


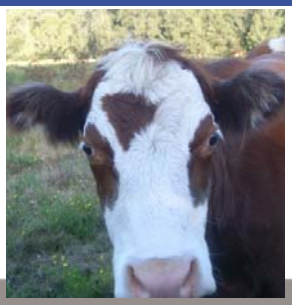


Dumaresq to Lismore 330kV Transmission Line Biodiversity Report

JUNE 2011

Prepared for

TransGrid

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43177662

URS

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Table of Contents

Tables

Plates

Figures

Appendices

Notes on Text

Following the New South Wales State elections on 26 March 2011, a number of State Agencies have changed their names. The Department of Planning (DoP) became the Department of Planning and Infrastructure (DP&I), the Department of Environment Climate Change and Water (DECCW) became the Office of Environment and Heritage (OEH), a division of the NSW Department of Premier and Cabinet (DPC) and Industry and Investment NSW (I&I NSW) became NSW Department of Trade and Investment, Regional Infrastructure and Services (NSW DTIRIS).

Therefore where DoP, DECCW or I&I NSW are mentioned, and where it is appropriate to do so, the reader should note that the new names apply.

Abbreviations

Abbreviation	Description
AP	Angle Position
ASL	Above sea level
CEMP	Construction Environmental Management Plan
CMA	Catchment Management Authority
CVA	Census of Australian Vertebrates
DBH	Diameter at breast height
DECCW	NSW Department of Environment Climate Change and Water
DGR	Director-General Requirements
DPI	Department of Primary Industry (now I&I NSW)
EA	Environmental Assessment
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EWP	Elevated Work Platform
FM Act	NSW *Fisheries Management Act 1994*
FMP	Fire Management Plan
FNSW	Forests NSW
FPC	Foliage Percent Cover
GIS	Geographic Information System
ha	Hectares
hr	Hour
I&I NSW	Industry and Investment NSW (formerly DPI)
km	Kilometre
KTP	Key Threatening Process
kV	Kilovolts
LGA	Local Government Area
m	Metre
mm	Millimetres
NES	National Environmental Significance
NPWS	NSW National Parkes and Wildlife Service
NSW	New South Wales
NV Act	NSW *Native Vegetation Act 2003*
NW Act	NSW *Noxious Weeds Act 1993*
Operational EMP	Operational Environmental Managament Plan
^{o}C	Degrees Celsius
QLD	Queensland
s.5A	Section 5A
SEPP	State Environmental Planning Policy
SEPP 44	*State Environmental Planning Policy No.44 Koala Habitat Protection*
SEPP MP	*State Environmental Planning Policy Major Projects*
SEWPAC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities, formerly known as Department of Environment, Water, Heritage and the Arts (DEWHA)
SIS	Species Impact Statement
sp.	Species
Spp	Species plural
subsp.	Subspecies
TEC	Threatened Ecological Community (formerly Endangered Ecological Community)
TSC Act	NSW *Threatened Species Conservation Act 1995*
URS	URS Australia Pty. Ltd.

Glossary

Terminology used in this EA	Definition
The Project	The Dumaresq to Lismore 330kV Transmission Line or Far North NSW Project comprising all components, i.e. the 205km 330kV alignment, upgrades at the Lismore Substation and Dumaresq Switching Station, establishment of a new substation north-east of Tenterfield, access tracks to and within the proposed easement and the earthwire replacement works and ancillary facilities. Also referred to as the proposed Project.
Study Area	The area in which environmental studies have been undertaken to assist in determining the route, scale and location of the Project components. The study area comprises a western and eastern component as defined below.
Study Area West	The area between and including Dumaresq Switching Station and Tenterfield 330kV Substation in which environmental studies have been undertaken to assist in determining the route, scale and location of the Project components. There is no existing transmission line within this study area.
Study Area East	The area between Tenterfield 330kV Substation and Lismore Substation in which environmental studies have been undertaken to assist in determining the route, scale and location of the Project components. This area includes the existing 132kV easement and adjacent areas to allow expansion to a 60m easement (90m from south of Casino to Lismore Substation) and access tracks.
Preferred Corridor	The corridor identified in September 2009, following initial consultation and environmental studies, within which an alignment would be identified. The corridor width varies between 500m and 1.6km.
Alignment	Refers to the proposed route of the transmission line (also referred to as the centreline) and the associated easement.
Alignment West	Refers to the identified 60m easement and centreline between and including Dumaresq Switching Station and the proposed Tenterfield 330kV Substation. Within this area there is no existing transmission line.
Alignment East	Refers to the proposed 60m easement between Tenterfield 330kV Substation and Lismore Substation (and including Lismore Substation). Between Tenterfield 330kV Substation and Casino, the existing 132kV transmission line would be dismantled and a 330kV line built in its place; and the existing 45m easement would be widened to 60m. Between structure 395 south of Casino and Lismore (14km), the new 330kV line would run adjacent to the existing 132kV line and the easement would be widened to 90m for this section.
Access Tracks	Refers to establishment of on-easement and off-easement access tracks for the purposes of transmission line construction and operational maintenance.
Easement	Refers to a 'right of way' along the transmission line route to enable TransGrid to access the line for inspection and maintenance purposes. The easement rights would also enable TransGrid to control any activity that may pose a risk to the line or to public safety.
Existing 132kV easement	The existing 45m wide easement or 'right of way' between Lismore Substation and Tenterfield 132kV Substation.
The 330kV easement	The proposed easement or 'right of way' associated with the proposed 330kV transmission line between Dumaresq Switching Station and Lismore Substation.

Terminology used in this EA	Definition
Structures	Refers to all of the proposed structures, both angle positions and intermediate structures (see below). Alignment East contains 253 structures and Alignment West 281 structures; however these figures may change as a result of the detailed design.
Angle Position (AP)	Angle positions represent the locations where the direction of the proposed transmission line changes. The majority of the angle positions would be 'tension supporting structures', i.e. rectangular or square based steel lattice towers. There are a total of 70 Angle Positions proposed for the Project.
Intermediate structures	Structures along which the conductors would be strung. Used principally in locations where the transmission line runs in a straight line. These suspension structures would mainly be twin pole H-frame structures, however wide spans may require 'tension supporting structures' such as steel lattice towers.
Transmission line	Refers to the physical wires (conductors) and the pole and tower structures along the alignment.

Executive Summary

TransGrid is proposing to establish a 330kV transmission line between Dumaresq Switching Station near Bonshaw and Lismore Substation (the Project). The Project involves construction of a new 330kV transmission line from Dumaresq Switching Station towards the town of Tenterfield in the west, and an upgrade to the majority of the existing 96L 132kV transmission line that runs between Tenterfield 132kV Substation to Lismore Substation. The Project has an overall length of 205km (**Figure 1**).The new transmission line is required to improve the reliability of electricity supply and meet demand to the far north NSW region.

The Project comprises a single circuit 330kV construction consisting of supporting structures and conductors (i.e. electricity carrying wires). This single circuit transmission line also includes two overhead ground wires, one being an optical fibre ground wire. These would be supported by suspension and tension structures, with spacing between the structures ranging from of 300m to 600m along the line. A total of 534 supporting structures have currently been identified for the Project. However, the final number of supporting structures may change depending on final design requirements. This Project includes the development of substations, structures and the associated access tracks. The Project passes through five Local Government Areas (LGA) of far north NSW, comprising; Tenterfield, Inverell, Kyogle, Richmond Valley and Lismore.

Construction impacts on vegetation and fauna habitat would include *temporary* and *permanent* disturbance to the ground layer, shrub layer and canopy layer vegetation of various vegetation communities.

This report assesses the ecological impacts of the Project with regard to Commonwealth and NSW state planning and environmental legislation. The Project is a Major Project which requires the approval of the Minister for Planning under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project was referred to the Commonwealth in relation to the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act), and has been determined a 'controlled action' because it is likely to have a significant impact on threatened species and communities listed under the EPBC Act (section 18 & 18A). Specifically, the Project was viewed as having potential to significantly impact the threatened ecological community (TEC): *White Box-Yellow Box-Blakeley's Red Gum Grassy Woodland and derived grasslands* ecological community ('Box Gum Woodland' listed under the EPBC Act).

The biodiversity assessment has been undertaken in accordance with the Department of Planning (DoP) Director-General's Requirements (DGRs) issued 11 September 2009 as well as Supplementary DGRs, issued 16 March 2010 (**Appendix A**). The assessment was designed and implemented using a tiered approach that has responded to the changing scope and relative design components for the Project. The approach included regional desktop investigations for the Preliminary Environmental Assessment (PEA), defined desktop investigations for the Environmental Assessment (EA), an EBPC Referral submission to the Commonwealth, numerous field surveys for the EA to address DoP DGRs, Supplementary DGRs as well as the changing scope of the Project as well as associated reporting and mapping.

The primary focus of the biodiversity assessment included potential impacts to Box Gum Woodland; along with all other species, populations and ecological communities and their habitats required by the State and Commonwealth within the DGRs for this EA. In addition to these species, an assessment has been undertaken of the potential impacts to any threatened biota listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), NSW *Fisheries Management Act 1994* (FM Act) and the EPBC Act.

Executive Summary

This biodiversity assessment focuses on the potential impacts associated with common and threatened biodiversity found within the easement, substations and associated access tracks across the project area. Based on survey effort, the following impacts were identified as a result of the Project:

- clearing of between 312 hectares (ha) and 434 ha of native vegetation;
- loss of important habitat features;
- loss of some landscape connectivity;
- increase of non-native flora and fauna species in the local area; and
- the potential alteration of waterway flow regime (**Section 6**).

Clearing of native vegetation and potential impacts to threatened biodiversity have formed the major emphasis for this assessment.

Clearing of Native Vegetation

Seven vegetation formations and 49 vegetation communities within these formations were mapped within the study area (**Table 5-1**). One aquatic ecological community was also identified: *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River* (AECDR).

Of these communities five were identified as TECs under the TSC Act, FM Act and EPBC Act (**Table 6-2**). These TECs were assessed as having potential to occur within the study area based on geographical location, suitable habitat and available mapping data. The Project is considered to have a significant impact on two of these communities:

- Natural Grasslands on Basalt and Alluvial Plains in Northern NSW and Southern Queensland; and
- White Box, Yellow Box, Blakely's Red Gum grassy woodland.

The Project is considered to have a significant impact on these communities because of their limited distribution within the region and the extent of clearing that would be required by the Project (**Table 6-3**). Both of these communities have already been significantly cleared within the region and further clearing of these communities is likely to reduce their regional viability (**Appendices I** and **J**).

Threatened Flora Species

A total of 195 threatened flora species were identified through the desktop review process. Of these threatened flora species, one listed under the FM Act, 69 listed under the TSC Act and 47 listed under the EPBC Act were assessed as having potential to occur within the project area based on suitable habitat and current identified locations. Two threatened species were identified within the project area (**Figure 9**) during field surveys. The Project is considered to have an impact on a number of identified species protected under the TSC Act and EPBC Act (**Table 6-1**).

Threatened Fauna Species

A total of 156 threatened fauna species were identified through the desktop review process. Of these threatened fauna species, one listed under the FM Act, 94 listed under the TSC Act and 18 listed under the EPBC Act were assessed as having potential to occur within the project area based on suitable habitat and available mapping data. Thirteen threatened species were identified within the project area (**Figure 9**). The Project is considered to have some degree of impact on 54 threatened

Executive Summary

species likely to be either potentially or adversely impacted by the project according to the assessment outcomes. Of these assessed species, the Project is considered to have a significant impact on five species listed under the EPBC Act (**Table 6-4**).

Threatened Populations

A total of three threatened fauna populations were identified through the desktop review process. Of these threatened populations, one listed under the TSC Act and one listed under the FM Act were assessed as having potential to occur within the project area based on suitable habitat and mapping data. No threatened populations were identified. The Project is not considered to have a significant impact on any threatened population.

Mitigation Measures

A CEMP would be developed and would include measures for the minimisation or avoidance of the impacts on native flora, fauna, populations and ecological communities, with a particular emphasis on threatened biodiversity. The CEMP would also include a Flora Management Plan and a Fauna Management Plan. The CEMP would include details for ongoing monitoring and aims to outline performance indicators, timing and responsibilities.

A Flora Management Plan and Fauna Management Plan would be developed to mitigate impacts from the clearing of the easements access tracks and structure footprints. Of particular importance would be the protection of the existing vegetation communities, avoiding mortality of animals during clearing, ensuring the protection of nesting habitat and promoting long-term connectivity within the landscape. A range of mitigation measures are proposed to minimise and avoid impacts during construction and operation. Strategies to be implemented would include:

- targeted pre-clearance assessments to be undertaken for specific ecological components;
- two-stage clearing of vegetation in ecological constraint specific areas;
- constrained clearing and maintenance in areas of significant habitat;
- management of edge effects;
- weed management;
- sediment and erosion control;
- management of vegetation corridors identified as having regional connectivity value; and
- management of nesting resources

A compensatory habitat and/or an offset strategy would also be required in addition to the proposed mitigation measures. The mitigation measures outlined in this report combined with an offset strategy would ensure the Project meets the ‘improve or maintain’ principle in line with the requirements of a Part 3A project assessed under the EP&A Act. The compensatory habitat is expected to improve or maintain biodiversity values within the area by offsetting the habitat lost by the proposed works. Requirements for compensatory habitat include consideration of structure, function and compositional elements of the proposed habitat and the long-term viability and functionality of biodiversity within the region.

1

Introduction

URS Australia Pty Ltd (URS) was engaged by TransGrid to undertake an assessment of the potential impacts on biodiversity of the proposed Project and aims to install a new transmission line between Dumaresq Switching Station near Bonshaw and Lismore Substation. The Project has an overall length of 205km (**Figure 1**). The new transmission line is required to improve the reliability of electricity supply and meet demand to the far north NSW region.

This report assesses the ecological impacts of the Project's construction and operational requirements with regard to Commonwealth and NSW State planning and environmental legislation.

The Project is considered a Major Project, with the Minster for Planning as the Approval Authority, and is being assessed under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Project would comprise:

- a 205km, 330kV transmission line and associated easement incorporating pole and tower structures and comprising:
  - construction of a new 96km 330kV transmission line with a 60m easement through greenfield areas from Dumaresq Switching Station to the proposed location of the new Tenterfield 330/132kV Substation (Tenterfield 330kV Substation);
  - construction of a new 109km 330kV transmission line between Tenterfield 330kV Substation and Lismore Substation. Between the Tenterfield 330kV Substation and Casino (95km), the 330kV transmission line would be located on the route of the existing 132kV transmission line and the existing 45m easement would be extended to 60m. Between Casino and Lismore Substation (14km), the new 330kV transmission line would run adjacent to the existing 132kV transmission line (which would remain operational on completion of construction). The existing 45m easement would be extended to 90m for this section.
  - removal of 95km of the existing 132kV transmission line between the proposed Tenterfield 330kV Substation and structure 395 to the south of Casino;
- upgrades to the Lismore Substation and Dumaresq Switching Station. Upgrades would be within the existing sub/switching station footprints;
- establishment of a new 330/132kV substation approximately 14km north east of Tenterfield to maintain the existing 132kV connection to the Tenterfield 132kV Substation;
- establishment of access tracks both within the easement and outside the easement for the purposes of transmission line construction and operational maintenance; and
- replacing and restringing the existing earthwire between the new Tenterfield 330kV Substation and existing Tenterfield 132kV Substation with optical ground wire (OPGW).
- a site storage facility with sufficient room for storage of crossarms, insulators, fittings and an area for welding/fabricating and storage of waste materials and other ancillary sites as required.

The biodiversity assessment has been undertaken in accordance with the Department of Planning (DoP) issued Director-General's Requirements (DGRs) issued 11 September 2009 as well as Supplementary DGRs, issued 16 March 2010 (**Appendix A**). The assessment was designed and implemented using a tiered approach that has responded to the changing scope and relative design components for the Project. The approach consisted of:

1 Introduction

1. Desktop investigations for the Preliminary Environmental Assessment (PEA) which identified key areas of risk within a broad regional study area as identified in the *Constraints Identification and Preferred Corridor Report,* (URS, 2009);
2. An EBPC Referral submission to the Commonwealth Director-General due to potential impacts on a matter of National Environmental Significance (NES), namely on the TEC: Box Gum Woodland;
3. Additional desktop investigations for the Environmental Assessment (EA) with a defined study area based on an alignment and access tracks, aligned with the requirements of the DoP DGRs; and
4. Numerous field surveys for the PEA and EA to address DoP DGRs, Supplementary DGRs as well as the changing scope of the Project, aligned with the relevant Commonwealth and State required assessment guidelines.
5. Reporting and mapping of ecological assessment findings.

This biodiversity assessment focuses on the potential impacts upon threatened biodiversity within the following Project areas:

- the 60m wide easement in the western portions of the project area between the Dumaresq Switching Station and the new 330kV Tenterfield Substation;
- the 60m easement in the eastern portion between the Tenterfield Substation and Casino (an increase of the existing easement from 45m to 60m); and
- the 90m easement in the extreme eastern portion between Casino and Lismore Substation (an increase of the existing easement from 45m to 90m).

For the purposes of this report the following terminology is used:

Study area: the area in which biodiversity studies have been undertaken to assist in determining the route, scale and location of the Project components. The study area includes all areas approximately 500 metres either side of the proposed easement, this also includes proposed access tracks and the Tenterfield 330kV Substation footprint (**Figure 1a-b**). This does not include the greater study area, henceforth referred to as the locality.

