spread weed seed and/or vegetative material throughout the Project footprint. Vehicles and machinery with approval to operate in the ‘dirty’ area will include those involved in vegetation clearing, topsoil removal, weed control and those involved in backfilling and reinstatement activities. This will apply to vehicles and machinery establishing access tracks, clearing and establishing the construction ROW, clearing and establishing temporary construction infrastructure (camps and water storage dams), and establishing the compressor station sites. The vehicles and machinery working in ‘dirty’ areas will be required to use weed hygiene facilities, and operators will be required to undertake weed hygiene training. Weed hygiene inspections will be undertaken on these vehicles between weed zones.

During reinstatement of disturbed areas (i.e. filling in trench, replacing topsoil and spreading cleared vegetation) weed management will again be around weed zones.

Some Landholders may have specific weed hygiene requirements. These will be taken into consideration when identifying week risk zones.

The Weed Management Plan (Appendix J) outlines responsibilities, monitoring, performance indicators, corrective actions and reporting.

Assessment of effectiveness

The Weed Management Plan (Appendix J) includes best-practice measures to ensure appropriate hygiene of vehicles, education of personnel (e.g. cleaning boots and equipment between weed infested sites and other areas), active management protocols (e.g. hand pulling, spraying), and protocols for suitable storage of material likely to contain weed seed.

Prior to commencement of construction activities, the Project footprint will be subject to a complete weed survey; weed infestations will be mapped and location-specific weed controls developed where necessary. The approach to weed survey will be in accordance with DLRM Guidelines (Weed Management Branch 2015), which are considered best-practice.

Residual risk

Assuming the proposed controls are effectively implemented, the residual risk is assessed as **SIGNIFICANT**. This residual level of risk may be able to be lowered following completion of the weed survey and further development of the Weed Management Plan. Justification for the reduction in risk is discussed below.

Risk component	Ranking	Justification for reduced risk level
Consequence	Severe	Given the controls proposed, a weed infestation due to construction phase activities should be localised, quickly identified and readily rectified. As such, there would only be temporary harm to the environment, containment to a small area and no off-site spread.
Likelihood	Possible	Effective weed hygiene procedures should ensure that a weed infestation due to construction phase activities would be an irregular occurrence.

6.5.9 FERAL FAUNA

Context and assumptions

Reduction in the quality of ecosystems and loss of threatened species could occur due to the introduction or proliferation of feral fauna species.

There are many vertebrate pest animal species extant within the Project area (Section 6.1.8.3), consistent with similar areas throughout Australia. It is therefore assumed that the region is already populated by the array of vertebrate pest animal species likely to occur in the semi-arid zone

Components of the construction phase have the potential to facilitate the proliferation of vertebrate pest animal species through, for instance, access to additional food resources during poorly-managed waste stream or the creation of breeding habitat (e.g. temporary dams for the Cane Toad).

In assessing the inherent risk (without controls), it is assumed that no waste mitigation occurs. In addition, for threatened species, it is assumed that:

- Cane Toad breeding habitat is established during construction activities.
- according to TSSC (2012), the main identified threat to the Plains Death Adder is mortality by ingestion of the toxic Cane Toad. As noted in Section 6.1.8.3, it is unclear to what extent Cane Toad occurs within the Project footprint. The most recent distribution modelling of Cane Toad includes the channel country to the eastern terminus of the pipeline, with modelling predicting potential distribution of the species westwards along the entire Project footprint. That region is considered marginal habitat for Cane Toad, with a maximum or 3 to 4 suitable breeding months.

  During field surveys for this EIS, ecologists recorded Cane Toads along the roadside near Camooweal – approximately 80 km north of the construction ROW. Camooweal is higher in the catchment than the Project footprint and so it could be assumed that Cane Toad would be presented downstream. However, there have been no observations of Cane Toad at either Avon Downs or Austral Downs, which are both located in black soil country (the latter only 4 km north of the construction ROW).

  Two possible conclusions can be drawn from this:

  a) Cane Toads have reached the limits of southerly expansion (as dictated by water availability) in the region, which does not include the construction ROW (except, perhaps, at the Mount Isa end). This seems the likeliest conclusion given the species is present in Camooweal, but not downstream at Austral Downs.

  b) Cane Toads have yet to spread as far south as the construction ROW (except, perhaps, at the Mount Isa end), but suitable (albeit sub-optimal) habitat occurs, and so expansion into that region is inevitable. This is only possible if the species only recently made it to Camooweal and has not yet had the opportunity to travel downstream.

Therefore, the inherent likelihood of Cane Toad being introduced into area of the Project footprint within which it does not yet occur is either zero (because the species cannot occur there) or else possible, but largely inconsequential, because self-introduction was inevitable and likely to occur soon. For these reasons, a risk assessment of the potential impact of feral fauna to threatened species has not been undertaken.

Inherent risk – ecosystems

There is a **LOW** risk that, without controls, pest animals could be introduced and spread by the Project activities and subsequently cause impacts at an ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Minor	Any impact would be minor on-site effects rectified with negligible residual impact. At worst, an increase in vertebrate pests would only be temporary with campsites moving every couple of months.

Risk component	Ranking	Explanation
Likelihood	Rare	The impact is not likely to occur in this location. It is likely that the region is already populated by the array of vertebrate pest animal species likely to occur in the semi-arid zone.

Controls

Notwithstanding the low inherent risk, there are controls in place that will ensure this risk is eliminated or remains low. Specifically, Chapter 13 outlines waste management controls that will be implemented across each Project phase.

Residual risk

Risks associated with this impact are inherently **LOW**, and implementation of standard procedures through the CEMP will further reduce the likelihood of impacts occurring over the construction phase of the Project.

6.5.10 NOISE AND VIBRATION

Context and assumptions

Reduction in the quality of ecosystems and threatened species' habitats (both temporary) could occur due to noise and vibration. It is difficult to quantify and measure noise disturbance to native fauna given that different species have different tolerances and different capacities to move away from a noise disturbance.

In assessing inherent risk (without controls) – based on the Noise Assessment Report (Appendix T) – it is assumed that:

- the 65 dB(A) threshold screening criteria is only exceeded within 200 m of construction activities
- for species which may be more sensitive to noise and which have permanent nesting, roosting or colony areas (e.g. bats), the conservative assessment criteria of 12 dB(A) above existing LA_{eq} levels was applied meaning that construction activities have the potential to cause disturbance of noise-sensitive fauna up to 1 km from the construction ROW.
- no such species have been detected in the vicinity of the construction footprint.
- blasting will only be undertaken for this Project in rocky areas. The intent of blasting is not to create a pit, but rather to fracture rock to be later removed by an excavator.
- sensitive fauna have the potential to be affected by vibration and overpressure within 400 m of the blasting.
- because construction will be progressive, any noise or blasting impacts will be short-lived.

Inherent risk

This inherent risk assessment on the impact to ecosystems also applies to the Plains Death Adder because that species has a vast and contiguous extent of occurrence within which to temporarily retreat (if necessary) and does not occur in areas where blasting will be required.

There is a **LOW** risk that, without controls, noise emissions would cause a level of disturbance to fauna that would result in impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Serious	A short-lived noise disturbance extending 200 m either side of the construction ROW constitutes a minor effect at an ecosystem level.
Likelihood	Rare	It would be an exceptional circumstance in which such a temporary and localised noise disturbance had an impact at an ecosystem level.

Controls

Notwithstanding the low inherent risk to the environment posed by this potential impact, there are controls in place that would further reduce this risk. A Noise Management Plan (Appendix U) has been developed which will minimise the noise impacts on the environment.

The blasting subcontractor will be required to provide a Blasting Management Plan demonstrating compliance with all approval conditions prior to the commencement of blasting activities. Monitoring and recording of the air blast overpressure and ground borne vibration will be undertaken in accordance with regulatory requirements using the *Queensland Transport – Technical Note 3 April 1993 – Measurement of Ground Vibration and Air Blast*.

Assessment of effectiveness

The noise controls that will be implemented are best-practice in accordance with the *Code of Environmental Practice for Onshore Pipelines* (APIA 2013) and regulatory requirements included in the Environment Authority for the Project issued pursuant to the EP Act in Queensland. The Construction Contractor has Standard Operating Procedures for management of noise, and experience implementing these procedures on other pipeline projects.

Residual risk

The residual risk without any additional controls is assessed as **LOW**. The routine controls are expected to ensure that the risk remains low for the duration of the construction phase.

6.5.11 DUST

Context and assumptions

Reduction in the quality of ecosystems and threatened species' habitats (both temporary) could occur due to dust. Construction will generate dust when vegetation is cleared – exposing soils to wind – and by vehicles travelling along unsealed roads. The Air Quality Assessment Report (Appendix V) modelled the likely impacts of dust emissions of human sensitive receptors, but not on the environment.

Matsuki et al. (2016) studied the impacts of dust on plants in a semi-arid environment. For chemically-inert dust (i.e. that which comes from a disturbance of the existing environment), the study made the following observations:

- negative effects of dust on plants have primarily been reported in temperate and arctic environments
- arid and semi-arid environments are inherently dusty due to constant wind erosion and occasional dust storms, therefore plants in these environments are likely to be exposed to dust naturally and may be less likely to suffer short term impacts
- during the dry season, when dust is more likely, many arid and semi-arid plants naturally either die or reduce growth
- dust deposition could be high within 150 m of the source, but decreased rapidly with increasing distance and over time
- the influence of rainfall had a stronger effect on plants than dust.

The study reached a similar conclusion to similar studies – it seems likely that short-term dust generation in arid and semi-arid environments does not result in negative impacts on vegetation.

In assessing the inherent risk (without controls), it is assumed that the semi-arid environment within which the NGP Project is proposed to be undertaken is similar to the semi-arid environment within which the abovementioned study was undertaken.