Locality: For the purposes of this report, the locality is defined as the area within a 10 km radius of the Project area (**Figures 4a-b** and **5a-b** and **Appendix C**). This is the area used for all searches of previous records of threatened species, populations and ecological communities.

Project area: the area in which all Project works would be undertaken (i.e. the area of impact). This would be comprised of the easement, access tracks and the Tenterfield 330kV Substation footprint.

1.1 Project Description

This section provides an overview of the key components of the Project and a description of relevant activities associated with the Project. For further detail refer to Chapter 4 of the Environmental Assessment. The key components described in this section include:

- the location of the proposed alignment;
- the components of the 330kV transmission line;
- the proposed substation works;
- the construction process;
- the proposed access tracks works; and

- easement maintenance and management in the operational phase of the Project.

Subject to approvals and property acquisition, it is anticipated that construction of the Project would commence in November 2011 with scheduled completion in mid 2014.

1.1.1 Proposed Alignment

The Project is divided into two sections for the purposes of the EA and this report.

Alignment West and Associated Access Tracks: this section of the alignment would be approximately 96km long and would traverse eastward from the existing Dumaresq Switching Station just south of Bonshaw to a point on the existing 132kV alignment approximately 14km north east of Tenterfield. Within this area, there is no existing transmission line. To maintain the existing 132kV supply to Tenterfield, a substation (Tenterfield 330kV Substation) would be established at this point. Access to each structure for both construction and maintenance during operation would be required.

Alignment East and Associated Access Tracks: the proposed alignment runs from the location of the proposed Tenterfield 330kV Substation to the Lismore Substation and would be approximately 109km in length. From the Tenterfield 330kV Substation to the south of Casino, the existing 132kV transmission line would be dismantled and replaced with the new 330kV transmission line. The existing easement would be widened from 45m to 60m. To allow the 330kV line to be built parallel to the existing 132kV transmission line, the easement would be 90m wide from south of Casino to Lismore (14km). This would maintain the existing 132kV supply to Country Energy's Casino Substation from TransGrid's 330/132kV Lismore Substation. The majority of access tracks in alignment east are currently established to provide access to the existing 132kV line. Some upgrade and/or re-alignment would be required in parts.

1.2 330kV Transmission Line Components

The Project would comprise a single circuit 330kV construction consisting of supporting structures and conductors (i.e. electricity carrying wires). The single circuit transmission line would carry twin conductors of approximately 27mm in diameter and spaced 380mm apart, as well as two overhead ground wires. These would be supported by suspension and tension structures, with spacing between the structures ranging from of 300m to 600m along the line. Longer and shorter spans would be used to respond to terrain conditions as well as design and environmental constraints. A total of approximately 534 supporting structures have currently been identified for the Project. However, the final number of supporting structures may change depending on final design requirements.

The transmission line would include two basic supporting structure types – suspension and tension frames. Suspension structures, or intermediate structures, are designed to simply 'suspend' the conductors. Suspension structures are typically used in straight line positions or where small angles are encountered. Tension structures are designed to withstand much larger loads. Tension structures would typically only be used at Angle Positions (APs), and where engineering requirements dictate the use of a more robust support structure.

Table 1-1 provides typical design components for each structure type used for 330kV transmission lines.

1 Introduction

Table 1-1 Supporting Structure Types

	Concrete H-Frame	Steel Lattice Tower
Typical use	Along straight line sections	At major directional changes and across gullies
Max Height	37m	37m*
Average Height	30m	28m
Dimensions of base	2 x 0.95m diameter poles spaced 11m apart	9.5m x 4.75m to 12.3m x 12.3m depending on structure type.
Max Height to cross-arm	33m	31m
Cross-arm width	22m	22m – 30m
Foundation Type	Typically bored footing	Typically bored footing or mass concrete footing
Typical foundation depth	Bored foundations 3-5m depth depending on soil and underlying rock	2-2.5m depth when mass foundations are required (soil and rock)
Typical average span across level ground	400m	400m
Typical length of earthing strips	6m	15m

*Note: The last two tension structures coming into Lismore Substation would be double circuit structures, supporting both the 132kV and 330kV lines. The height of these structures would be between 46m – 54m.

Plate 1-1 H-Frame 330kV Supporting/Intermediate Structure

1 Introduction

Plate 1-2 Steel Tower 330kV Tension Structure (Angle Position)

1.2.1 Proposed Alignment

The location of the proposed alignment is shown in **Figures 2a and 2b,** and in greater detail in **Figures 7a-m** and **Figures 8a–m**. The proposed alignment has been developed following consideration of environmental constraints, route options, and line design requirements, as well as on-going discussions with property owners, the community and other key stakeholders. All attempts were made to select an alignment that avoided TECs and threatened species habitat as much as possible as well as common vegetation communities, particularly in areas with the greatest connectivity at a landscape level.

At the time of preparation of this report, discussions with landowners are ongoing and would continue as the Project progresses. Whilst intermediate structure locations have been identified for the purposes of environmental assessment, it should be noted that their final location is subject to continued liaison with landowners. Should a move in the location of any structure be proposed following these discussions, any new proposed location would take account of the identified environmental constraints, and avoid them, wherever possible.

A total of approximately 70 APs have been identified along the 205km alignment (refer to **Figures 7a-m**). For the purposes of this report, APs are used as location markers and reference points along the alignment. They indicate where there is a change in the angle of the alignment, and are numerically ordered from west to east.

The majority of the existing 132kV line from approximately 14km north east of Tenterfield 330kV Substation to the Lismore Substation would be deconstructed prior to the construction of the proposed 330kV line. An exception would be made from south of Casino to Lismore (approximately 14km), where the proposed 330kV line would be constructed alongside the existing 132kV transmission line.

The addition of the 330kV line to this section of the 132kV line would widen the existing easement a further 45m to create a 90m easement in total. There is no existing transmission line from Tenterfield to Dumaresq.

1.3 Substation Works

1.3.1 Dumaresq and Lismore Substations

The proposed development would involve modifications to the existing Dumaresq Switching Station and Lismore Substations. All upgrade works would occur within the existing facilities and boundaries.

1.3.2 Tenterfield 330kV Substation

A new 330/132kV substation would be established approximately 14km north-east of TransGrid's existing Tenterfield 132/22kV Substation. Substation dimensions would be 150m x 130m. Construction would involve the excavation and preparation of the compound including required civil and electrical works; the preparation of the switchyard and the supply and installation of required busbar and transformer bays. A services building, internal access roads, drainage, fencing and security/lighting would be established.

1.4 Alignment Works

The construction work would involve a number of stages outlined in Chapter 4 Project Description of the Environmental Assessment. The key works with regard to the biodiversity are discussed below.

1.4.1 Establishment of Easements

TransGrid has a statutory responsibility to maintain adequate clearance between transmission line conductors and vegetation. Section 48 of the *Electricity Supply Act 1995* requires that trees that present a danger to the lines or a hazard to public safety, including bushfire risk, must be trimmed or removed. All vegetation clearance would take place in line with any issued conditions of consent and be carried out in accordance with TransGrid's *Easements and Access Track Maintenance Policy* (GM AS L1 002) provided within **Appendix C, TransGrid Policies, Volume 2, EA.**

An easement width of approximately 60m would be required to maintain the safe electrical clearance for the 330kV transmission line. Along the easement, clearing would generally be undertaken to a level where the remaining vegetation could be maintained by periodic slashing and chemical control, however clearing requirements would be assessed on a case by case basis and would depend on the type of topography, vegetation and height of conductors. In general easement clearing will include:

- retention of ground layer vegetation;
- some shrubs and trees to be maintained where they to do not exceed clearance requirements for overhead conductors;
- retention of vegetation at spans where topography allows (i.e. gullies and escarpments) where conductor height is sufficient to make clearing unnecessary; and
- minimal clearing for environmentally sensitive areas such as where Threatened Ecological Communities (TECs), significant threatened species habitat, water courses or steeply sloping lands have been identified. In such areas restrictive clearing practices would be applied to conform with relevant approvals, typically enabling vegetation with a mature height of 4m or less to be left in situ.

1 Introduction

1.4.2 Establishment of Access Tracks

Access to each new structure along the proposed alignment would be required to ensure that plant, machinery, equipment and materials could be transported from roads to each proposed work site for the duration of the construction phase. For the purposes of construction, access to each structure site would be required for a truck-mounted auger and excavator, one or two steel tower erection cranes, trucks transporting the supporting structure components, concrete trucks and construction equipment carrying vehicles.

Existing access tracks would be used wherever possible. Opportunities for this approach occur, in particular, along the Tenterfield to Lismore section where a number of existing tracks currently facilitate maintenance of the 132kV transmission line.

A number of new access tracks would also be required. The selection of access track locations has been undertaken in consultation with landowners to identify owner requirements and minimise disturbance to the overall environment.

Access track locations have been proposed in accordance with the recommendations contained in the "*Guidelines for the Planning, Construction and Maintenance of Access Tracks*" (DLWC (now DNR), 1994). The principles for selecting the location of access tracks involved the following:

- site assessment involving TransGrid and landowners wherever possible;
- minimising the disturbance to, soils, vegetation, protected ecological features and sensitive heritage features;
- minimising the number of waterway and drainage line crossings;
- avoidance of steep slopes, rugged terrain, and low lying wet areas or waterlogged land; and
- maximising topographic opportunities to ensure track construction occurs on lands that would reduce works required and minimise environmental impact.

Current estimates for the number of waterway and drainage crossings required for the Project have been summarised in **Table 1-2** below.

Table 1-2 Alignment West Waterway crossing requirements (preliminary)

	Watercourse crossings to be upgraded		Watercourse crossings to be installed	
	On easement	**Off easement**	**On easement**	**Off easement**
Alignment West	6	11	14	11
Alignment East	7	4	0	0

Figures 7a-m, shows the location of the proposed access tracks along the Project's alignment. The access tracks have been differentiated into three categories depending on the level and types of works required. The three categories are:

- **Category 1**: Minimal work required including removal of surface obstacles and/or minor upgrades to existing tracks (i.e. resurfacing, widening etc.). Some imported sand and gravel may be required to support these tracks.
- **Category 2**: Earth works required including construction of tracks through flat or undulating timbered/rocky areas where existing tracks do not exist.

- **Category 3**: Earth works required including construction to develop access tracks in wet and swampy areas requiring excavation of unstable material, drainage works and the import of rock material in some cases.

Two clearing scenarios have been assessed for the purposes of determining the vegetation clearing impacts of access track development. Since the exact amount of clearing required would not be known prior to the detailed design stage of the Project, a maximum vegetation clearing width of 6m, and a minimum width of 4m, have been assumed for category 2 and 3 access tracks.

Refer to **Section 4.3** for further detail on the maximum and minimum clearing scenarios with respect to access tracks.

1.4.3 Establishment of Work Sites & ancillary sites

Work sites include both the location of each supporting structure and the immediate surrounding area that would be used as a temporary lay-down area for plant and equipment used to erect each structure, as well as for future maintenance work.

At each supporting structure work site, the following clearing would be undertaken:

- The ***temporary*** removal of all groundcover within the immediate vicinity of the supporting structure site. The clearance area would typically be a 21m radius around the centre point of the structure.
- The **permanent** clearing of the canopy and shrub layer within a 21m around the centre point of the structure.

Additional benching of the underlying ground level may be required adjacent to each work site location where sloped terrain is encountered. Equipment to be used during the construction phase would require a level area, which would be created by cut and fill methods in areas of sloping topography. The bench area required for the use of cranes and elevated work platform (EWP) would be typically 8m by 4m. Where possible, blocks would be used to set up the EWP at a level position. Soil disturbance works with the appropriate soil erosion controls would only be carried out at locations where this would be required for the safe operation of equipment during construction. Whether or not each work site would require gravelling would be dependent upon terrain. In locations where only temporary soil disturbance is required for the set up of the EWP, work laydown sites would be allowed to revegetate at the conclusion of works.

1.4.4 Rehabilitation Works

Erosion control measures would be implemented at each work site in accordance with "*Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and Volume 2 (DECC, 2008)" (The Blue Book Volumes 1 & 2) during the work period and at the completion of work. Rehabilitation of work sites would be carried out as work proceeds, and as soon as possible after the completion of work at each structure site.

Erosion control measures would be implemented at each work site during the work period and at the completion of work. Measures to restore the pre-existing ground condition would be implemented following completion of works. Revegetation techniques such as loosening of compacted ground, application of fertiliser and revegetation would be implemented as required.

All materials and debris resulting from the construction activities would be removed from each work site. Access to each structure site would be left in a suitable condition for future maintenance of the transmission line.

Revegetation post construction and vegetation screening would be considered for certain areas after consultation between TransGrid and the affected property owners.

1.5 Operational Phase

After the completion of construction and commissioning of the transmission line, the amount of activity on site would decrease substantially. Nonetheless, ongoing maintenance of the easement and access tracks would be required. *TransGrid's Easement and Access Track Maintenance Policy* outlines the operational works required, which in summary include:

- an assessment of the expected maintenance frequency required at locations along the transmission line;
- an assessment of 'hot spot' regions which might require more frequent maintenance due to steeper slopes, watercourses, areas of threatened species or identified wildlife corridors;
- a maintenance assessment to scope the work for the easement maintenance visit;
- conducting easement maintenance works including required vegetation clearing to maintain safe clearances from conductors to vegetation;
- application of herbicide (according to **Appendix K**) where vegetation is identified as likely to infringe clearances in between scheduled maintenance visit;
- repairing or replacing key elements of the transmission line; and
- maintaining associated access tracks, to allow safe passage for all weather access to transmission lines and structures for emergency repairs, routine maintenance, inspection or construction.

1.6 Vegetation Control and Maintenance

Vegetation clearing requirements would be undertaken in accordance with the detailed design and vegetation clearing criteria presented in **Appendix C, TransGrid Policies, Volume 2, EA** as well as **Appendix K**, TransGrid's Use of Herbicide for Vegetaion Control policy.

Three basic types of vegetation control would be used during the operation of the project: chemical control, hand clearing, and/or mechanical vegetation control. Chemical control would be the preferred option. However all three would be used on particular parts of the alignment. The three types of control are summarised below:

- ***Chemical control*** is used selectively to remove fast growing species within the easement, generally in places where mechanical control is not appropriate because of terrain, i.e. parts of alignment west. Chemical control has proved effective in reducing regrowth rates often allowing for longer maintenance cycles across the easement where this control method is applied. Only approved herbicides would be used, and strictly in accordance with the existing TransGrid Environmental Policy '*Use of Herbicide for Vegetation Control*' (**Appendix K**).
- ***Hand clearing*** can be used in sensitive areas or in areas too steep for mechanical control. Vegetation is typically lopped rather than removed to keep disturbance to a minimum.
- ***Mechanical vegetation control*** would involve a tractor driven brush cutting equipment capable of clearing small trees. Slashing vegetation is also considered mechanical vegetation control. This technique is commonly used to maintain access tracks and where heavy regrowth is occurring within the easement.

1 Introduction

The frequency of vegetation maintenance activity would be determined by the nature and growth rates of the existing vegetation, the terrain, as well as identified constraints where the presence of threatened species or property owner relations can necessitate reduced or constrained clearing. All activities would be carried out in compliance with *TransGrid's Easement and Access Track Maintenance Policy* (**Appendix C, TransGrid Policies, Volume 2, EA**) and re-enforced through the development and implementation of the operational mitigation measures.

TransGrid's Easement and Access Track Maintenance Policy (**Appendix C, TransGrid Policies, Volume 2, EA**) as well as TransGrid's Use of Herbicide for Vegetation Control Policy (**Appendix K**) outlines the easement maintenance process involving removal of vegetation by hand, chainsaw, slasher, tritter (or equivalent) and herbicide application.

2

Legislative Framework

2.1 Commonwealth Legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The purpose of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is to ensure that actions likely to cause a significant impact on a matter of national environmental significance undergo an assessment and approval process. Under the EPBC Act, an action includes a Project, undertaking, development or activity. An action that 'has, would have or is likely to have a significant impact on a matter of national environmental significance' may not be undertaken without prior approval from the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities (SEWPAC formerly known as DEWHA).

The Administrative Guidelines for the EPBC Act set out criteria intended to assist in assessing whether an action requires approval. In particular, the Guidelines contain criteria for assessing whether a proposed action is likely to have a 'significant impact' on a matter of National Environmental Significance (NES) and hence called 'Significant Impact Criteria' (SIC) assessment guidelines. Should the proponent deem the Project to have a significant potential impact on a matter of NES, a referral to the Commonwealth Minister for Sustainability, Environment, Water, Population (formerly the Minister of Environment, Water, Heritage and the Arts) would be undertaken to obtain a confirmation as to whether the Commonwealth considers the Project a "controlled action".

This Project was referred to the Commonwealth in relation to the EPBC Act, and has been determined a 'controlled action' because it is likely to have a significant impact on threatened species and communities listed under the EPBC Act (section 18 & 18A). Specifically, the Project was viewed as having a potential to significantly impact the threatened ecological community (TEC): White Box-Yellow Box-Blakeley's Red Gum Grassy Woodland and derived grasslands ecological community.

The Project requires assessment under the EPBC Act.The Commonwealth has advised that, in accordance with the bilateral agreement between itself and the NSW Government made under section 45 of the EPBC Act, it relies on the Environmental Assessment carried out under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) . In support of this, the Commonwealth Department of SEWPAC provided its requirements for environmental assessment under the EPBC Act to the NSW Department of Planning (DoP). These have been issued to the proponent as Supplementary Director-General's Requirements (DGRs) to accompany the DGRs submitted by the DoP under the EP&A Act (**Appendix A**). A response table demonstrating the location of each condition stipulated under the Supplementary DGRs, within this report is provided in **Appendix A.**

2.2 NSW State Legislation

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act forms the legal and policy platform for development assessment and approval in NSW and aims to, *inter alia*, '*encourage the proper management, development and conservation of natural and artificial resources*'.

The Project is considered to be a Major Project under Part 3A of the EP&A Act and *State Environmental Planning Policy (Major Projects) 2005* (SEPP MP). Consequently, the Project will require the approval of the Minster for Planning.

2 Legislative Framework

For the purposes of assessing the potential impact of the Project on threatened species, populations and ecological communities, the Department of Planning has issued guidelines drafted jointly by the Department of Environment and Conservation, and the Department of Primary Industry (DEC/DPI 2005). These guidelines identify a series of steps to be followed in that assessment process. These include:

- Evaluation of impacts.
- Avoiding, mitigating and offsetting impacts.
- Project justification against 4 key thresholds.

Section 5A (s.5A) of the EP&A Act lists key assessment criteria that must be taken into account with the determination of the significance of potential impacts of a proposed development on 'threatened species, populations or ecological communities (or their habitats)', as listed under the TSC Act. Part 3A of the EP&A Act removes the requirement for the proponent and consent authority to consider s.5A of the EP&A Act when determining a Project Application. Notwithstanding, the Assessment of Significance (previously called seven part tests) pursuant to s.5A of the EP&A has been used as part of this report methodology to inform the evaluation of impacts that the Project may have on threatened species, populations and ecological communities.

2.2.2 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) provides legal status for biota of conservation significance in NSW. The Act aims to, *inter alia,* '*conserve biological diversity and promote ecologically sustainable development*'. The TSC Act covers the following:

- protection of 'threatened species, populations and ecological communities', with endangered species, populations and communities listed under Schedule 1, 'critically endangered' species and communities listed under Schedule 1A and vulnerable species and communities listed under Schedule 2;
- listing of 'Key Threatening Processes' under Schedule 3;
- preparation and implementation of Recovery Plans and Threat Abatement Plans;
- guidelines for the preparation of Species Impact Statements; and
- listing of identification of critical habitat for threatened species.

The Director General's Requirements and the Supplement to the Director General's Requirements require that the actual and potential impacts relating to threatened species, populations and ecological communities are assessed for the Project.

This assessment includes retrieval of previous records of threatened species within the locality of the facility, targeted searches for threatened species and their habitats during field surveys, and thorough evaluation of impacts on threatened biota.

2.2.3 Fisheries Management Act 1994

The objects of the *Fisheries Management Act 1994* (FM Act) are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations.

Part 7a of the FM Act provides for the conservation of all biological diversity of aquatic and marine vegetation. It also ensures that the impact of any 'action' affecting threatened species, populations or ecological communities is appropriately assessed.

2 Legislative Framework

The Director General's Requirements and the Supplement to the Director General's Requirements require that the actual and potential impacts of a proposal on threatened species, populations and ecological communities. Schedules to the FM Act provide the listings of aquatic threatened species, populations and ecological communities that would be considered in this assessment.

This assessment includes retrieval of previous records of threatened species listed under the FM Act. Within the locality of the alignment, targeted searches for threatened species and their habitats during field surveys and an assessment of impacts on threatened biota.

Permits under Section 219 of the FM Act (fish passage) are not required for Part 3A approvals. Despite the Part 3A exemption from this formal requirement, all Project works relating to riparian areas would be consistent with the Department Water and Energy's *Controlled Activity Guidelines* (2008) and all watercourse crossings would be constructed in accordance with TransGrid specifications and Industry and Investment NSW (formerly Department of Primary Industries) policies and guidelines.

2.2.4 Native Vegetation Act 2003

The *NSW Native Vegetation Act 2003* (NV Act) was established to prevent broad scale clearing, protect native vegetation of high conservation significance, improve the condition of existing native vegetation and encourage the regeneration of native vegetation in NSW. In assessing applications, consent authorities apply the 'maintain or improve test', which means assessing how the Project maintains or improves environmental values such as salinity, water, soils and biodiversity.

The NV Act requires approval from the relevant Council or Catchment Management Authorities (CMA) for the clearing of native vegetation (with the exception of land listed in Schedule 1 of the Act).

Notwithstanding the above, Projects assessed under Part 3A of the EP&A Act does not require consideration of the requirements of the NV Act. However, the principles of the 'maintain improve test' as required under Part 3A assessments, and which is also used under the NV Act, have been used to guide this assessment and related offset processes for this Project.

2.2.5 Noxious Weeds Act 1993

Under the NSW *Noxious Weeds Act 1993* (NW Act), all councils are responsible for the control of noxious weeds within their local government area (LGA). The NW Act provides for the declaration of noxious weeds by the Minister of Agriculture. Weeds may be considered noxious on a national, state, regional or local scale. All private landowners, occupiers, public authorities and councils are required to control noxious weeds on their land under Part 3 Division 1 of the NW Act. Noxious weeds in the alignment have been addressed as part of this assessment.

2.2.6 State Environmental Planning Policy 44 – Koala Habitat Protection

State Environmental Planning Policy No.44 Koala Habitat Protection (SEPP 44) aims to encourage the '*proper conservation and management of areas of natural vegetation that provide habitat for koalas'*. SEPP 44 applies to local government areas (LGAs) listed under Schedule 1 of the Policy. All LGAs within the project area (**Figure 2**) are listed under Schedule 1 of SEPP 44.

SEPP 44 requires that consent authorities making determinations under Part 4 of the EP&A Act consider whether 'potential koala habitat' and 'core koala habitat' would be affected. Where core koala habitat is found to occur, SEPP 44 requires that a site-specific Koala Plan of Management be prepared.

3

Site Description

3.1 Project Location

The Project is located between Dumaresq Switching Station near Bonshaw and Lismore Substation, in far northern NSW (**Figure 1a** and **b**). The Project crosses five Local Government Areas (LGAs) consisting of Tenterfield and Inverell in the west and Lismore, Kyogle, and Richmond Valley in the east. The Project is also located across two Catchment Management Areas (CMAs), Border Rivers/Gwydir in the west and Northern Rivers in the east. Within these CMAs the Project falls specifically within nine CMA sub-regions including, Tenterfield Plateau and Nandewar Northern Complex in Border Rivers/Gwydir CMA and Richmond Tweed, Woodenbong, Cataract, Stanthorpe Plateau, Rocky River George, Clarence Sandstone, Clarence lowlands in the Northern Rivers CMA (**Figure 2**).

The study area is located within the NSW North Coast, South Eastern Queensland, Nandewar and New England Tablelands bioregions (**Figure 2a** and **b**) as defined in the *Interim Biogeographic Regionalisation for Australia* (Thackway & Creswell 1995).

3.2 Land Uses

Land use within the study area includes several principal uses:

- agricultural - dairy and cattle farming, sheep farming and cropping;
- forestry activities - state forests and privately owned plantation forestry operations;
- conservation areas - national parks, nature reserves, aboriginal areas, state conservation reserves and privately managed conservation areas;
- infrastructure - existing transmission line easements and associated access tracks, railway lines and roads; and
- urbanised areas - consisting of the regional centres of Tenterfield and Lismore, as well as numerous small towns and villages.

3.3 Geology and Soils

3.3.1 Study Area West

The alignment from Dumaresq to Tenterfield lies predominantly within the New England Tableland and Nandewar bioregions, and is part of the New England Fold Belt. The geology of this region is described as consisting of several intrusions of granites each of slightly different in composition. The soil type consists of siliceous sands amongst granite rock outcrops. Widespread mellow texture contrast soils of relatively low fertility and poor structure, prone to erosion (DECC, 2008).

Soil in basalt areas consists of shallow stony loams on the steep areas, and red brown to black, fertile, well-structured loams are found on the flatter slopes. In the valley floors soils are sometimes waterlogged. Siliceous sands and red earths occur on tertiary sands and gravels (DECC 2008).

3.3.2 Study Area East

In Study Area East, between Tenterfield and Lismore, the alignment lies within the South Eastern Queensland, North Coast and the New England Tableland Bioregions, and it is part of the New England Fold Belt. Small bodies of granite have intruded the sedimentary rocks and there are three centres of tertiary basalt eruption (DECC, 2008).

The geology of the alignment from Casino to Lismore consists of deep alluvial sediments – alluvium, clay and sand, and fine-grained basaltic sediments predominate (Soil Landscapes of the Lismore to Ballina 1:100 000 Sheet).

Soils within the North Coast Bioregion are typically red, friable loams or clay loams with high fertility, good structure and excellent water-holding capacity, on the basalts. Whereas shallow yellow earths are found on hillcrests, yellow and brown texture contrast profiles are found on the slopes, and organic loams or sandy loams are found on the alluvial plains, on granites and most of the quartz rich sedimentary rocks (DECC, 2008).

3.4 Topography

The study area is located within the NSW North Coast, South Eastern Queensland, Nandewar and New England Tablelands bioregions (**Figure 2a** and 2**b** of **Section 3 Biodiversity Figures, Volume 3**) as defined in the *Interim Biogeographic Regionalisation for Australia* [IBRA] (Thackway & Creswell 1995).

3.4.1 Study Area West

Study Area West traverses the Nandewar and New England Tablelands Bioregions (Figure **2a** of **Section 3 Biodiversity Figures, Volume 3**), Topography within the New England Tablelands Bioregion is generally described as a "*stepped plateau of hills and plains*" with elevations ranging from 600 to 1500m above sea level (DECC, 2008). The Nandewar Bioregion consists of *"hilly landscapes"* that are warmer and drier than the tablelands.

3.4.2 Study Area East

Study Area East falls within the IBRA South Eastern Queensland and North Coast Bioregions. The portions of these two IBRA Bioregions that fall within NSW are classified as the North Coast Bioregion by DECCW (NPWS, 2003) Landforms in this area range from floodplains through to low foothills and ranges, within the coastal lowlands of the east, to the steep slopes and gorges of the Great Escarpment in the west. (DECC, 2008).

3.5 Hydrology

The Project is located within the Richmond River and the Clarence River catchment areas as apart of the broader Northern Rivers and Border Rivers/Gwydir catchments. There are a number of river systems around and throughout the alignment and study area (**Figure 3**). These include the Richmond River and Wilsons River in the vicinity of Lismore and Casino, the Clarence River in the vicinity of Tabulam and the Dumaresq River near the Dumaresq Switching Station and the first few kilometres of the easement from the switching station towards the east. The Dumaresq River forms the border between New South Wales (NSW) and Queensland (QLD).

There are also many smaller waterways and a number of rural dams, swamps and billabongs within the project and study area.

3 Site Description

This biodiversity assessment has considered and classified waterways according to flow characteristics and the relative importance of the waterway as potential fish habitat. This approach is outlined in **Table 3-1** below as per the I&I NSW guidelines - *Why do fish need to cross the road?* (Fairfull and Witheridge, 2003).

Table 3-1 Waterway Classification

Waterway type	Characteristics of Waterway Type	Potential importance as aquatic habitat
Class 1	Major permanently flowing waterway	Major fish habitat
Class 2	Named creeks or waterway with clearly defined bed and banks with semi or permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present.	Moderate fish habitat
Class 3	Generally unnamed waterways or drainage lines with intermittent flow, or flow only following rain events. Aquatic vegetation which would provide some refuge, breeding or feeding areas may or may not be present.	Unlikely fish Habitat

Further details and associated mapping can be found regarding water classification within **Appendix E, Surface Water and Hydrology, Volume 2, EA** which classifies the waterways across the Project area by flow characteristic and potential aquatic habitat provision, as per the above descriptions.

According to data available from NRAtlas the depth of groundwater across the study area ranges from approximately 6m to 40m depth below ground level.

3.5.1 Study Area West

The Dumaresq to Tenterfield section of the Project lies within the Border Rivers/Gwydir catchment and the Macintyre River catchment forms part of the Border Rivers Basin. Half of the catchment lies within Queensland, with 25,580km^2 of the total 49,470km^2 in NSW. The NSW portion of the upper Macintyre catchment includes the Mole, Dumaresq and Severn Rivers, while in the plains Croppa, Whalan and Gil Gil Creeks and the Boomi River are also included. This river forms part of the headwaters the Barwon River which flows south into the Darling River. The main rivers that drain the eastern slopes of the eastern highlands are the Dumaresq, Severn and Macintyre rivers (**Figure 3**). The Gwydir River is located to the south of the alignment in the southern part of the overall catchment (NSW National Parks and Wildlife Service, 2003).

3.5.2 Study Area East

The existing easement within the eastern section of the Project lies partially within the Richmond River catchment covers an area of 7,022km^2 and includes the Wilsons River and the Richmond River. The Richmond River ultimately flows out to the ocean at Ballina on the NSW north coast. The catchment coastal plain extends from Cape Byron in the north to Evans Head in the south with the Border Ranges National Park and the Richmond Ranges forming the northern and western limits of the catchment. The townships of Lismore, Ballina, Casino and Kyogle are located within this catchment.

The easement also lies partially within the Clarence catchment covering an area of 22,716km^2. Included in this catchment is the Clarence River (**Figure 2**), which is the biggest river on the east coast of NSW, and flows out into the ocean at Yamba. The Clarence catchment extends from near

Coffs Harbour to just north of Yamba in the east, inland to Maclean and Bonalbo, with Woodenbong and Stanthorpe forming the northern boundary along the McPherson Ranges. The western boundary runs from Stanthorpe to Tenterfield and Glen Innes along the Great Dividing Range. The catchment boundary then heads eastwards from north of Guyra to Ebor and Dorrigo in the south, along the Doughboy Ranges and Dorrigo Plateau.

3.6 Climate

3.6.1 Study Area West

Climatic conditions within the western half of the Project are primarily temperate to cool temperate, characterised by warm summers with uniform rainfall typically occurring in summer. Where the North Coast bioregion adjoins on the north-east edge of the bioregion the climate tends to be warmer and tropical. Patches of montane climate occur at higher elevations, and these are characterised by mild summers and no dry season. Temperatures range from winter extremes of minus 1.2°C to over 40°C in summer. Rainfall within the bioregion varies from an average of 600mm per year in the hotter and drier western portion to 1200mm in the cooler and wetter eastern section (Bureau of Meteorology, 2009).

3.6.2 Study Area East

Climatic conditions within the area between Tenterfield and Lismore change with topography however can generally be described as sub-tropical in the east near the coast, with hot summers, through to tropical conditions on the slopes, to a cool temperate climate in the uplands/tablelands in the west with warm summers and no dry season. A montane climate occurs in a small area in the southwest of the bioregion at higher elevations. Temperatures range from winter extremes of minus 5°C to over 40°C in summer. Coastal areas typically experience milder conditions; however some inland areas experience extremes of temperature year round. Rainfall is highest in summer. Rainfall ranges from between 1350 – 1650mm per year in coastal areas to around 800mm per year in inland areas. Rainfall is highly variable (Bureau of Meteorology, 2009 and 2010).

4

Biodiversity Assessment Methodology

The biodiversity assessment methodology consists of two key components:

- The desktop review; and
- The field survey effort.

Each stage is discussed in detail below.

The methodology used to calculate the impact of vegetation clearing is also provided in this section of the report.

4.1 Desktop Review

A literature review was undertaken by URS to identify threatened species, populations and ecological communities listed under the TSC and EPBC Acts that could be expected to occur within the alignment. To this end, the following secondary data sources were reviewed prior to field investigations:

- the Department of Environment, Climate Change and Water (DECCW) Online Wildlife Atlas database was reviewed for all TSC Act listed species within the locality (i.e. a 10km buffer around the project area) (**Appendix B**);
- a Geographic Information System (GIS) data request was sent to the Spatial Data Programs at the NSW Department of Environment, Climate Change and Water (DECCW) for all records of threatened species within the Ashford (9139), Texas (9140), Clive (9239), Stanthorpe (9240), Tenterfield (9339), Drake (9340), Coaldale (9439), Bonalbo (9440) and Lismore (9540) 1:100,000 map sheets on 10 March 2009 (**Figures 4** & **5**);
- the Commonwealth EPBC Online Protected Matters Database search tool was reviewed for all EPBC Act listed species, populations, ecological communities, migratory species and Ramsar sites within the locality (i.e. a 10km buffer of the project area) (SEWPAC, 2010) (**Appendix C**).
- the DECCW 'Find by Geographic Region' threatened species, populations and ecological communities online search tool for the Northern Rivers CMA (Clarence Lowlands, Richmond - Tweed (Qld - Scenic Rim), Rocky River Gorge, Cataract, Woodenbong and Stanthorpe Plateau sub-regions), and the Border Rivers/Gwydir CMA (Nandewar, Northern Complex and Tenterfield Plateau sub-regions) (Department of Environment and Climate Change 2009) (**Appendix D**).
- the Industry and Investment NSW (I&I NSW) 'Threatened fish and marine vegetation – find a species by geographic region' online search tool for the Border Rivers/Gwydir CMA and Northern Rivers CMA (**Appendix E**);
- 'Threatened Species Records', recorded by Forest NSW (2008) for the far north NSW region (**Figures 4** & **5**);
- relevant vegetation mapping and classification for the region including State Forest mapping, NSW National Parks mapping, CMA mapping, DECCW Vegetation Types Database (2008), and Keith (2004) *Ocean Shores to Desert Dunes: the native vegetation of New South Wales and the ACT*; and
- relevant Plans of Management for National Parks, State Forests and Nature Reserves within the vicinity of the alignment.