In the absence of any indications otherwise, it is assumed that dust will have a negligible impact on Plains Death Adder. The species is not especially dependant on the health of the vegetation in its environment (especially if that health is only compromised for a short period of time), and has a vast and contiguous extent of occurrence within which to temporarily retreat (if necessary). Therefore, a risk assessment of the potential impact of dust to threatened species has not been undertaken.

Inherent risk – ecosystems

There is a **LOW** risk that, without controls, dust emissions would cause a level of disturbance to vegetation communities and fauna that would result in impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Serious	A short-lived dust disturbance a few hundred metres either side of the construction ROW constitutes a temporary, localised effect at an ecosystem level.
Likelihood	Rare	It would be an exceptional circumstance in which such a temporary and localised dust disturbance had an impact at an ecosystem level.

Controls

Notwithstanding the low inherent risk, there are controls in place that would further reduce this risk. General controls including dust suppression from water carts, and reinstatement and rehabilitation are outlined in the Air Quality Management Plan (Appendix W).

Assessment of effectiveness

The dust controls that will be implemented are best-practice in accordance with the *Code of Environmental Practice for Onshore Pipelines* (APIA 2013). The Construction Contractor has Standard

Operating Procedures for management of air quality, and experience implementing these procedures on other pipeline projects.

Residual risk

The residual risk without any additional controls is assessed as **LOW**. The routine dust controls are expected to ensure that the risk remains low for the duration of the construction phase.

6.5.12 WATER QUALITY

Context and assumptions

Reduction in the quality of ecosystems and threatened species' habitats (both either long term or permanent) may occur due to reduced water quality caused by:

- chemical spill
- sedimentation from erosion
- uncontrolled release of contaminated water.

Changes in the quality of surface and/or groundwater can lead to enduring impacts on ecosystems that depend on that water. For this Project, such changes to water quality may potentially occur during the transportation and storage of chemicals, during camp waste water treatment, from disposal of water used for hydrostatic testing, by exposure of problematic soils, and by sedimentation entering watercourses from the erosion of disturbed soils.

In assessing the inherent risk (without controls), it is assumed that:

- impact is localised and temporary due to the low volumes of potential contaminants and there being no permanent water in the construction footprint.
- works are undertaken during times when there is no flow or low flow in the watercourses.

The Plains Death Adder does not live within waterbodies, and so changes in water quality will not affect this species. Therefore, a risk assessment of the potential impact from reduced water quality to threatened species has not been undertaken.

Inherent risks – ecosystems

There is an **HIGH** risk that, without controls, water quality could be compromised and by Project activities and subsequently cause impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Severe	Given the nature of the Project and the semi-arid environmental context, compromised water quality could have a temporary localised effect at an ecosystem level.
Likelihood	Likely	It is likely that unmitigated Project construction activities could lead to compromised water quality that had an impact at an ecosystem level.

Controls

There are a large number of specific management and mitigation measures to reduce this risk that will be incorporated into relevant management plans (Water Management Plan, CEMP and Hydrostatic Test Management Plan) prior to the commencement of construction.

See the water risk assessment (Chapter 7) for details of these measures.

Assessment of effectiveness

Given the large number of specific management and mitigation measures proposed to reduce this risk, the reader is referred to the water risk assessment (Chapter 7) for a detailed assessment of those measures' likely effectiveness.

Residual risk

All residual risks were assessed as **LOW** apart from the disposal of hydrostatic test water, which remained **MODERATE**. This risk remained moderate as the level of information currently available precludes its robust assessment; however, the nature of the Project necessitates that the information relevant to this risk is further refined during the detailed design phase of the Project.

6.5.13 WATER AVAILABILITY

Context and assumptions

Reduction in the quality of ecosystems, loss of threatened species and loss of sensitive vegetation types may occur due to reduced water availability because of extraction of water for construction activities from natural sources and/or because of altered surface water flows due to construction activities. The wetlands and watercourses in the region are ephemeral, thus environmental water from surface water sources is only temporarily available. Seasonal groundwater levels may influence the duration that the region's swamps and wetlands retain water.

Changes in the quantity and/or availability of surface and/or groundwater can lead to enduring impacts on ecosystems that depend on that water. For this Project, such changes may potentially occur due to water extraction for construction and/or hydrostatic testing purposes, and/or from construction activities alter surface water flows as a result of the installation of the pipeline across watercourses.

In assessing the inherent risk (without controls), it is assumed that:

- at any one site, volumes extracted will be relatively small one-off events
- works are undertaken during times when there is no flow or low flow in the watercourses.

The Plains Death Adder does not live or depend on waterbodies, and so changes in water availability will not affect this species. Therefore, a risk assessment of the potential impact from changes in water availability to threatened species has not been undertaken.

Inherent risks – ecosystems and sensitive vegetation types

There is an **HIGH** risk that, without controls, water quantity could be compromised by Project activities and subsequently cause impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Severe	Given the nature of the Project and the semi-arid environmental context, reduced water quantity could have a temporary localised effect at an ecosystem level.
Likelihood	Likely	It is likely that unmitigated Project construction activities could lead to reduced water quantity that had an impact at an ecosystem level.