Initial database searches were undertaken in early April 2009. Subsequent searches were then undertaken in October 2010 to update the previous review and to capture any newly listed species, populations or ecological communities.

4.2 Field Surveys

All field surveys were undertaken by the URS ecologists and designed in accordance with the *Threatened Biodiversity and Assessment; Guidelines for Developments and Activities Working Draft* (DEC, 2004), *Threatened Species Assessment Guidelines: the Assessment of Significance* (DECC 2007), the *BioBanking Assessment Methodology and Credit Calculator Operational Manual* (DECC 2009) and *Guidelines for Threatened Species Assessment* (DEC & DPI 2005).

4.2.1 Field Survey Effort

Field surveys focused on mapping vegetation communities and identifying any terrestrial and aquatic threatened flora and fauna within and adjacent to the proposed alignment and access tracks. Due to access limitations and the extensive size of the project area a full assessment of all areas was not feasible. However, surveys were undertaken in areas identified as being likely to be representative of the majority of the project area and based on a survey effort recommended in the aforementioned guidelines. Survey locations were also selected on the basis of likelihood of providing habitat for threatened species and communities, connectivity and landscape/topographic position and previous records. A summary of field work effort conducted within the broader study area by URS ecologists is provided in **Table 4-1.**

Table 4-1 Summary of URS Field Survey Effort

Survey Type	Survey Effort and Technique	Date	Season
Preliminary site visit	• Site walk/drive over (5 days) • Aerial photo interpretation (10 hours) • Ground truthing of existing mapping (5 days)	5-9 April 2009	Autumn
Vegetation community mapping	• Site walk/drive over (6 days) • Random meander (16 hours) • Aerial photo interpretation (5 hours)	5-9 April 2009 7-11 September 2009 22-25 September 2009 3-6 November 2009 9-12 March 2010	Autumn Spring Spring Spring Autumn
Targeted flora survey	• 82, 20m by 20m quadrates (80 hours) • Random meander threatened species searches (20 hours) • Targeted habitat assessment for threatened species (25 hours)	5-9 April 2009 7-11 September 2009 22-25 September 2009 3-6 November 2009 9-12 March 2010	Autumn Spring Spring Spring Autumn
Targeted fauna survey	• Anabat recording (1008 hours over 8 nights) • Spotlighting (32 hours over 8 nights) • Call playback (8 hours over 8 nights) • Diurnal bird survey (20 hours over 10 days) • General track and scat searches (30 hours) • Hair tube transect lines (170 tubes left over 10 days) • Frogging (10 hours over 10 days and nights)	7-11 September 2009 7-11 December 2009	Spring Summer

4 Biodiversity Assessment Methodology

Survey Type	Survey Effort and Technique	Date	Season
	• Targeted habitat assessment for threatened species (40 hours) • Targeted koala scat searches (10 hours over 10 days) • Biophysical environment assessment (10 hours over 10 days)		
Access track survey	• Site walk/drive over (4 days) • Random meander threatened species searches (13 hours) • Targeted habitat assessment for threatened species (13 hours)	23-29 September 2010	Spring

4.2.2 Nomenclature

Flora identification and classification used in this report follows: Harden, 1990, 1991, 1992, 1993b; Brooker & Kleinig 1999; Jones, 2000; Lamp, Forbes and Cade, 2001; Richardson, Richardson and Shepherd, 2006; Floyd, 2008; Leiper, Glazebrook, Cox and Rathie, 2008; Jacobs, Whalley and Wheeler, 2008; Costemans, L, 2010; DECCW, 2008 and Auld and Medd, 1996 or subsequent advice from the National Herbarium of NSW. The National Herbarium of New South Wales Flora Online Reference was also cross referenced to gain the most up to date flora information.

Flora species are referred to in this report using both common and scientific names initially (e.g. River Red Gum (*Eucalyptus camaldulensis*)). Any subsequent references to these species cite the scientific name only. All flora species identified during field surveys are listed in **Appendix G**.

Fauna species are referred to in this report using the Census of Australian Vertebrates (CAVs) maintained by SEWPAC, Freshwater Fish of NSW information authored by Allen, Midgley and Allen 2003 as well as fauna information maintained by DECCW. In the body of this report fauna is referred to as both common and scientific names initially, similar to that described for flora citing. Subsequent references to these species cite the common name only. Common and scientific names of fauna identified during field surveys are included in **Appendix H**.

4.2.3 Weather Conditions

Weather conditions during the September 2009 survey period were generally warm to hot, with overnight temperatures of around 5°C, to 28°C during the day, with clear skies, minimal cloud and north westerly winds of up to 9km/h. There was a minor storm on the afternoon and evening of Monday 7 September, with reports of up to 16mm of rain falling in highly localised areas around Drake. There was no rain recorded for the rest of the week (Bureau of Meteorology, 2009).

Weather conditions during the December 2009 survey period were average with overnight temperatures of around 15°C, to 35°C during the day with localised rain and electrical storms, and winds of up to 9km/h (Bureau of Meteorology, 2009). There were a number of wildfires burning during the survey period in and around Torrington State Conservation Area and Basket Swamp National Park. Wildfires are likely to have impacted fauna survey results around these areas.

4 Biodiversity Assessment Methodology

Weather conditions during the March 2010 survey period were generally warm during the day and cool in evening, with overnight temperatures of around 10 to 15°C, and up to 28 degrees during the day. In general skies were clear with minimal cloud. There was one minor storm on the afternoon of Tuesday 9 March 2010, with 1.4mm of rainfall around Tenterfield and up to 80km west. There was no rain recorded for the rest of the week (Bureau of Meteorology, 2010).

Weather conditions during the September 2010 survey period were generally warm during the day and cool in the evening, with overnight temperatures of around 12 to 13˚C, and from 18 to 23˚C during the day. There were a few storms on the 23 and 25 of September 2010, with 4.2mm and 2.4mm, respectively of rainfall in Tenterfield and up to 50km west and east of the township. There was no rain recorded for the rest of the week (Bureau of Meteorology, 2010).

4.2.4 Flora

Vegetation Community Mapping

The primary objective of the vegetation community mapping survey effort was:

- to map and describe the vegetation communities within and adjacent to the project area;
- the vegetation community condition; and
- identify TECs as well as potential habitat.

Aerial imagery of the alignment was assessed prior to visiting the site.

Preliminary vegetation mapping within the alignment was conducted during the week of 5 to 9 April, 2009. This involved ground truthing of existing mapping determined through desktop review of the DECCW *Vegetation Types Database* (2008) for each relevant CMA area as well as Keith (2004) vegetation classifications of far north NSW for the identification of general vegetation formations (i.e. grasslands, grassy woodlands, forested wetlands etc.). Mapping utilised the; topography, contour and hydrology GIS layers in order to highlight areas that would be likely to impose constraints upon the location and placement of the proposed alignment. This included TECs and threatened species' habitats. Local CMA subdivisions are used given their relevance to the 'find by geographical region' DECCW Vegetation Types Database (2008), used as the basis for the vegetation community mapping and reporting in this assessment.

Preliminary vegetation mapping within alignment west was primarily conducted along public roads and access tracks due to access limitations on certain private lands.

Within alignment east, preliminary vegetation mapping was conducted from public access tracks, Forests New South Wales (FNSW – formerly State Forests New South Wales) access tracks, public roads (including the Bruxner Highway and many of the smaller formed roads throughout the region), access tracks throughout National Parks and private property where access was granted.

Additional vegetation mapping within alignment east was completed during the periods 7 to11 and 22 to 25 September 2009, 3 to 6 November 2009 and 9 to12 March 2010. This involved confirming several assumptions made in the preliminary mapping period, as well as visiting new sections of the existing alignment.

Additional vegetation mapping within alignment west was undertaken during the weeks of September 22–25, November 3–6, 2009 and 9-12 March 2010. This involved visiting several areas of privately owned land that were previously inaccessible due to access restrictions.

4 Biodiversity Assessment Methodology

Further surveys to identify vegetation communities associated with proposed access tracks for both Study Area East and west were undertaken between the 23 and 29 of September 2010.

Habitat assessments were undertaken during the weeks of 7–11 September 2009, 7-11 December 2009 and 23-29 September 2010.

Due to access limitations, not every part of the proposed and/or existing corridor alignment was traversed during field surveys. Instead, areas that were inaccessible (due to private land access limitations, terrain restrictions or seasonal constraints) were mapped based on landscape patterns and existing vegetation mapping.

Flora Surveys

Eighty-two (82) 20m x 20m quadrats were surveyed during the July, September, November 2009 and March 2010 field surveys. Within each quadrat species composition, condition, vegetation cover according to Specht, in Gillison and Anderson (1981) *Vegetation classification in Australia* and structural diversity were recorded.

The locations of quadrats are provided in **Figure 6a** and **Table 4-2** shows the number of vegetation quadrats that were conducted within each vegetation formation unit and the area of each unit that would be impacted by the Project. Seven quadrats featuring in **Figure 6a** are located beyond the ecological study area boundaries. These quadrats were surveyed during the constraints identification part of the work.

Survey effort for each vegetation formation was set according to the recommendations provided in the DEC (2004) and DECC (2009) guidelines. These suggest that a certain number of quadrats would be conducted per hectare value of stratification. In this case stratification refers to vegetation formations, as described by Keith (2004) and the DECCW *Vegetation Types Database* (2008) for each CMA area.

In addition to this, targeted surveys using the random meander method (Cropper, 1993) were used to assess the distribution and/or occurrence of threatened flora species and populations within the project area. Noxious weeds were also identified during quadrat and random meander surveys.

Table 4-2 Vegetation Quadrats Carried Out in Each Vegetation Formation Mapped within the Easement

Vegetation Formation Unit	Area within Proposed Easement*		Vegetation	
	(ha)	Percent	Quadrants	Percent
Dry Sclerophyll Forests (shrub/grass formation)	193.6	34.3%	28	37.3%
Dry Sclerophyll Forests (shrubby formation)	60.6	10.7%	12	16.0%
Forested Wetland	10.4	1.8%	7	9.3%
Grasslands	3.5	0.6%	5	6.7%
Grassy Woodland	120.3	21.3%	16	21.3%
Semi Arid Woodlands (shrubby sub formation)	106.4	18.8%	4	5.3%
Wet Sclerophyll Forest (Shrubby formation)	9.4	1.7%	3	4.0%
Exotic	1.1	0.2%	0	0.0%
Un-Surveyed Wooded Vegetation	59.8	10.6%	0	0.0%
Total	**565**	**100%**	**75**	**100%**

* The figures in **Table 4-2** relate to the survey effort for the whole of the proposed easement (including the existing 132kV easement between Tenterfield and Lismore) irrespective of the clearing scenarios discussed in **Section 4.3**.

4 Biodiversity Assessment Methodology

Exotic Flora Assessment

Declared noxious weeds listed under the NW Act for the five relevant LGAs were targeted during field surveys of the project and study area.

Common weeds found within the region were observed opportunistically while traversing the project and study area, particularly during threatened flora searches and vegetation mapping. A full list of the noxious weeds observed within the study area is provided in **Section 5.2.5**. Noxious and common weeds are included in the flora survey results presented in **Appendix G**.

Habitat Assessment

An assessment of suitable habitats present for both TSC Act and EPBC Act listed flora species within the project area was made during the July, September, November, December 2009 and March 2010 field surveys. Additional assessments of habitat suitability within access track and alignment areas were undertaken in the September of 2010. The assessment of suitable habitat was undertaken to determine the potential for listed species to inhabit the site rather than relying solely on one-off surveys to provide a snapshot of ecological assemblages present but are often subject to seasonal and weather constraints. A list of habitat requirements for threatened flora species is presented in **Appendix F**. This assessment determines the likelihood of a species occurring within the alignment based on habitat requirements, landscape features, vegetation communities and previous records.

4.2.5 Fauna

Fauna surveys were carried out between September 7 to11 and December 7 to11, 2009. Survey techniques were consistent with the *Threatened Biodiversity and Assessment; Guidelines for Developments and Activities Working Draft* (DEC 2004).

Surveys targeted threatened species identified in the desktop review as potentially occurring within the project and study area, and potential threatened species habitats identified as part of assessments conducted during the field surveys.

Techniques included:

- diurnal and opportunistic bird counts;
- fauna spotlighting;
- nocturnal call playback;
- ultrasonic call recording (Anabat) to identify presence of microchiropteran bat species;
- amphibian searches;
- koala habitat assessments;
- hair tubes transects;
- opportunistic observations including identification of scats and tracks; and
- fauna habitat assessments.

Diurnal and Opportunistic Bird Surveys

Diurnal bird surveys undertaken during the September and December survey period were undertaken at selected survey locations (**Figure 6b**) and were consistent with DEC (2004) survey guidelines. Searches were conducted across the study area at dawn or dusk for one hour each day, with each search area ranging in size from 1ha to 5ha. The locations of diurnal bird survey sites are given in **Figure 6b**.

4 Biodiversity Assessment Methodology

Opportunistic observations were recorded throughout the entire field survey period. Species were identified visually or by calls. Abundance, behaviour, breeding activity and habitat type were documented. A full list of birds observed during diurnal and opportunistic field surveys is provided in **Appendix H**.

Fauna Spotlighting

Spotlighting surveys were performed on the evenings of 7 to10 September and 7 to10 December 2009 and involved walking along selected transects and surveying from within a vehicle driven at approximately 1km/h for up to 60 minutes along existing access roads and whilst entering and exiting survey locations. Spotlighting targeted a range of fauna species, including nocturnal birds, arboreal and ground dwelling mammals and reptiles. Spotlighting surveys were consistent with the (DEC, 2004) survey guidelines.

Nocturnal Call Playback

Call playback was performed on the evenings of 7–10 September and 7–10 December 2009, targeting threatened nocturnal birds and mammals. Call playback was undertaken in accordance with (DEC, 2004) guidelines, which includes at least five minutes of broadcasting and ten minutes of listening. Call playback sites are shown on **Figure 6b**. Call playback was conducted at sites with appropriate habitat (e.g. call playback for the Marbled Frogmouth was only conducted in rainforest areas) for six threatened birds and mammals known or predicted to occur within the area, which are:

- Barking Owl (*Ninox connivens*);
- Powerful Owl (*Ninox strenua*);
- Masked Owl (*Tyto novaehollandiae*);
- Sooty Owl (*Tyto tenebricosa*);
- Marbled Frogmouth (*Podargus ocellatus*);
- Yellow-bellied Glider (*Petaurus australis*); and
- Squirrel Glider (*Petaurus norfolcensis*).

Ultrasonic Call Recording (Anabats) - for Microchiropteran Bats

Passive microchiropteran surveys were conducted at 22 sites on the evenings of 7–10 September and 7-10 December 2009 using Anabat recording devices. Anabat detectors started recording at dusk (6pm) until dawn (6am). Survey locations are shown on **Figure 6b**. Anabats were placed in areas of potential habitat such as fly-ways, creek and drainage channels with sufficient water or habitat resources. Anabat recordings were identified to at least genus level, or species level, where possible. The Anabat recording analysis only identified each species as either ‘probable’ or ‘possible’. This may have been due to poor recordings from the unit, weather or the proximity of the microchiropteran species to the Anabat device. One of the Anabats was removed during the December field surveys due to bushfire risk/threat.

Amphibian Searches

Amphibian searches were conducted between the dates of 7 to 11 September and 7 to 11 December 20 2009 during spotlighting surveys. These searches were undertaken when the following habitat features were present waterways, wetlands and other appropriate habitat types or when amphibians were heard calling. This method involved triangulation to identify the location of species and calls. Assessments of suitable habitat for threatened amphibian species were used to determine the likelihood of these species occurring in the project and study area.

4 Biodiversity Assessment Methodology

Koala Habitat Assessments

Surveys were conducted to determine the likelihood of koala populations occurring within the alignment. Surveys were based on:

- a detailed desktop assessment of existing information, including koala records and habitat mapping; and
- sweep surveys for koala scat and scratch marks conducted randomly within 50m x 50m plots.

Sweep survey plots were placed randomly within representative habitat in the study area. Within each plot a 10m radius sweep search for koala scats and scratches was carried out at the base of primary and secondary feed trees (**Table 4-3**). Sweep surveys were undertaken by two URS ecologists for a period of 30 minutes within each plot. Survey locations are shown on **Figure 6b.**

Koala surveys selectively targeted areas with a high density of primary/secondary or supplementary feed trees as identified in SEPP 44 Koala Habitat Protection and the 'Recovery Plan for the Koala (*Phascolarctos cinereus*) (DECC 2008a). **Table 4-3** provides the definition of primary, secondary and supplementary feed trees and provides a list of relevant species for the alignment.

Table 4-3 Primary, Secondary and Supplementary Koala Feed Trees.

Feed Tree Category	Known feed trees surveyed within the Study area (species identified DECC 2008a)*
Primary Primary food trees exhibit a level of use that is significantly higher than that of other Eucalyptus spp. while also demonstrating a mode of utilisation by koalas that is independent of density (DECCW 2008).	Forest Red Gum (*Eucalyptus tereticornis*) Cabbage Gum (*E. amplilifolia*) Grey Gum (*E. propinqua*) Yellow Box (*E. melliodora*) River Red Gum (*E. camaldulensis*)
Secondary or Supplementary Feed Trees: Secondary and/or Supplementary food trees exhibit (on average) a significantly lower level of use than a primary food tree while also demonstrating evidence of more complex variables associated with their use, generally by being both density and/or size class dependent (DECCW 2008).	Thin-leaved stringybark (*E. eugenoides*) White Stringybark (*E. globoidea*) Grey Box (*E. moluccana*) Yellow Box (*E. melliodora*) Fuzzy Box (*E. conica*) White Box (*E. albens*) New England Peppermint (*E. nova anglica*) Blakely's Red Gum (*E. blakelyi*) Tumbledown Gum (*E. delabata*) Youman's Stringybark (*E. youmanii*) Broad-leaved Stringybark (*E caliginosa*) Red Stringybark (*E. macrorhyncha*) Red Mahogany (*E. resinifera*)

*For the purposes of this assessment primary, secondary and supplementary feed trees listed for the Western Slopes, North Coast and Northern Tablelands have been combined.

Based on the density of primary, secondary or supplementary feed trees, koala habitat found within the study area was identified as being either primary or secondary habitat. The definition of these habitat classes is given below.

4 Biodiversity Assessment Methodology

Primary Habitat

Primary habitat is:

- *an area of land with a resident breeding population of koalas, evidenced by attributes such as breeding females and recent sightings and historical records of a population* (SEPP 44).

or

- *an area of forest and/or woodland wherein primary food tree species comprise of the dominant overstorey tree species to an amount of ≥ 50%. These areas are capable of supporting high density koala populations, ≥ 0.75 koala/ha* (DECCW, 2008).

Secondary Habitat

Secondary habitat is defined as an area with either:

- *Primary food tree species present, usually, but not always, growing in association with one or more secondary food tree species but with these species forming less than 40% of the over-storey species* (DECC 2008a).

or

- *Primary food tree species absent, habitat comprised of secondary and supplementary food tree species only* (DECC 2008a).

Hair Tubes

A series of hair tube transects were laid out within the study area (refer to **Figure 6b** for locations) to survey for small and medium sized ground and arboreal mammals. Hair tubes were baited with either a mixture of peanut butter, rolled oats, honey and bird seed or peanut butter, honey, oats, kangaroo mince and marinated olives. A range of both meat and vegetarian baits were used in each trap line. Honey and truffle oil water was sprayed along trap lines as an attractant.

Twenty hair tubes, ten small and ten large, were lined with double sided tape at the top of the opening and placed approximately 10m apart along each transect. Three arboreal hair tubes were used per transect. Two transects was placed in each vegetation formation along the project area. Tubes were left on site for four days and three nights. Hair samples were sent to Barbara Triggs (qualified hair and scat analysis technician) for identification.

Opportunistic Observations

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys. Records of these observations form part of the full species listed provided in **Appendix H**. Scats and tracks were also noted opportunistically. Any scat samples were sent to Barbara Triggs for identification. Fauna tracks were identified using the Triggs (1997) *Tracks, Scats and Other Traces: A Field Guide to Australian Mammals*, Oxford University print, Melbourne.

Aquatic Fauna Survey

Assessments of suitable aquatic habitat for threatened species have been undertaken and detailed in **Appendix F.** The assessment considered online aquatic databases and evaluated the aquatic habitat conditions and associated waterway classes present within the study area (Table 3-1). The aquatic habitat suitability information (**Appendix F**) was utilised to guide which species would be surveyed for as part of field investigations for threatened species, populations and ecological communities.

Fauna Habitat Assessment

An assessment of the quality of habitats present for TSC, FM and EPBC Act listed species within the alignment was made during field surveys. Habitat suitability was based on the level of breeding, nesting, feeding and roosting resources available. Survey sites were walked and an assessment of significant habitat features, such as fallen timber, hollow bearing trees, stags and rocky outcrops likely to provide foraging or nesting habitat for threatened fauna species was completed.

Habitat assessments are important in determining the potential for listed species to use the site rather than relying solely on one-off surveys that are subject to seasonal and weather limitations and which provide a snapshot of ecological assemblages present. Habitat assessments are also useful when assessing a site for highly cryptic or shy species, or for species that may only use areas on a seasonal or transient basis. A list of habitat requirements for threatened fauna species identified in the desktop review, that are predicted or known to occur within the study area is presented in **Appendix F**.

4.2.6 Staff Qualifications

Field surveys were undertaken by qualified URS ecologists with experience as laid out in **Table 4-4**.

Table 4-4 URS Ecology Personnel and Experience

Name	Position	Qualifications	Relevant Experience
Jane Murray	Associate Ecologist	B. App. Sc. Environmental Management, University of Western Sydney	10+ years
Lauren Branson	Senior Ecologist	Master of Science (Hons) (Research) Macquarie University Bachelor of Science (Biodiversity and Conservation) Macquarie University	6+ years
Melina Budden	Ecologist	Bachelor of Environmental Science University of Newcastle Bachelor of Science (Biodiversity and Conservation) Macquarie University Masters of Wildlife Management (Habitat) - Partially Complete - Macquarie University	6 years
Kathryn Chesnut	Ecologist	Bachelor of Environmental Science (Hons) Southern Cross University	4+ year

URS holds both a DECCW 'Scientific' licence and I&I NSW and Animal Care and Ethics Committee 'Animal Research' Authority. The 'Scientific' licence enables the URS ecologists to pick flora specimens for identification and voucher specimens as well the capture and release of fauna for identification. The 'Animal Research' Authority enables the URS ecologists to handle and identify fauna in a research capacity.

4.2.7 Survey Limitations

Due to access constraints and general logistic limitations (weather, seasonal constraints, and natural events) not all threatened species with the potential to occur in the study area were the subject of targeted surveys. Due to the extent of the alignment and associated access tracks, survey locations were selected on the basis of representative vegetation, aspect, soils, terrain, and the vegetation connectivity across the broader study area. Large areas of contiguous vegetation were targeted for survey locations, as they are more likely to support a representative assemblage of fauna within the region given the immigration and emigration potential within these areas.

Some areas within the proposed alignment and along access tracks were not accessible during field surveys due to private land owner access constraints and wet weather access issues. To ensure that consideration was given to these areas, surveys were conducted in locations with vegetation formations and topographic features representative of these areas. Consequently, there is an area of between 9 and 52 ha of wooded vegetation that remains unmapped, but that would potentially be impacted by the project.

Due to access and wet weather constraints, fauna surveys were not conducted in the Wet Sclerophyll vegetation formation unit. Less than 2 ha of this formation would be impacted by the Project and there is a large amount of existing data on the threatened fauna found within these areas, as they are located in State Forests and are subject to regular surveys by Forest NSW.

Field surveys were generally limited by physical constraints such as steep gullies, rocky access preventing vehicular access, fence lines and access to private property. Additionally, seasons and scope of works posed constraints to the duration and type of surveys that were able to be conducted. Project timing also limited the seasons during which works were undertaken. Several fires hindered the team's ability to undertake full fauna surveys during the December 2009 survey period. In this period, one Anabat recording device and one hair tube transect had to be retrieved from the semi-arid woodland formations close to western extremity of the project area given the approaching wild fires. Spotlighting and call playback was also prevented on one night during this survey period.

Notwithstandng the above, and as noted previously, surveys were undertaken in areas identified as being likely to be representative of the majority of the project area and based on a survey effort recommended in the relevant guidelines noted in the introduction to **Section 4.2**.

To further compensate for survey limitations a habitat assessment for all species predicted or known to occur within the alignment was completed (**Appendix F**). This technique allows for assessment of cryptic or seasonal species that may be impacted by the Project.

4.3 Vegetation Clearing Considerations and Calculations

TransGrid has a statutory responsibility to maintain adequate clearance between transmission line conductors and vegetation. These clearing related impacts have been considered throughout the assessment process using the principle of avoid, minimise, mitigate and offset. Avoidance was the first

priority, during the route selection stage of the Project (URS 2009). All attempts were made to select an alignment that avoided TECs and threatened species habitat as much as possible as well as common vegetation communities, particularly in areas with the greatest connectivity at a landscape level. Precise measurements of the amount of clearing required will not be available until the detailed design stage of the Project. Therefore, two clearing scenarios have been identified to assist with determining the upper (maximum) and lower (minimum) limits of the likely clearing areas. For the purposes of this report, vegetation clearing calculations have been determined according to the following construction and maintenance needs of the Project:

- access track clearing; and
- transmission line clearing.

The clearing calculations methodology is provided in the following sections.

Access Track Clearance

Access track clearance involves the clearing of vegetation in order to provide access to each proposed site for a new structure along the proposed alignment for both the construction and maintenance phases of the Project. The majority of tracks, once created, would remain as permanent tracks to allow access for maintenance purposes during the operational phase. Vegetation clearance for access tracks would involve the clearing of an approximately 6m width corridor depending on terrain, environmental conditions and route.

The access tracks have been split into three categories as discussed in **Section 1.4.2** which have associated vegetation clearance requirements as follows:

- **Category 1**: Category 1 tracks have been assessed as 4m in width.
- **Category 2**: Category 2 tracks have been assessed as 6m in width for maximum clearing estimates and 4m in width for minimum clearing estimates.
- **Category 3**: Category 3 tracks have been assessed as 6m in width for maximum clearing estimates and 4m in width for minimum clearing estimates.

Although the broader Project EA states that access tracks will have a 6m impact, for the purposes of the biodiversity assessment the clearance requirements have used a maximum and minimum clearance scenario as there will not be precise dimensions available until the detailed design stage of the Project. Therefore a *maximum* and *minimum* scenario for access track clearing has been calculated in order to determine the potential impact on biodiversity as a result of the Project and to help guide the biodiversity offset process, as required by DECCW NSW.

Transmission Line Clearance

Precise estimates of clearing requirements for the transmission line are only likely to be available at the detailed design stage of the Project. Therefore a *maximum* and *minimum* scenario for easement clearing has been calculated in order to determine the potential impact on biodiversity as a result of the Project and to help guide the biodiversity offset process, as required by DECCW NSW.

Maximum Clearance

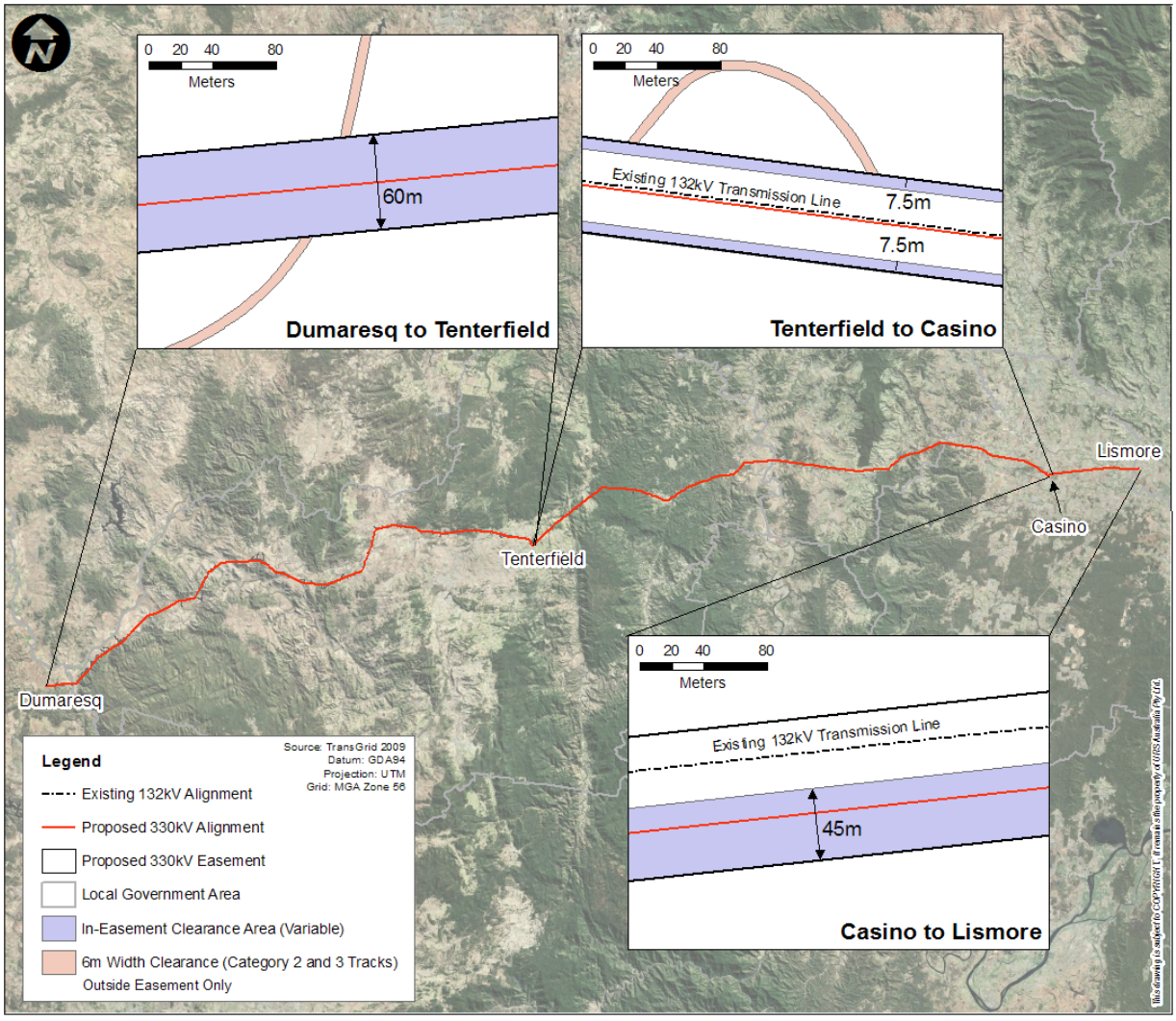
The *maximum* vegetation clearance scenario (**Table 4-5** and **Plate 4-1**) outline the greatest clearing area which would be required for the transmission line easement and for the establishment of proposed access tracks.

4 Biodiversity Assessment Methodology

Table 4-5 Maximum Clearing Scenario Requirements

Alignment Section	Vegetation Clearing Required
Alignment west (Dumaresq Switching Station to Tenterfield 330kV Substation).	Full 60m wide easement, plus access tracks located outside the easement.
Alignment east (Tenterfield 330kV Substation to structure 395, South of Casino).	Clearing of a 7.5m width either side of the existing 132kV transmission line, plus access tracks located outside the easement.
Alignment east (structure 395, South of Casino to Lismore Substation).	Clearing of a 45m easement on the southern side of the existing 132kV transmission line.

Plate 4-1 Maximum Clearing Scenario Schematic



The maximum scenario is an overestimate of the actual area that would be cleared. The final clearing requirement of the easement would be assessed on a case by case basis for each span and would depend on the terrain, vegetation, environmental conditions and precise height of conductors.

4 Biodiversity Assessment Methodology

The removal of vegetation under the maximum scenario considers all off easement access tracks for development of category 2 and 3 tracks of which clearing calculations have considered a 6m clearing width for both categories. Category 1 access tracks do not require clearing and have therefore not formed part of any clearing calculations.

All clearing would be consistent with maintenance requirements of 330kV lines. Typical manifestations of these requirements (outside the direct impact footprint for the pole and tower structures and the access tracks) are listed below:

- all ground layer vegetation is retained;
- pruning and clearing of canopy trees and shrubs within the easement, generally by slashing (with ground cover retained). However
  (a) at spans where topography allows (i.e. gullies and escarpments) vegetation can be retained where the mature height of vegetation would not infringe clearance requirements to conductors (conductor height is sufficient to make clearing unnecessary);
  (b) in environmentally sensitive areas including water courses and steeply sloping land, vegetation clearing can be restricted, leaving some canopy and shrub species intact where they to do not exceed clearance requirements to conductors; and
- habitat features such as felled hollow bearing trees and coarse woody debris can be placed in areas where vegetation is retained to provide fauna corridors in accordance with a Coarse Woody Debris placement plan designed by DECCW.

Minimum Clearance

The *minimum* vegetation clearance scenario identifies the smallest area that would be required for the development of the transmission line, specifically the structures, conductor clearance and associated access tracks and incorporates minimal clearing in areas where TECs occur.

This clearing scenario applies minimal clearing to areas:

- where TECs of TSC Act or EPBC Act status have been mapped and identified along the easement; and
- areas of un-surveyed wooded vegetation have been mapped; this approach is precautionary and assumes this vegetation may be a TEC.

The minimum scenario calculates the removal of vegetation in such areas using the following principles:

- The removal of vegetation required for conductor clearance, based on three dimensional data obtained from Aurecon Group. The Aurecon data was calculated based on a clearance requirement of 4m (known as a '4m violation') between all vegetation and the conductors, under the following environmental conditions:
  - Conductor temp of 15°C and NO wind.
  - Conductor temp of 55°C and NO wind.
  - Conductor temp of 32.9°C and 120Pa wind pressure (14m/s).
  - Conductor temp of 32.3°C and 240Pa wind pressure (20m/s).
  - Conductor temp of 32.1°C and 360Pa wind pressure (24m/s).
  - Conductor temp of 31.9°C and 500Pa wind pressure (29m/s).