Controls

There are a large number of specific management and mitigation measures to reduce this risk, including:

- develop, prior to construction, and implement a Hydrostatic Testing Management Plan that adheres to the requirements of the *APIA Code of Environmental Practice: Onshore Pipelines* (2013).
- source water from approved sources in accordance with agreements.
- prior to construction, assess the sustainable yields for proposed groundwater extraction bores.
- measure the standing water level in bores prior to, during, and immediately following extraction to provide insight into drawdown.
- any new bores required will be drilled by a driller licenced under relevant legislation (e.g. NT *Water Act*).
- develop and implement a Water Management Plan (Construction).
- construct watercourse crossings in the following order of preference; firstly, in times when there is no water present, secondly in times of no flow, or thirdly, in times of flow, but in a way that does not impede low flow.
- develop and implement specific Progressive ESCP for watercourse crossings in accordance with Appendix P of the IECA Guidelines.
- design, install and reinstate watercourse crossings in accordance with the *APIA Code of Environmental Practice: Onshore Pipelines* (2013)
- reinstate watercourse crossings as soon as practicable after construction of crossing is complete to minimise duration of disturbance.
- only activities directly required for linear infrastructure construction are to be undertaken within watercourses.

Assessment of effectiveness

The Hydrostatic Test Management Plan will need to comply with the *APIA Code of Environmental Practice: Onshore Pipelines* (2013).

Adherence to the IECA Guidelines is considered best practice, and industry standard. This is considered an effective mitigation measure when implemented appropriately.

Residual risk

All residual risks were assessed as **LOW** apart from groundwater extraction, which remained **MODERATE**. This risk remained moderate as the level of information currently available precludes its robust assessment. For new bores, use of a licenced driller and compliance with relevant sections of relevant legislation (e.g. NT *Water Act*) is considered to be proven effective in minimising impacts of new bores on the aquifer. For existing bores, further work is required to demonstrate the effectiveness of controls once additional detail is available on the location and volumes of groundwater extraction.

6.5.14 BUSHFIRE

Context and assumptions

Reduction in the quality of ecosystems and threatened species' habitats (both temporary) may occur due to bushfire. Construction works – particularly welding – could generate sparks and cause bushfires. Bushfire has the potential to cause direct mortality to fauna, displacement of fauna, and/or reduction in habitat quality. Bushfire, however, is a common occurrence in some vegetation communities in the region (see Section 6.1.8.1).

As detailed in Section 6.1.8.1, fire mapping indicates that approximately half of the Project footprint has burnt two to three times between 2003 and 2015. This is on the higher scale of burning frequency for central Australia. The black soil country between KP 353 and KP 561 generally experienced no fires between 2003 and 2015 – likely due to cattle grazing (fuel-load reduction) and perhaps the lack of spinifex-dominated grasslands.

Given the above context, in assessing the inherent risk (without controls) for this potential impact, it is assumed that that any bushfires generated by Project activities serve to increase the frequency of bushfires that occur in the region.

It is also assumed that no attempts are made to control bushfires generated by Project activities.

With respect to the Plains Death Adder, it is assumed that the black soil country which comprises critical Plains Death Adder habitat also has a low susceptibility to bushfire and is not heavily impacted by the few bushfires which do occur. This assumption is based on field observations of that habitat being sparsely vegetated (tussocks of grass occurring in small, discrete patches – see Figure 6-13) and exhibiting little evidence of historic burning (confirmed by the fire mapping mentioned above).

For these reasons, a specific risk assessment of the threat of bushfire to threatened species has not been undertaken.

Inherent risk – ecosystems

There is a **SIGNIFICANT** risk that, without controls, fire caused by construction activities could result in impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Severe	A bushfire could have a major temporary effect at an ecosystem level.
Likelihood	Possible	It is possible that unmitigated Project construction activities could cause a bushfire that had an impact at an ecosystem level.

Controls

All construction activities, including establishment and operation of temporary camps, will occur within cleared Project footprints to minimise the risk of ignition sources coming into contact with flammable material (such as cleared vegetation). Any works involving potential ignition sources will have fire prevention and control requirements included in relevant procedures. All vehicles and equipment will be equipped with fire extinguishers and water carts will be located in the proximity of high fire risk activities on high fire danger days. There will be dedicated places for smoking and butt collection bins. Fire ratings and warnings in the area will be monitored and Jemena and the Construction Contractor will liaise with Bushfires NT and Rural Fire Service Queensland as required.

Assessment of effectiveness

The above controls all represent industry best-practice and are expected to be effective in reducing the probability and extent of bushfire.

Residual risk – ecosystems

Assuming the proposed controls are effectively implemented, the residual risk is assessed as **MODERATE**. Justification for the reduced risk level is discussed below.