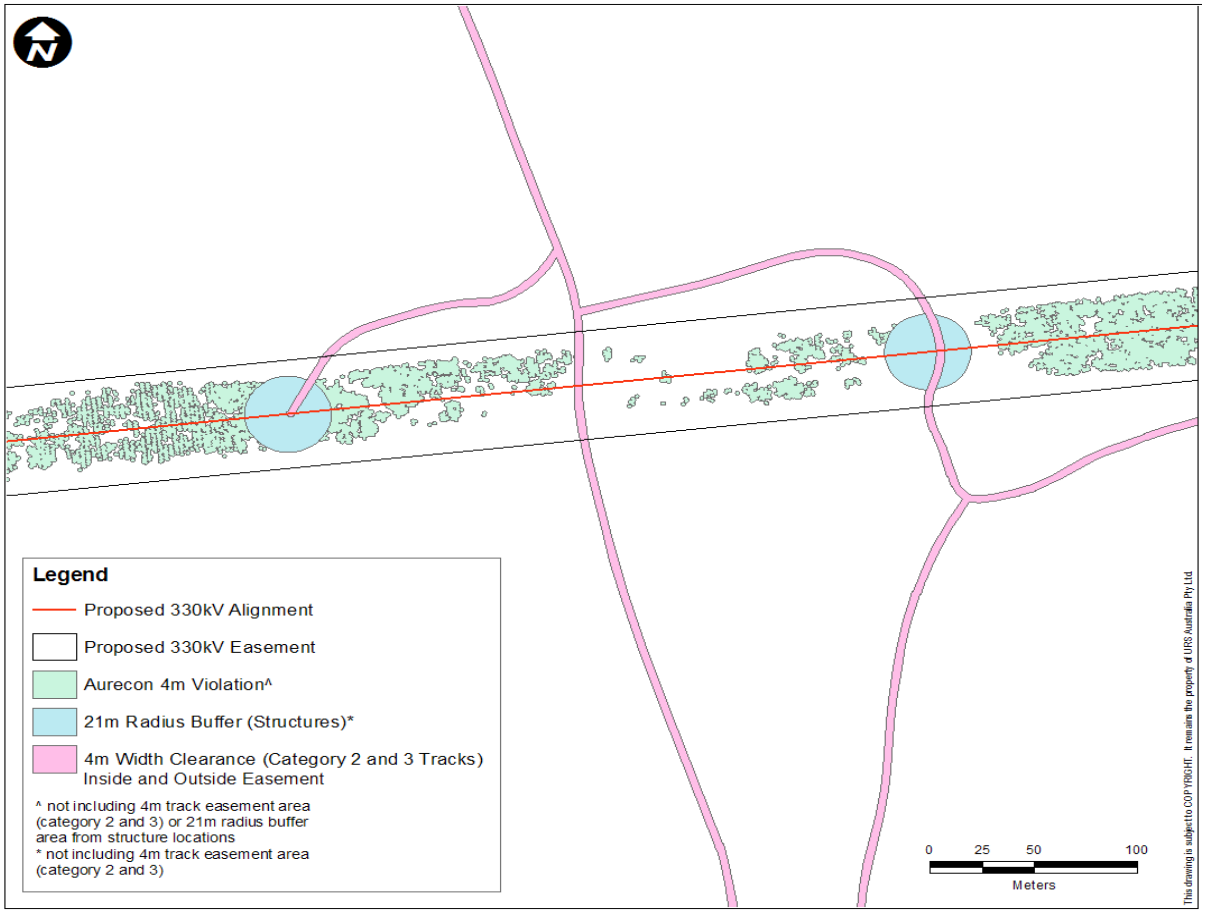
0 Biodiversity Assessment Methodology

— Conductor temp of 15°C and wind gust of 48m/s (or 1412.3Pa).

- The removal of vegetation for the construction of structures between Dumaresq Switching Station and the Tenterfield 330kV Substation and Casino and Lismore Substation. This would require the clearing of all three vegetative strata levels (ground-storey, mid-storey and canopy) for the installation of structures. This scenario comprises a 21m radius from the centre point of each H-frame structure and a steel lattice tower, based on TransGrid's construction and clearing requirements for 330kV transmission line structures (**Appendic C, TransGrid Policies, Volume 2, EA**).
- The removal of vegetation for development of category 2 and 3 access tracks that fall within and outside the easement. Access track calculations have been based on a 4m clearing width for both category 2 and 3 access tracks for both on-easement and off easement tracks. Note: category 1 access tracks do not require clearing and have therefore not formed part of any clearing calculations.

In all other areas (i.e. where non TEC vegetation communities occur), the minimum scenario incorporates removal of all vegetation for the full width of the easement (as per the maximum clearing scenario) and clearing of 6m wide access tracks for category 2 and 3 tracks where they are located outside the easement.

Plate 4-2 Minimum Clearing Scenario Schematic



5

Biodiversity Assessment Results

5.1 Desktop Review

5.1.1 Flora

Threatened Species

The results of online searches [DECCW NSW Wildlife Atlas database using a 10km radius of the project area and the DECCW 'Find by Geographic Region' threatened species, populations and ecological communities online search tool for the Northern Rivers CMA[1], and the Border Rivers/Gwydir CMA[2])] identified a total of 170 known or predicted records of threatened flora species (**Appendices B** and **D**, respectively). Data taken from the NSW Wildlife Atlas database only includes records from 1980 onwards. It is likely that a number of species from the CMA searches are recorded in more than one CMA region.

The GIS request to the Spatial Data Programs department of the NSW DECCW returned known records of 31 species of threatened flora, distributed between 127 locations, recorded within 10km of the alignment within the last 10 years (**Figures 4a** and **4b**).

Results of the I&I NSW 'Threatened fish and marine vegetation – find a species by geographic region' online search tool for the Border Rivers/Gwydir CMA and Northern Rivers CMA identified that one threatened aquatic species, Marine brown alga *(Nereia lophocladia*), is likely to occur in the project area. Results of the search are provided in **Appendix E**.

The Commonwealth EPBC online Protected Matters Database search tool identified that 85 threatened species or their habitat may occur within 10km of the Project (**Appendix C**).

Threatened Populations

The results of the DECCW 'Find by Geographic Region' online search tool identified no threatened flora populations as being known or predicted to occur within the CMA sub regions along the proposed alignment.

Threatened Ecological Communities

The results of the DECCW 'Find by Geographic Region' online search tool identified fourteen TECs that are known or predicted to occur within the relevant CMA sub regions. These communities are:

- *Cadellia pentastylis* (ooline) community in the Nandewar and Brigalow Belt South Bioregion;
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern;
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Grey Box - Grey Gum Wet Sclerophyll Forest in the NSW North Coast Bioregion;
- Littoral Rainforest in the NSW North Coast; Sydney Basin and South East Corner Bioregions;
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion;
- Sub-tropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion;

[1] Clarence Lowlands, Rocky River Gorge, Cataract, Woodenbong and Stanthorpe Plateau sub-regions..
[2] Nandewar, Northern Complex and Tenterfield Plateau sub-regions.

- Swamp sclerophyll forest on coastal floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Weeping Myall Open Woodland of the Darling Riverine Plains and Brigalow Belt South Bioregions;
- New England Peppermint (*Eucalyptus nova-anglica*) Woodland on Basalts and Sediments in the New England Tableland Bioregion;
- White Box, Yellow Box, Blakely's Red Gum Woodland;
- White Gum moist forest in the NSW North Coast Bioregion; and
- Upland wetlands of the drainage divide of the New England Tableland Bioregion.

The I&I NSW 'Threatened fish and marine vegetation – find a species by geographic region' online search tool for the Border Rivers/Gwydir CMA and Northern Rivers CMA identified one aquatic ecological community may occur within the project and study area: the Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River (AECDR) (**Appendix E**). This community includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, anabranches, flow diversions to anabranches and floodplains of the Darling River within NSW. Consequently any native species inhabiting the community gains the same protected status as a 'threatened species' under the FM Act.

The Commonwealth EPBC Online Protected Matters Database search tool identified three TECs as "likely to occur within area" (**Appendix C**).

5.1.2 Fauna

Threatened Species

The results of online searches [DECCW NSW Wildlife Atlas database using a 10km radius of the project area and the DECCW 'Find by Geographic Region' threatened species, populations and ecological communities online search tool for the Northern Rivers CMA, and the Border Rivers Gwydir CMA] identified a total of 140 known or predicted records of threatened fauna species (**Appendices B** and **D**, respectively). Data taken from the NSW Wildlife Atlas database only includes records from 1980 onwards. It is likely that a number of species from the CMA searches are recorded in more than one CMA region.

The GIS request to the Spatial Data Programs Department of the NSW DECCW returned records of 61 species of threatened fauna, distributed between 812 locations within 10km of the alignment in the last 10 years (**Figures 5a** and **5b**).

Results of the I&I NSW 'Threatened fish and marine vegetation – find a species by geographic region' online search tool for the Border Rivers/Gwydir CMA and Northern Rivers CMA identified that nine threatened aquatic species may occur within the alignment. Results of the search are provided in **Appendix E**.

The Commonwealth EPBC Online Protected Matters Database search tool identified that 26 threatened species or their habitat may occur within 10km of the Project (**Appendix C**).

Threatened Populations

The results of the DECCW 'Find by Geographic Region' online search tool identified two listed fauna populations that are known or predicted to occur within the CMA sub regions of the proposed alignment. These populations are:

- Emu population in the NSW north coast Bioregion and Port Stephens LGA; and
- Tusked Frog population in the Nandewar and New England Tablelands Bioregions.

The results of the I&I NSW 'Threatened fish and marine vegetation – find a species by geographic region' online search tool for the Border Rivers/Gwydir CMA and Northern Rivers CMA identified that one endangered population is predicted to occur in the alignment and study area; Olive Perchlet *(Ambassis agassizii)*- Endangered population of the Murray-Darling system.

5.2 Field Survey

5.2.1 Flora

Flora Species

Approximately 345 flora species were recorded during field surveys, conducted by URS, across the study area. The majority of these were native species common to woodland and forest communities previously mapped within the region. A full species list is provided in **Appendix G**.

Vegetation Communities

Seven vegetation formations and 49 vegetation communities were mapped within the study areas west and east (**Figures 7a – 7m**). **Table 5-1** lists each vegetation community and the vegetation formations to which they relate. A description of each community and the status of the community, where relevant, are provided in the following sections.

Communities and formations are based on the DECCW *Vegetation Types Database* (2008) communities for the Northern Rivers CMA and Border Rivers/Gwydir CMA areas, Keith (2004) vegetation classifications of far north NSW and Forest's NSW mapping.

Several of the 49 communities have been described as intergrades as they contain areas where similar but not identical vegetation communities meet. Several vegetation communities are recorded on the vegetation mapping (**Figures 7a – 7m**) but are not described within the biodiversity report because they are located outside the project area and are not likely to be impacted. However, these communities are likely to provide habitat for local flora and fauna and consequently have been included on the mapping to illustrate the communities that occur in areas adjacent to the alignment.

In some circumstances vegetation communities may not consistently match the vegetation formation they have been assigned for a variety of reasons. Vegetation communities within the project area have been assigned a formation based on the corresponding DECCW *Vegetation Types Database* (2008). The database contains vegetation types based on original pre-clearing or pre-1750 structure and condition for each CMA area. Given these communities are reflective of pre-clearing communities, the structure and condition of the vegetation type may vary from the original descriptors. Despite inconsistencies in the classification of vegetation types and communities into formations, this grouping has been maintained to be consistent with the DECCW *Vegetation Types Database* (**Table 5-1**).

5 Biodiversity Assessment Results

Further, some communities listed in **Table 5-1** do not correspond to any vegetation types within the DECCW database, due to the highly disturbed nature of the communities. These communities have generally been linked with other community types based on terrain, soils and surrounding vegetation.

Table 5-1 Formation and Vegetation Communities Within The Project Area

Formation Unit	Vegetation Community	TEC Listing
Dry Sclerophyll Forest (shrub/grass sub formation)	Dirty Gum/White Cypress Pine/Silver-leaved Ironbark Open Forest (Integrades)	-
	Flood Gum/Grey Ironbark Tall Open Forest (Disturbed)	-
	Forest Red Gum Grassy Open Forest	-
	Forest Red Gum/Broad-leaved Apple Dry Open Forest	-
	Forest Red Gum/Pink Bloodwood Open Forest	-
	Grey Gum/Grey Ironbark Open Forest	-
	Grey Ironbark/Grey Gum/New England Blackbutt Open Forest (Intergrades)	-
	Ironbark Wattle Woodland (Disturbed)	-
	Narrow-leaved Ironbark Dry Open Forest	-
	New England Blackbutt Dry Heathy Open Forest on Granites	-
	New England Stringybark Open Forest	-
	New England Stringybark/Peppermint/Grey Ironbark/Grey Gum Open Forest (Intergrades)	-
	Spotted Gum/Grey Box /Grey Ironbark Open Forest	-
	Spotted Gum/Grey Ironbark/Dry Open Forest	-
	Spotted Gum/Grey Ironbark/Narrow-leaved Ironbark Open Forest	-
	Spotted Gum/Grey Ironbark/Pink Bloodwood Open Forest	-
	Spotted Gum/Grey Ironbark/Thin-leaved Stringybark Dry Open Forest	-
	Spotted Gum/Thin-leaved Stringybark/Pink Bloodwood Open Forest	-
	Thin-leaved Stringybark/Broad-leaved Apple Open Forest	-
Dry Sclerophyll Forest (shrubby sub formation)	Grey Box - Narrow-leaved Ironbark - White Cypress Pine Open Forest	-
	Tumbledown Red Gum/Blakely's Red Gum/Pine Shrubby Open Forest	-
	Tumbledown Red Gum/Blakely's Red Gum/Pine Shrubby Open Forest (Disturbed-Regrowth)	-
	Youman's Stringybark/Yellow box/Blakely's Red Gum Woodland (Intergrades)	-
Forested Wetland	River Oak Riparian Woodland	-
	River Red Gum Riverine Woodland	-
	River Red Gum Riverine Woodlands (Disturbed)	-
	Swamp Box Swamp Forest (Disturbed)*	Swamp Sclerophyll Forest

5 Biodiversity Assessment Results

Formation Unit	Vegetation Community	TEC Listing
	Swamp Box/Swamp Mahogany Swamp Forest (Integrades)*	Swamp Sclerophyll Forest
	Water Gum/Forest Red Gum Riparian Woodland	-
Grassland	Natural Grasslands on Basalt and Fine Textured Alluvial Soils & White Box Grassy Woodland†	Natural Grasslands on Basalt and Fine Alluvial Plains
	Natural Grasslands on Basalt and Fine Textured Alluvial Soils†	Natural Grasslands on Basalt and Fine Alluvial Plains
Grassy Woodland	Blakely's Red Gum/Grey Box/Rough Barked Apple Grassy Woodland*	Box Gum Woodland
	Blakely's Red Gum/Grey Box/Rough Barked Apple Grassy Woodland* (Disturbed)	Box Gum Woodland
	Blakely's Red Gum/Grey Box/Rough-barked Apple Grassy Woodland†*	Box Gum Woodland
	Blakely's Red Gum/White Box Grassy Woodland* (Regeneration)	Box Gum Woodland
	Blakely's Red Gum/White Box Grassy Woodland* / †*	Box Gum Woodland
	Cabbage Gum Grassy Woodland	-
	Forest Red Gum/Swamp Box Open Forest (Disturbed)*	Sub-tropical Coastal Floodplain Forest
	Forest Red Gum/Swamp Box Open Forest*	Sub-tropical Coastal Floodplain Forest
	Fuzzy Box/Grey Box Grassy Woodland (Disturbed)	-
	Inland Grey Box Tall Grassy Woodland (Disturbed)	-
	Rough-barked Apple riparian forb/grass open forest	-
	White Box Grassy Woodland (Disturbed)*	Box Gum Woodland
	White Box Grassy Woodland†*	Box Gum Woodland
Semi Arid Woodlands (shrubby sub formation)	Dirty Gum Tall Woodland	-
	Silver-leaved Ironbark/White Cypress Pine Woodland	-
Wet Sclerophyll Forest (shrubby formation)	Messmate/Brown Barrel Grassy Open Forest	-
	Spotted Gum/Brush Box Moist Forest	-
	Sydney Blue Gum Open Forest	-
Exotic	Exotic Riparian Vegetation	-
Unknown	Un-Surveyed Wooded Vegetation	-

† = TEC listed under the EPBC Act

** = TEC listed under the NSW TSC Act*

More detailed results for each formation and vegetation communities within these are discussed below.

5 Biodiversity Assessment Results

DRY SCLEROPHYLL FORESTS (SHRUB/GRASS FORMATION)

During the field study, conducted by URS, it was noted that this vegetation formation occupies sandstone plains and granite outcrops of the western slopes. It is characterised by trees with tall straight trunks up to 25m tall. The dominance of sclerophyll shrubs and relative scarcity of grasses in this stratification unit adds contrast to grassy woodlands of the region (Keith, 2004). Nineteen vegetation communities were identified within this formation **Table 5-1**.

Dirty Gum/White Cypress Pine/Silver-leaved Ironbark Shrub/Grass Open Forest (Intergrades) (DS)

This community correlates to the DECCW *Vegetation Types Database* community Dirty Gum-White Cypress Pine - Northern Smooth-bark Apple shrub/grass open forest in the far north of the Nandewar Bioregion in the Border Rivers/Gwydir CMA. The characteristic canopy species of this community are *Eucalyptus chloroclada, Callitris glaucophylla* and *E. melanophloia.* During the field study, conducted by URS, it was noted that in some sections of this community *E. melanophloia* became almost pure stands with only a few of the two alternative species occurring. In some sections, *E. cebra* also became a co-dominant in the community.

The most common shrub layer species consisted of *Notelaea microcarpa.* Given the high level of disturbance in the understorey layer, multiple *Acacia* species, the most dominant being *A. falcata,* were present.

The ground -layer is typically dominated by pasture grasses, small herbs and rock ferns. Some of the native species in the community include *Aristida vagans*, *Imperata cylindrica* var. *major, Cheilanthes distans* and *C. sieberi.*

This community occurs on the mid slopes and hills in alignment and Study Area West, approximately 30km east of Bonshaw (**Figure 7m**). It is in moderate to poor condition with a number of weeds growing in the understorey. The community joins directly to the ironbark and cypress forests along the ranges between the Bruxner Highway and Torrington State Forest.

This community does not qualify as a TEC listed under either the TSC Act or EPBC Act.

Flood Gum/Grey Ironbark Tall Open Forest (Disturbed) (FGId)

This community is described in conjunction with several others below.

Forest Red Gum Grassy Open Forest (F), Forest Red Gum/Broad-leaved Apple Dry Open Forest (FB), Forest Red Gum/Pink Bloodwood Open Forest (FP)

These three communities are described together as they are similar in structure and composition. The three communities correlate to separate DECCW *Vegetation Types Database* communities within the Northern Rivers CMA as listed below:

- Forest Red Gum grassy open forest of the coastal ranges of the North Coast (Forest Red Gum Grassy Open Forest);
- Forest Red Gum – Broad-leaved Apple Dry Open Forest of the Gorges of the North Coast (Forest red gum/Board-leaved Apple Dry Open Forest); and
- Forest Red Gum – Pink Bloodwood open forest of the Coastal Ranges of the North Coast (Forest Red Gum/Pink Bloodwood open forest).

5 Biodiversity Assessment Results

During the field study, conducted by URS, it was noted that canopy dominance in the community varies as the names suggest with a common element of *Eucalyptus tereticornis.* Other dominant canopy species in both the Broad-leaved Apple and Pink Bloodwood community are *Angophora floribunda* and *A. subvelutina. Corymbia intermedia* is only found in the Forest Red Gum/Pink Bloodwood Open Forest Pink Bloodwood community and *E. crebra* is common throughout the three communities.

Dominant shrub species within the three communities include *Acacia terminalis*, *A. linifolia*, *Leptospermum polygalifolium*, *L. trinervium*, *A. implexa*, *Xanthorrhoea johnsonii* and *Allocasuarina torulosa*. Shrub density varied within each community as a result of past and current disturbance.

Ground cover composition was highly variable between and within communities. Some of the more common ground cover species include *Cymbopogon refractus*, *Themeda australis*, *Austrostipa* sp. *Poa* sp., *Dichondra repens*, and *Imperata cylindrica.*

The most common weed species found within these communities were Lantana (*Lantana camara*), Blackberry (*Rubus* sp.), Whisky Grass (*Andropogon virginicus*), Oxalis spp., and African Love Grass (*Eragrostis curvula*).

These communities occur primarily within alignment and Study Area East (**Figure 7g-l**) and are found in varying condition. In the areas between Tenterfield and Drake, communities are in good condition and form part the large vegetation corridor that crosses the slopes and ranges. Forest Red Gum/Pink Bloodwood Open Forest was the most dominant of these communities within this area.

Forest Red Gum/Broad-leaved Apple Dry Open Forest and Forest Red Gum Grassy Open Forest occur as small remnant patches in the lower slopes and hills between the ranges. Surrounding the town of Tabulam these communities form part of the vegetation corridor through the slopes and ranges. In other areas where these communities occur they have been extensively cleared and only remain as isolated remnants with little connectivity.

These communities do not qualify as a TEC listed under either the TSC or EPBC Acts.

Grey Gum/Grey Ironbark Open Forest (GG), Grey Ironbark/Grey Gum/New England Blackbutt Open Forest (Intergrades) (GIGGNB)

These two communities are described together as they are similar in structure and composition. Grey Ironbark/Grey Gum Open Forest correlates to the DECCW *Vegetation Types Database* community *Grey Ironbark – Grey Gum Open Forest of the Northern Escarpment Ranges of the North Coast* in the Northern Rivers CMA and is described and mapped by NPWS (1999) as *Grey Gum – White Mahogany Open Forest*. The community *Grey Ironbark/Grey Gum/New England Blackbutt Open Forest (Intergrades)* This intergrade community does not fit any of the listed biometric communities for the region.

The main difference between the two communities is the relative occurrence of *Eucalyptus andrewsii.* Dominant overstorey species within both communities includes *E. siderophloia,* and *E. propinqua*, with *E. tereticornis, E. caliginosa* and *Corymbia intermedia* occurring as secondary species.

Dominant shrub species include *Acacia terminalis, A. linifolia, A. implexa, A. longifolia, Leucopogon lanceolata, Melichrus urceolatus, Indigofera australis* and *Allocasuarina torulosa.* During the field study, conducted by URS, it was noted that throughout the alignment shrub density varied reflecting on past and current levels of disturbance.

5 Biodiversity Assessment Results

Ground cover composition was highly variable within and between communities. Some of the more common species include: *Imperata cylindrica, Themeda australis, Cymbopogon refractus, Dianella caerulea, Austrostipa* sp., and *Dichondra repens.*

The most common weed species found within these communities were Cotton bush (*Gomphocarpus* spp.), Fleabane (*Conyza* sp.) and Lantana (*Lantana camara*). Weeds are generally restricted to edges of native communities and within the 132kV existing transmission line alignment.

These communities occur primarily within alignment and Study Area East (**Figure 7h**). Within the study area they are generally found in good condition and form part of the vegetation corridor that crosses the slopes and ranges between Tenterfield and Drake. Vegetation along the edges of the existing alignment appears to be regrowth (approximately 15-30 years). However, this vegetation is still in moderate condition.

These communities do not qualify as a TEC listed under either the TSC or EPBC Acts.

Ironbark Wattle Woodland (IWd)

This community is described in conjunction with several others below.

Narrow-leaved Ironbark Dry Open Forest (N)

This community correlates to the DECCW *Vegetation Types Database* community *Narrow-leaved Ironbark dry open forest of the North Coast* in the Northern Rivers CMA. Dominant canopy species include *Eucalyptus crebra, E. tereticornis, Angophora floribunda,* and *A. subvelutina.*

Primary shrub species include *Acacia linifolia* and *Allocasuarina torulosa*, and the ground cover was dominated by *Imperata cylindrica, Themeda australis, Entolasia* sp., and *Glycine* sp. No weeds were recorded within this community.

This community occurs in small patches at the base of the steep ranges in alignment and Study Area East and is in good condition (**Figure 7i-j**).

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

New England Blackbutt Dry Heathy Open Forest on Granites (NEBHG)

This community correlates to the DECCW *Vegetation Types Database* community *New England Blackbutt Dry Heathy Open Forest on Granites of the eastern New England Tablelands* in the Border Rivers/Gwydir CMA. This community is mapped by NPWS (1999) as *Dry Heathy New England Blackbutt*. This vegetation community ranges from the mid slope to the ridge top aspect. Along the ridge tops the primary canopy species is *Eucalyptus campanulata, with other canopy species including; E. andrewsii* subsp. *andrewsii*, *E. acaciiformis, E. radiata* and a varied combination of the latter species occur as the dominant species in the upper to mid slopes of the community. It also appears that there may be some hybridisation of the *E. campanulata* and *E. andrewsii* subsp. *andrewsii* species within this community. The location of this community occurs at the margin for both the western and eastern varieties of the *Eucalyptus* species, thus encouraging the cross pollination of the two species.

Primary shrub species include; *Allocasuarina torulosa, Melichrus procumbens, Acacia irrorata, A. falcata, A. ulicifolia, Leucopogon lanceolata, Leucopogon muticus, Monotoca* scoparia. Understorey species included: *Hovea linearis, Themeda australis, Pimelia linifolia, Pratia purpurascens, Kennedia rubicunda, Pteridium esculentumm and Lomandra filiformis* as well as *Imperata cylindrica* in disturbed

areas. During the field study conducted by URS, it was noted that where this community occurs within the project area, shrub density varies as result of low intensity grazing, past clearing and changes in soil content.

Weed occurrence was relatively minor with only Silver-leaved Nightshade (*Solanum elaeagnifolium)* occurring in small patches within the community.

This community occurs as a large patch in the mid slope and ridge top areas just north west of Tenterfield in alignment and Study Area West (**Figure 7g**). The community is in good condition and forms part of the vegetation corridor that crosses the slopes and ranges between Tenterfield and Drake. Basket-swamp National Park joins directly to this community to the north of the alignment. It is known to be home to number of threatened species such as Koala (*Phascolarctos cinereus*), Spotted-tailed Quolls *(Dasyurus maculatus)* and Powerful Owls *(Ninox strenua).*

Since the initial URS constraints assessment (URS (2009) *Constraints Identification and Preferred Corridor Report*), a more qualified botanist has classified this community to align with biometric vegetation types for the CMA. This amended classification was due to characteristic floristic associations, landscape position and underlying geology.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

New England Stringybark Open Forest (NES)

This community correlates to the DECCW *Vegetation Types Database* community *New England Stringybark – Peppermint open forest of the New England Tablelands* in the Northern Rivers CMA and has been mapped and described by NPWS (1999) as *New England Stringybark Open Forest*. Dominant canopy species in this community include *Eucalyptus caliginosa*, *E. laevopinea, E. propinqua, E. radiata.* Secondary overstorey species include *E. tereticornis, E. caliginosa* and *Corymbia intermedia.*

Primary shrub species in this community include *Acacia implexa, A. filicifolia, Leucopogon lanceolata and Allocasuarina torulosa.* Where this community occurs within the alignment and study area, shrub density varies as result of past and current levels of disturbance.

Ground cover composition was highly variable. Some of the more common species in the community include *Imperata cylindrica, Themeda australis, Pteridium esculentum, Entolasia* sp.*, Lomandra* sp. and *Glycine* sp.

The most common weed species found within this community are African Love Grass (*Eragrostis curvula*), Dandelion (*Taraxacum officinale*) and *Sonchus* sp. Weeds are restricted to edges of native vegetation and within the existing 132kV transmission line easement.

Within the project area these communities are in good condition and form part of the vegetation corridor that crosses the slopes and ranges between Tenterfield and Drake (**Figure 7h**).

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

New England Stringybark/Peppermint/Grey Ironbark/Grey Gum Open Forest (Intergrades) (NESPGG)

This community is mapped where New England Stringybark open forest and Grey Ironbark/Grey Box intergrade (**Figure 7h**). Primary over-storey species in this community are *Eucalyptus caliginosa, E. propinqua, E. radiata* and *E. siderophloia.*

5 Biodiversity Assessment Results

Primary shrub species include *Acacia implexa, A. filicifolia, Leucopogon lanceolata and Allocasuarina torulosa.* Where this community occurs within the alignment shrub density varies as result of past and current disturbance levels.

Ground cover composition was highly variable within the community. Some of the more common species include *Imperata cylindrica, Themeda australis, Pteridium esculentum, Entolasia* sp., *Lomandra* sp., and *Glycine* sp.

The most common weed species within the community are African Love Grass (*Eragrostis curvula*) and *Sonchus* sp. Weeds are restricted to edges of the community and within the existing transmission line easement.

During the field study, conducted by URS, it was noted that only small areas of this community occur within Study Area East (**Figure 7h**). Where it occurs, this community is in good condition and forms part of the vegetation corridor that crosses the slopes and ranges between Tenterfield and Drake.

This community does not qualify as a TEC listed under ither the TSC or EPBC Acts.

Spotted Gum/Grey Box/Grey Ironbark Open Forest (SGG), Spotted Gum/Grey Ironbark Dry Open Forest (SG), Spotted Gum/Grey Ironbark/Narrow-leaved Ironbark Open Forest (SGN), Spotted Gum/Grey Ironbark/Pink Bloodwood Open Forest (SGP), Spotted Gum/Grey Ironbark/Thin-leaved Stringybark Dry Open Forest (SGT), Spotted Gum/Thin-leaved Stringybark/Pink Bloodwood Open Forest (STP), Flood Gum/ Grey Ironbark Tall Open Forest (FGId) and Ironbark Wattle Woodland (Disturbed) (IWd)

These communities are described together as they have similar structure and composition. Three of these communities correlate with DECCW *Vegetation Types Database* communities of the Northern Rivers CMA as shown below:

- Spotted Gum – Grey Box – Grey Ironbark dry open forest of the Clarence Valley Lowlands of the north coast (Spotted Gum/Grey Box/Grey Ironbark Open Forest);
- Spotted Gum- Grey Ironbark shrubby open forest of the Richmond Ranges of the north coast (Spotted Gum/Grey Ironbark/Open Forest); and
- Spotted Gum – Grey Ironbark – Pink Bloodwood open forest of the Clarence Valley Lowlands of the north coast (Spotted Gum/Grey Ironbark/Pink Bloodwood Open Forest).

The main difference between the communities is varying dominance/occurrence of *Eucalyptus moluccana, E. siderophloia, E. eugenioides* and *Corymbia intermedia.*

The community mapped as Flood Gum- Grey-Ironbark tall open forest has been included in this group as it still contains the characteristic species such as: *C. variegata, E. moluccana* and *E. siderophloia* and it is located in an area surrounded by the Spotted Gum communities. The occurrence of the *E. grandis* as a dominant in this community may be the influence of the terrain, north east facing aspect or the close vicinity of the Dry Land Rainforest in Mallanganee National Park over the hill to the south west. Similarly, the community mapped as Ironbark /wWattle Wwoodland is included with this group, as it appears to be a highly disturbed and degraded form of some of the previous communities where *E. siderophloia* occurs as the dominant.

In general, canopy dominance varies as the community names suggest and can include *Eucalyptus siderophloia, Corymbia henryi, C. variegata, E. moluccana, C. intermedia* and *E. eugenioides.*

Characteristic shrub species include: *Acacia terminalis, A. falcata, A. longifolia, A. implexa, Jacksonia scorpodia and Allocasuarina torulosa.* Where these communities occur within the alignment, shrub density varies depending on past and current disturbance.

Ground cover composition was highly variable within and between communities. Some of the more common gound cover species are: *Pratia purpurascens, Cymbopogon refractus, Themeda australis, Dichondra repens,* and *Imperata cylindrica.*

The most common weed species found within these communities are: Lantana (*Lantana camara*), Purpletop (*Verbena* sp.), *Bidens* spp., *Oxalis* spp., Sweet Briar (*Rosa rubiginosa*) and African lovegrass (*Eragrostis curvula*). Weeds are restricted to the existing transmission line easement and other disturbed edges. The Flooded Gum- Grey Ironbark tall open forest community contains a major weed infestation in the mid-storey layer with Lantana and Sweet Briar forming the major part of the this strata layer.

These communities only occur on the hilly and undulating terrain within alignment and Study Area East (**Figure 7g-l**) and are found in varying condition. On average they are in good condition and form part of the vegetation corridor that crosses the slopes and ranges between Drake and Casino. Some areas along the edges of the existing easement are regrowth; however they are still in moderate condition.

These communities do not qualify as TEC listed under either the TSC or EPBC Acts.

Thin-leaved Stringybark/Broad-leaved Apple Open Forest (TB)

This community correlates to the DECCW *Vegetation Types Database* community *Thin-leaved Stringybark/Broad-leaved Apple open forest of the gorges of the north coast* in the Northern Rivers CMA. Dominant canopy species include: *Angophora subvelutina* and *Eucalyptus eugeniodies.* Secondary overstorey species include: *E. tereticornis* and *E. melliodora.*

Primary shrub species include: *Breynia oblongifolia* and *Rubus parvifolius.* Where this community occurs within the alignment shrub species were sparse.

Ground cover composition was highly variable. Some of the more common species include: *Imperata cylindrica* and *Themeda australis.*

The most common weed species found within this community are *Sonchus* sp., Blackberry (*Rubus* sp.), Fleabane (*Conyza* spp.), and *Senecio* sp. Weeds accounted for 20-30% of the understorey within this community.

During the field study, conducted by URS, it was noted that this community occurs along the Bruxner Highway in roadside reserve outside Tenterfield (**Figure 7g**). The community has been cleared for farming and some areas have no overstorey remaining. This community is continuous with the vegetation along the Bruxner Highway only.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

DRY SCLEROPHYLL FOREST (SHRUBBY FORMATION)

This vegetation formation occupies hilly terrain. Trees form an open canopy up to 25m tall and are widely spaced. The shrub stratum of this class is particularly distinctive because it comprises a variable mixture of larger sclerophyllous and non-sclerophyllous species, which can form dense clumps up to 5m tall (Keith, 2004). Four vegetation communities were identified within this formation (**Table 5-1**).

5 Biodiversity Assessment Results

Grey Box/Narrow-leaved Ironbark/White Cypress Pine Open Forest (GIWC)

This community most closely correlates to the DECCW *Vegetation Types Database* community White Cypress Pine- Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion in the Border Rivers/Gwydir CMA. The characteristic canopy species are: *Eucalyptus crebra; Callitris glaucophylla* and *E. blakelyi. E. microcarpa* also occurs as a dominant in distinct patches within the community.

Common shrublayer species include *Dodanea viscosa, Notelaea microcarpa* var. *macrocarpa* and *Allocasuarina luehmannii*.

The ground layer is typically dominated by grasses, herb and forbs interspaced between lose shale substrate, including: *Austrostipa scabra subsp. Scabra, Cymbopogon refractus, Cheilanthes sieberi, Bulbine bulbosa* and *Lomandra filiformis*. Some weeds have invaded the ground layer; these consist of Prickly Pear (*Opuntia stricta*) and Silver-leaved Nightshade (*Solanum elaeagnifolium*).