Risk component	Ranking	Justification for reduced risk level
Consequence	Severe	A bushfire could have a temporary effect at an ecosystem level.
Likelihood	Rare	With the controls in place, it would be an exceptional circumstance in which Project activities cause a bushfire that had an impact at an ecosystem level.

6.5.15 FAILURE OF REHABILITATION

Context and assumptions

Reduction in the quality of ecosystems and threatened species’ habitats (both either long term or permanent) may occur due to inadequate reinstatement contributing to a failure of rehabilitation. During the construction phase, reinstatement of all disturbed areas will be undertaken progressively (apart from tracks required for access to permanent facilities or requested to be retained by the landholder or manager). Reinstatement will involve replacing all sub-soils where excavated, re-spreading all top soils, re-contouring of the disturbed area to match the surrounding landscape, installation of flow diversion banks as required by the Primary ESCP and re-spreading cleared vegetation over the reinstated soils. The topsoil will contain seed stock which will aid in natural revegetation of the area. Rehabilitation

success will depend, to varying degrees, on the adequacy of the reinstatement – particularly because inadequate reinstatement may lead to loss of topsoil due to erosion.

The majority of the land clearing is narrow and linear, and the vegetation communities within the Project footprint are regionally common and widespread (see Section 6.1.3).

In assessing the inherent risk (without controls), it is assumed that inadequate reinstatement only occurs in discrete locations (i.e. it is not systemic).

It is further assumed that the critical habitat of Plains Death Adder is sparsely-vegetated (see Figure 6-13), and so vegetation integrity is not an important ecological requirement for this species (as compared with, for instance, a woodland species). Therefore, localised rehabilitation failure due to inadequate reinstatement would have a negligible impact on the habitat quality of this threatened species, and so a risk assessment of the potential impact to threatened species has not been undertaken.

Inherent risk – ecosystems

There is a **HIGH** risk that, without controls, reinstatement and rehabilitation may fail and this could cause impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Severe	Failure of rehabilitation due to inadequate reinstatement could have at temporary, localised effect at an ecosystem level.
Likelihood	Likely	Poor rehabilitation is evident along the corridors of other linear projects that have been undertaken in Northern Australia.

Controls

The reinstatement and rehabilitation procedures for the construction footprint and associated acceptance criteria are detailed in the Environmental Management Plan (Chapter 13). Reinstatement will follow the Construction Contractor's Reinstatement Management Procedure. It details how land will be cleared, vegetation stored, and land reinstated in the optimal way to give reinstatement the best chance of being successful. Reinstatement will be audited against strict acceptance criteria. Reinstatement works and weed control will be undertaken as required. In addition to re-instatement of species richness to at least 70 per cent of pre-disturbance, the acceptance criteria include a requirement that declared plant pest species (weeds) must be equal to or less than the pre-disturbance land use.

Assessment of effectiveness

The process for reinstatement detailed in the Environmental Management Plan (Chapter 13) is derived from the *APIA Code of Environmental Practice for Onshore Pipelines (2013).*

The reinstatement and rehabilitation acceptance criteria for the NGP are prescribed in the Environmental Authority for the Queensland component of the NGP Project issued by the Department of Environment and Heritage Protection (DEHP); these acceptance criteria will be used across the Project area. These acceptance criteria are applied routinely to similar Projects in Queensland and therefore are considered effective for long-term mitigation of biodiversity impacts. As the acceptance criteria apply to the life of the Project they are expected to be effective in ensuring that any failure of rehabilitation is detected and rectified.

The effectiveness of rehabilitation will only be determined during the Project's' Operation Phase. The extent to which the Project has the potential to cause a significant impact to the environment because of unsuccessful reinstatement will largely depend on the effectiveness of the weed control measures implemented through the Weed Management Plan (Construction), and during operational phase weed surveillance and control.

Residual risk

Assuming the proposed controls are effectively implemented (including ongoing monitoring and management in the Operations Phase (see section 6.6.1), the residual risk is assessed as **MODERATE**. Justification for the reduced risk level is discussed below.

Risk component	Ranking	Justification for reduced risk level
Consequence	Severe	Failure of rehabilitation due to inadequate reinstatement could have at temporary, localised effect at an ecosystem level.
Likelihood	Unlikely	With the controls in place, it would be an uncommon occurrence for failure of rehabilitation due to inadequate reinstatement to have an effect at an ecosystem level.

6.6 OPERATIONAL PHASE RISKS

The Project's Operational Phase will have a small team of field staff responsible for the operation and maintenance activities in Mount Isa and Tennant Creek. There will be ongoing weed control and rehabilitation monitoring. There is also risk of pipeline failure leading to bushfire.

6.6.1 WEEDS

Context and assumptions

Reduction in the quality of ecosystems and threatened species' habitats (both either long term or permanent) may occur due to weed introduction and/or proliferation caused by operational usage of vehicles. During the Project's construction phase, weeds will be managed according to the Construction Weed Management Plan (Appendix J). That plan allows for hygiene and weed management as required. However, the effectiveness of the Weed Management Plan cannot be determined during the short term construction phase, consequently ongoing surveillance and, if necessary weed management, is required.

During the operations phase, opportunities for weed spread due to Project activities are substantially reduced. The only traffic along the reinstated ROW will be that associated with weed surveillance and control.

In assessing the inherent risk (without controls), it is assumed that construction phase weed management has been largely successful, but that there is still the occasional new outbreak of weeds. It is also assumed that there will be low traffic volumes associated with operations work.

Construction phase weed management has been largely successful, but that there is still the occasional new outbreak of weeds.

Weeds are not considered a threatening process for Plains Death Adder (TSSC 2012) and so a risk assessment of the potential impact of weeds to threatened species has not been undertaken.

Inherent risk

There is an **EXTREME** risk that, without controls, weeds introduced during the construction phase could spread, and could cause impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Major	A weed infestation, especially in a weed-free environment, could have a major consequence at an ecosystem level. Rectification would be difficult, particularly of a weed that naturally spreads on introduction.
Likelihood	Likely	Without controls in place, weeds spread very readily on vehicles driven from infested areas into weed-free areas. A weed infestation impacting at an ecosystem level due to planning phase activities would be a likely occurrence.

Controls

The control for weeds is ongoing surveillance and management which will be outlined in the Operations Weed Management Plan. This plan will outline the surveillance strategy which will be supported by the pre-construction weed mapping.

Assessment of effectiveness

The effectiveness is dependent on implementation of the Operations Weed Management Plan. If the plan is implemented fully – including strategic surveillance and control for the period that is required to assess weeds – it is expected to be effective.

Residual risk

Assuming the proposed controls are effectively implemented, the residual risk is assessed as **MODERATE**. Justification for the reduced risk level is discussed below.

Risk component	Ranking	Justification for reduced risk level
Consequence	Severe	Given the controls proposed, a weed infestation due to operations phase activities should be localised, quickly identified and readily rectified. As such, there would only be temporary harm at an ecosystem level, containment to a small area and no off-site spread.
Likelihood	Unlikely	Effective weed hygiene procedures should ensure that a weed infestation due to planning phase activities would be an uncommon occurrence.

6.6.2 NOISE

Context and assumptions

Reduction in the quality of ecosystems and threatened species' habitats (both temporary) may occur due to noise from the compressor stations. During operations, gas flaring and venting will occur at the

compressor stations. This will occur during emergency release of gas and during maintenance periods. The venting duration is expected to be 15 minutes once every 6 months.

The Noise Assessment Report (Appendix T) states that during venting noise levels have the potential to exceed the LA_{eq} short term criteria at a distance of up to 1.5 km. Therefore, a potential impact on noise-sensitive ecological receptors is predicted up to 1 km from the compressor stations (using the criteria of 12 dB(A) above background).

It is difficult to quantify and measure noise disturbance to native fauna given that different species have different tolerances and different capacities to move away from a noise disturbance. In assessing the inherent risk (without controls), it is assumed that there are no threatened fauna or noise-sensitive ecological receptors (e.g. significant bat colonies) within the zone of influence (as reported in the Threatened Species Survey Report – Appendix G). Therefore, a risk assessment of the potential impact of noise during operations to threatened species has not been undertaken.

Inherent risk – ecosystems

There is a **LOW** risk that, without controls, noise emissions would create an amount of disturbance to fauna that would lead to impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Minor	A short-lived noise disturbance twice a year constitutes a minor effect at an ecosystem level.
Likelihood	Rare	It would be an exceptional circumstance in which such a temporary and localised noise disturbance had an impact at an ecosystem level.

Controls

Notwithstanding the low inherent risk, there are controls in place that would further reduce this risk. A Noise Management Plan (Appendix U) has been developed which will minimise the noise impacts on the environment.

Assessment of effectiveness

The Noise Management Plan was prepared by specialist consultants based on numerical modelling of potential impacts. Therefore, the noise controls are likely to be effective in eliminating or further reducing the level of risk, and ensuring it remains low for the duration of the Project life.

Residual risk

The residual risk without any additional controls is assessed as **LOW**. The proposed controls are expected to ensure that the risk remains low for the duration of the operations phase.

6.6.3 FAILURE OF REHABILITATION

Context and assumptions

Reduction in the quality of ecosystems and threatened species' habitats (both either long term or permanent) may occur due to the failure of rehabilitation (because of insufficient natural revegetation).

During the construction phase all disturbed areas not required for operations or not requested by landholders to be retained (for example dams and access tracks) will be reinstated. Rehabilitation will be from natural growth of grasses and shrubs. The success of rehabilitation will not be known for some years after reinstatement.

A failure of rehabilitation could lead to weed establishment and may lead to erosion issues.

In assessing inherent risk (without controls), it is assumed that unsuccessful rehabilitation only occurs in discrete locations (i.e. it is not systemic). It is further assumed that the critical habitat of Plains Death Adder is sparsely-vegetated (see Figure 6-13), and so vegetation integrity is not an important ecological requirement for this species (as compared with, for instance, a woodland species). Therefore, localised rehabilitation failure due to inadequate reinstatement would have a negligible impact on the habitat quality for the species.

Inherent risk

There is a **HIGH** risk that, without controls, that rehabilitation could fail and this could lead to impacts at the ecosystem level. The likelihood and consequences of this impact occurring are discussed below.

Risk component	Ranking	Explanation
Consequence	Severe	Failure of rehabilitation could have at temporary, localised effect at an ecosystem level.
Likelihood	Likely	Poor rehabilitation is evident along the corridors of other linear projects that have been undertaken in Northern Australia.

Controls

The reinstatement and rehabilitation procedures for the construction footprint and associated acceptance criteria are detailed in the Environmental Management Plan (Chapter 13). Reinstatement will follow the Construction Contractor's Reinstatement Management Procedure, which details how land will be cleared, vegetation stored, and land reinstated in the optimal way to give reinstatement the best chance of being successful.

Reinstatement will be audited against strict acceptance criteria. Reinstatement works and weed control will be undertaken as required. In addition to re-instatement of species richness to at least 70 per cent of pre-disturbance, the acceptance criteria include a requirement that declared plant pest species (weeds) must be equal to or less than the pre-disturbance land use.

To mitigate the potential of this risk being realised, rehabilitation success and erosion will be monitored. If initial reinstatement activities do not facilitate regrowth in some areas, then active revegetation (e.g. hand seeding) will be undertaken, if required. This is most likely to occur in watercourse crossings (approaches and banks). Seeding will also be considered for areas where erosion risk is high; grass seed will be spread to establish a ground cover in those areas.

Assessment of effectiveness

The process for reinstatement and rehabilitation detailed in the Environmental Management Plan (Chapter 13) is derived from the *APIA Code of Environmental Practice for Onshore Pipelines (2013).*

The reinstatement and rehabilitation acceptance criteria for the NGP are prescribed in the Environmental Authority for the Queensland component of the NGP Project issued by the Department of Environment and Heritage Protection (DEHP); these acceptance criteria will be used across the Project area. These acceptance criteria are applied routinely to similar projects in Queensland and therefore are considered effective for long-term mitigation of biodiversity impacts. As the acceptance criteria apply to the life of the Project they are expected to be effective in ensuring that any failure of rehabilitation is detected and rectified.

The extent to which the Project has the potential to cause a significant impact to the environment because of unsuccessful rehabilitation will largely depend on the effectiveness of the weed control measures implemented through the Weed Management Plan (Construction), and during operational phase weed surveillance and control (see Section 6.6.1).

Residual risk

Assuming the proposed controls are effectively implemented, the residual risk is assessed as **MODERATE**. Justification for the reduced risk level is discussed below.

Risk component	Ranking	Explanation
Consequence	Severe	Failure of rehabilitation could have at temporary, localised effect at an ecosystem level.
Likelihood	Unlikely	With the controls in place, it would be an uncommon occurrence for failure of rehabilitation to have an effect at an ecosystem level.

6.6.4 PIPELINE FAILURE

Context and assumptions

Reduction in the quality of ecosystems and threatened species habitats (both temporary) may occur due to a bushfire caused by pipeline failure and ignition.

The pipeline will be designed, constructed, tested, operated and maintained in accordance with *Australian Standard 2885 Pipelines – Gas and Liquid Petroleum (AS 2885)* and other applicable standards and regulations or industry Codes of Practice. This industry is mature and such incidents are rare. As part of the NGP Initial *AS2885 Safety Management Study* (SMS), the likelihood of an ignited gas release was assessed as low.

For the same reasons presented in Section 6.5.14, a risk assessment of the threat of bushfire to threatened species has not been undertaken.

Inherent risk

Whilst it is unlikely that fire or explosion would occur on a pipeline designed and operated in accordance with *AS2885*, the inherent risk (without controls) is assessed as **MODERATE.** Justification for the reduced risk level is discussed below.

Risk component	Ranking	Explanation
Consequence	Major	A bushfire could have a major temporary effect at an ecosystem level.
Likelihood	Rare	The pipeline industry is mature and pipeline failures occur only in exceptional circumstances.

Controls

During the operation phase, the following controls will be implemented in accordance with AS 2885:

- signage installed and maintained to mark location
- 'Dial Before You Dig' active for pipeline
- regular aerial and ground patrols of pipeline and facilities
- third party crossings are recorded in the Crossing Notification System (CNS), and are subject to the Jemena Permit to Work system
- community awareness and engagement program
- 24/7 monitoring of the pipeline enables gross leak detection
- implement Pipeline Isolation Plan
- implement Emergency Response Plan
- securely fence compressor stations and pipeline facilities
- automated fire and leak detection and alarm systems.

The pressure, flow and volumes of gas sent and received at each end will be continuously monitored. Any change in pressure or volumes indicative of a gas leak would be identified by the Jemena Control Room and immediately investigated. Compressor station staff, local contractors or emergency services would be contacted depending on the nature of the issue detected.

Smoke, flame and/or gas detection equipment is installed at the compressor stations and pipeline facilities huts and are remotely monitored by the Control Room. In the event of an emergency involving gas release from the pipeline, the Control Room, through remote or local actuation of MLVs, will isolate the gas flow.

In the very unlikely event of an ignited gas release fire, initiation outside the site boundaries is prevented through the design of the facilities, which requires sufficient spacing of gas containing equipment from the site boundary to prevent thermal radiation initiated fires. In addition, all facilities have automatic shut-off capabilities and gas flow can be controlled from the Jemena Control Centre. Based on the safety measures that are integrated into the facilities design, the likelihood of a fire or explosion occurring is remote.

Assessment of effectiveness

The proposed controls are in accordance with AS 2885, which is best-practice for pipeline construction and operation. These controls are proven to be effective in ensuring the safety of communities that reside near to many pipelines that are currently operational in Australia.

Residual risk

The residual risk is assessed as **LOW** for fire. This residual level of risk is due to the consequences of an incident occurring irrespective of how unlikely it is that the community would be impacted.

Risk component	Ranking	Explanation
Consequence	Serious	If a fire is initiated due to pipeline failure, the control measures detailed above should ensure the extent is localised, with only a minor effect at an ecosystem level.
Likelihood	Rare	The pipeline industry is mature and pipeline failures occur only in exceptional circumstances.

6.7 MITIGATION AND MANAGEMENT

This section provides additional detail in relation to Jemena's approach to mitigation and management of biodiversity and threatened species risks. Through implementation of the risk controls discussed in the sections above, within the management framework described below, residual risks are expected to be reduced to levels that Jemena considers will be tolerable to Project stakeholders.

Jemena's approach to mitigation and management of biodiversity risks across each Project phase is detailed in the Environmental Management Plan (Chapter 13). As requested in Section 5.4.3 of the EIS ToR, a Biodiversity Management Plan (BMP) (Appendix H) has been prepared to provide clear and concise methods to mitigate impacts on biodiversity. This plan was prepared by Environmental Consultants with demonstrated experience in the mitigation and monitoring of adverse impacts to biodiversity, and incorporates advice received from various advisors with specific expertise in relation to the threatened species – Plains Death Adder – which is likely to occur within the Project footprint. Details of personnel involved in the preparation of the BMP are provided in Appendix D of this EIS.

As the most significant potential impacts to biodiversity are associated with the Project construction phase, the BMP has been prepared specifically to provide the Construction Contractor with clear guidance in relation to appropriate risk controls and monitoring requirements. In addition to the BMP, the following EIS documents provide for mitigation and management of biodiversity impacts:

- Weed Management Procedures (Planning phase) – Appendix I
- Weed Management Plan – Appendix J
- Noise Management Plan – Appendix U
- Air Quality Management Plan – Appendix W
- Traffic Management Plan (Construction) – Appendix E
- Water Management Plan – Appendix O
- Primary Erosion and Sediment Control Plan – Appendix P.

The Construction Contractor will incorporate all biodiversity controls into the CEMP and associated procedures, which will be finalised prior to the commencement of construction activities.

Operational biodiversity risks are less significant and do not require a stand-alone management plan. Biodiversity mitigation and management requirements applicable to the Project operational phase are

detailed in the Environmental Management Plan (Chapter 13 – Section 13.5). Jemena will incorporate these controls into the Operational Environmental Management Plan (OEMP), which will be finalised prior to commencement of operations.

This management framework is consistent with the *Code of Environmental Practice for Onshore Pipelines* (APIA 2013) and is proven to be effective in managing risks associated with the various phases of pipeline projects.

6.8 SUMMARY AND RESIDUAL RISK

The NGP Project will involve activities which do have potential to impact on the area's biodiversity. Each identified risk has been reduced to 'as low as reasonably practicable' through the application of management and mitigation measures, many of which are standard practice for onshore pipeline projects. The mitigation measures prescribed in this chapter are expected to reduce most risks to low; with the exception of residual 'Significant' risks relating to weeds, and 'Moderate' risks associated with failure of reinstatement and rehabilitation.

The residual risk profile for biodiversity is shown in Table 6-9.

Table 6-9. Residual risk profile for biodiversity

PROJECT PHASE	Low	Moderate	Significant	High	Extreme
PLANNING	1	1	-	-	-
CONSTRUCTION	11	4	1	-	-
OPERATIONS	2	2	-	-	-

It is also concluded that the residual risks to Plains Death Adder due to this Project are all 'LOW'. The residual risk table for threatened species is shown in Table 6-10.

Table 6-10. Residual risk profile for threatened species

PROJECT PHASE	Low	Moderate	Significant	High	Extreme
PLANNING	3	-	-	-	-
CONSTRUCTION	25	-	-	-	-
OPERATIONS	6	-	-	-	-

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