During the field study, conducted by URS, it was noted that this community occurs in undulating to hilly terrain just west of Tenterfield in alignment and Study Area West (**Figure 7f**). It is in moderate to good condition with large sections of regeneration but some weed invasion. This community is isolated to the west by extensive clearing in the flats. To the east the community adjoins patches of grassy woodland in the travelling stock reserve across the New England Highway and roadside reserves.

This community does not qualify as a TEC listed under either the TSC Act or EPBC Act.

Tumbledown Red Gum/Blakely's Red Gum/Pine Shrubby Open Forest (TBP) and Tumbledown Gum/Blakely's Red Gum/Pine Shrubby Open Forest (Disturbed – Regrowth) (TBPd)

This community correlates to the DECCW *Vegetation Types Database* community *Tumbledown Red Gum – Blakely's Red Gum – pine shrubby forest of the Nandewar Bioregion* in the Border Rivers/Gwydir CMA. Dominant canopy species include: *Eucalyptus delbata, E. blakelyi, Calilitris glaucophylla*, and *C. endlicheri.*

Characteristic shrub layer species are: *Leptospermum brevipes, Lucopogon muticus, Olearia elliptica* and *Melichrus urceolatus.*

The ground storey is typically dominated by grasses including: *Aristida ramosa, Cymobopogan refractus* and *Chelianthes sieberi* subsp. *sieberi*.

This community occurs on the hills and foothills in alignment and study area, west (**Figure 7a-d**) and is in good condition. Historically the cypress pine species were selectively cleared from large areas of this community to establish pasture; however it is regenerating in a number of areas.

This community does not qualify as a TEC listed under either the TSC or EPBC Act.

Yuouman's Stringybark/Yellow Box/Blakely's Red Gum Woodland (Intergrades) (YY)

This community is an intergrade of Blakely's Red Gum/White Box grassy woodland described below and the DECCW *Vegetation Types Database* community *Youman's Stringybark – New England Blackbutt – Narrow-leaved Peppermint – Eucalyptus subtilior open forest of the New England Tablelands* in the Border Rivers/Gwydir CMA. Dominant canopy species include: *Eucalyptus mellliodora, E. blakelii, E. youmanii,* and *E. campanulata.* Co-occurring species include: *E. parava* and *E. albens.*

Characteristic shrub species include: *Melichrus urceolatus* and *Persoonia* spp.

The ground layer is dominated by forbs and grasses including *Poa sieberiana* var. *sieberiana, Gonocarpus tetragynus, Geranium solanderi, Geitonoplesium cymosum, Dioscorea transversa*, and *Dianella longifolia*.

This community occurs in Study Area West near Tenterfield (**Figure 7f**) and forms part of the vegetation corridor that crosses the ranges to the north of the town. The community is in moderate condition, with a number of typical weed infestations associated with grazing and agriculture. Increased fire frequency and intensity within the region has the potential to further impact the species diversity within this community.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

FORESTED WETLANDS

This vegetation formation is restricted to riverine corridors and floodplains and structure and composition varies depending on elevation and distance from the coast (Keith, 2004). Six vegetation communities were identified within this forested wetlands formation (**Table 5-1**).

River Oak Riparian Woodland (RO)

This community correlates with the DECCW *Vegetation Types Database* community *River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions (Benson 84)* in the Border Rivers/Gwydir CMA. The characteristic canopy species is *Casuarina cunninghamiana* and other co-occurring species such as *Angophora floribunda* and *Eucalyptus blakelyi.*

Dominant shrub species include: *Melaleuca bracteata, Bursaria spinosa subsp. Spinosa, Callistemon viminalis, Leptospermum brevipes* and *Notelaea microcarpa* var. *microcarpa.*

The groundstorey is dominated by grasses and forbs including: *Microlaena stipoides* var. *stipoides, Oplismenus imbecillis, Lomandra longifolia, Urtica incise, Cymbopogon refractus, Austrostipa verticillata, Elymus scaber, Dicondra repens* and *Carex appressa.*

This community occurs along one of the water ways in alignment and Study Area West (**Figure 7f**) and is in moderate condition. In large areas it has been cleared for recreational and agricultural purposes with only scattered canopy trees remaining. In these disturbed areas the understorey is dominated by *Callistemon* sp., pasture grasses and weeds like Stinging Nettle (*Urtica* spp.) and Thistle (*Cirsium* spp).

This community does not qualify as a TEC listed under either the TSC Act or EPBC Act.

River Red Gum Riverine Woodland (RRG) and River Red Gum Riverine Woodlands (Disturbed) (RRGd)

This community correlates with the DECCW *Vegetation Types Database* community *River Red Gum Riverine woodlands and forest in the Nandewar and Briglow Belt South Bioregions (Benson 78)* in the Border Rivers/Gwydir CMA. The characteristic canopy species is *Eucalyptus camaldulensis,* and other co-occurring species include: *Angophora floribunda, Casurina cunninghamiana, E. melliodora, E. blakelyi, E. albens* and *Corymbia tessellaris.*

Dominant shrub species include: *Melaleuca bracteata, Callistemon viminalis, C. sieberi, Leptospermum polygalifolium, L. brachyandrum, L. brevipes* and *Notelaea microcarpa* var. *microcarpa.*

The groundstorey is dominated by grasses and forbs including: *Cynodon dactylon, Austrostipa verticillata, Aristadia vagans, Swainsona galegifolia* and *Carex incomitata.*

5 Biodiversity Assessment Results

During the field study, conducted by URS, it was noted that this community occurs along the water ways within Study Area West (**Figure 7a-d**) and is of varying condition. In large areas it has been cleared for recreational and agricultural purposes with only scattered canopy trees remaining. In these disturbed areas the understorey is dominated by *Callistemon* sp., pasture grasses and weeds like Stinging Nettle (*Urtica* spp.) and Thistle (*Cirsium* spp).

This community does not qualify as a TEC listed under either the TSC Act or EPBC Act.

Swamp Box Swamp Forest (Disturbed) (Sd) and Swamp Box/Swamp Mahogany Swamp Forest (Intergrades) (SS)

These two communities are described together as they are similar in structure and composition. Both these communities correlate to the DECCW *Vegetation Types Database* community *Swamp Box swamp forest of the coastal lowlands of the north coast* in the Northern Rives CMA.

Canopy dominance varies as the names suggest with *Eucalyptus robusta* only occurring in the intergrade community. Common canopy species include: *Eucalyptus tereticornis, E. siderophloia, Lophostemon suaveolens* and *Corymbia intermedia.*

Characteristic shrub species include *Melaleuca quinquenervia* and *M. decora*.

Ground cover composition was highly variable within and between communities. Some of the more common species are: *Imperata cylindrica*, *Gahnia clarkei*, and *Juncus* sp.

The most common weed species found within these communities are Fleabane (*Conyza* spp.), *Senecio* spp. and *Oxalis* spp.

These communities are found within Study Area East (**Figure 7g-l**), and are in varying condition, ranging from highly disturbed to moderately healthy patches along the floodplains close to Casino. Large areas of these communities have been cleared for agriculture and only isolated patches remain. Typically these patches have reduced overstorey diversity and the understorey is dominated by pasture grasses. The one exception to this is where the community occurs adjacent to large patches of Forest Red Gum/Swamp Box open forest and is in a moderate condition.

These communities qualify as the TEC listed under the TSC Act *Swamp Sclerophyll forest on Coastal Floodplains of the NSW North Coast Bioregions*. Disturbed patches are mapped on **Figure 7i** are a degraded form of this TEC. These communities, however, do not qualify as a TEC under the EPBC Act.

Water Gum/Forest Red Gum Riparian Woodland (W)

This community does not correlate strongly with any descriptions provided within the DECCW *Vegetation Types Database* for the CMA. The characteristic canopy species are *Tristaniopsis laurina* and *Eucalyptus tereticornis*. The understorey is characterised by a dense cover of *Lomandra longifolia* with scattered clumps of exotic pasture grass species. This

During the field study, conducted by URS, it was noted that this community occurs along one waterway approximately 6km north east of Drake. and is of moderate to good condition. The community occurs adjacent to an area that has been disturbed in the past to allow access to the existing transmission line. This community also appears to be heavily influenced by the creek around which it grows, with evidence of flood events in much of the vegetation and debris deposited by flood events scattered around the immediate vicinity.

This community does not qualify as a TEC listed under either the TSC Act or EPBC Act.

GRASSLANDS

This vegetation formation is characterised by a complete or almost treeless overstorey and dominance by large perennial tussock grasses. In addition to the presence of tussock grasses, broad-leaved herbs are fairly common in the inter-tussock spaces. Another common feature of grasslands is their occurrence on heavy clay soils on flat alluvial terrain (Keith, 2004). Two vegetation communities were identified within this formation (**Table 5-1**).

Natural Grasslands on Basalt and Fine Textured Alluvial Soils & White Box Grassy Woodland (NGWB) and Natural Grasslands on Basalt and Fine Textured Alluvial Soils (NG)

Both of these communities correlate to the DECCW *Vegetation Types Database* community *Bluegrass - Redleg Grass - Common Woodruff clay plain grassland of northern Brigalow Belt South Bioregion* in the Border Rivers/Gwydir CMA. The characteristic canopy species are *E. albens, E. camaldulensis, Angphora floribunda* and *E. melanophloia.* Canopy species dominance varies according to the terrain, with *Eucalyptus camaldulensis* occurring more commonly along the alluvial plains close to creeklines, *Angphora floribunda* along the edges of the alluvial plains and *E. albens* and *E. melanophloia* on the lower slopes. Protective foliage cover in the grassland community is less then 10% with tree intervals occurring on average between 20 to 30 meters apart.

The primary difference between the grassland community and the grassland/grassy woodland community is the slight change in the degree of slope, the protective foliage cover which increases towards the grassy woodland transitional zones and the loss of the alluvial soils further up the slopes in the grassy woodland.

The shrub layer was mostly absent with only a few scattered *Leptospermum brevipes* and *Melichrus urceolatus.* Some regeneration of the canopy species is also evident.

The ground storey is dominated by western grassland species including; *Bothriochloa biloba*, *Bothriochloa decipiens Dichanthium sericeum* subsp. *sericeum, Cymobogon refractus, Austrodanthonia bipartite, Austrostipa aristiglumis, Aristida ramosea* and *Panicum decompositum.*

Both communities occur in one small patch within the western section of the alignment and study area (**Figure 7c)**. The condition of both communities is fairly good with a high diversity of species, minimal weed invasion (weeds are only present along the edges of the creekline) and limited physical disturbances.

These communities qualify as the TEC *Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern Queensland* listed as critically endangered under the EPBC Act.

GRASSY WOODLAND

This vegetation formation is dominated by widely spaced eucalypts and a conspicuous and diverse ground cover of grasses and herbs (Keith, 2004). Thirteen vegetation communities have been identified in this formation (**Table 5-1**).

Blakely's Red Gum/Grey Box/Rough Barked Apple Grassy Woodland (BGB) and Blakely's Red Gum/Grey Box/Rough Barked Apple Grassy Woodland (Disturbed) (BGBd)

As this community occurs within the proposed easement, this community correlates to the DECCW (2008) *Vegetation Types Database* community: *Grey Box-Blakely's- Red Gum- Yellow Box Grassy Woodland Grassy Open Forest of the Nandewar Bioregion* in the Border Rivers/Gwydir CMA.

Dominant canopy species in this community include: *Eucalyptus blakelyi* and *E. microcarpa*. *Angophora floribunda* is found throughout the community and can dominate on granite outcrops.

The shrub layer in this community is relatively sparse in most areas. Where shrubs do occur, characteristic species include; *Notelaea microcarpa* var*. macrocarpa*, *Melichrus urceolatus* and *Jacksonia scoparia.*

The ground cover is dominated by native grasses, herbs and forbs including; *Austrostipa scabra subsp. scabra, Lomandra filiformis, Wurmbea biglandulosa, Geranium sp., Pimelea linifolia, Ranunculus lappaceus* and *Dichondra repens.*

This community occurs in several locations along the length of the proposed transmission line, and in varying conditions. Some patches are in good condition, with a large patch size, an intact canopy, regeneration of canopy species and an understorey dominated by native species. Other patches are much smaller, and occur as disturbed and degraded remnants, lacking a native understorey. A good condition remnant of this community is found to the west of Tenterfield in Study Area West (**Figure 7f**) along the lower slopes and flats. At this location, the community is in good condition with a predominantly native understorey and regenerating overstorey. A small disturbed patch of this community occurs close to Tarban Road. This patch is highly modified with only a few scattered key canopy species remaining. Other small patches are located in west and east of Tenterfield.

Good condition patches of this community meet the criteria for inclusion within the TEC *White Box, Yellow Box, Blakely's Red Gum grassy woodland* listed under the TSC Act and also as the TEC *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and derived Native Grassland* listed under the EPBC Act. Lower quality disturbed remnants, and remnants with a small patch size only meet the criteria for inclusion as the TSC Act listed community, failing to meet the standards of the federal listing.

Blakely's Red Gum/White Box Grassy Woodland (BWBr) and Blakely's Red Gum/Rough Barked Apple/Red Stringybark Grassy Open Forest (BRR)

This community correlates to the DECCW *Vegetation Types Database* community *Blakely's Red Gum – Rough-barked Apple – Red Stringybark Grassy Open Forest of the western New England Tablelands* in the Border Rivers/Gwydir CMA. Dominant canopy species within this community are *Angophora floribunda, Eucalyptus macrorhyncha* and *E. blakelii.*

Within this community the shrub layer is generally absent however, where it does occur characteristic species are; *Jacksonia scoparia*, *Cassinia* sp. and *Allocasuarina torulosa*. The ground cover is dominated by grasses and forbs including; *Themeda australis, Austrostipa* sp*., Poa sieberiana, Dichondra repens, Swainsona* sp*., Mulga fern, Lomandra multiflora.*

The most common weed species found within this community are Blackberry (*Rubus* spp.), Fleabane (*Conyza* spp.), *Olxalis* spp., Large-leaved privet (*Ligustrum lucidum*), *Plantago* sp. and Great Mullein (*Verbascum thapsus*). Weeds are generally restricted to the existing transmission line easement and other disturbed edges of the community.

These communities occur just outside of Tenterfield on undulating slopes in alignment and Study Area East (**Figure 7g)**. This community forms large stands across the hills broken by cleared valleys that are used for grazing.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

5 Biodiversity Assessment Results

Blakely's Red Gum/White Box Grassy Woodland (BWB)

This These community communities correlates closest to the DECCW *Vegetation Types Database* community *White Box grassy woodland of the Nandewar and Briglow Belt South Bioregions* in the Border Rivers/Gwydir CMA. Dominant canopy species in this community include: *Eucalyptus blakelyi,* with scattered *E. albens*, *E*. *melliodora* in some stands. *Angophora floribunda* is found throughout the community and can dominate on granite outcrops.

Characteristic shrub species are *Cassinia laevis*, *Olearia elliptica, Acacia implexa,* and *Notelaea microcarpa var. microcarpa*.

The ground cover is dominated by native grasses and forbs including *Themeda australis, Cymbopogon refractus, Aristida ramosa, Austrostipa scabra subsp. Scabra, Microlaena stipoides, Desmodium varian*s and *Dichondra repens.*

During the field study, conducted by URS, it was noted that this community occurs to the west of Tenterfield in alignment and Study Area West (**Figure 7a-g**) along the lower slopes and flats. The community is in good condition with a predominantly native understorey and regenerating overstorey. In some areas only scattered mature canopy trees remain and the canopy is dominated by regenerating eucalyptus. Canopy dominance varies with soil type, *E. melliodora* is dominant on richer soils, *Angophora floribunda* dominates granite outcrops and *E. albens* and *E*. *blakelyi* are found throughout. In some areas, stands of this community were thought to be the result of regeneration in response to historical disturbance; such areas were considered to be of slightly lesser condition that stands with large mature hollow bearing trees. However, over time, it is considered that these stands of the community would develop mature hollow bearing trees.

This community qualifies as the TEC *White Box- Yellow Box- Blakely's Red Gum grassy woodland* listed under the TSC Act. Large continuous patches of the community also qualify as the TEC *White Box – Yellow Box – Blakely's Red Gum grassy woodland and derived native grassland* listed under the EPBC Act.

Blakely's Red Gum/Grey Box/Rough-barked Apple Grassy Woodland (BGB)

As it occurs within the proposed easement, this community correlates to the DECCW (2008) *Vegetation Types Database* community *Grey Box-Blakey's- Red Gum- Yellow Box Grassy Woodland grassy open forest of the Nandewar Bioregion* in the Border Rivers/Gwydir CMA. Dominant canopy species in this community include: *Eucalyptus blakelyi* and *E. microcarpa*. *Angophora floribunda* is found throughout the community and can dominate on granite outcrops.

The shrub layer in this community is relatively sparse in most areas. Where shrubs do occur, characteristic species include *Notelaea microcarpa* var*. macrocarpa*, *Melichrus urceolatus* and *Jacksonia scoparia.*

The ground cover is dominated by native grasses, herbs and forbs including*, Austrostipa scabra subsp. scabra, Lomandra filiformis, Wurmbea biglandulosa, Geranium sp., Pimelea linifolia, Ranunculus lappaceus* and *Dichondra repens.*

This community occurs in several locations along the length of the proposed transmission line, and in varying conditions. Some patches are in good condition, with a large patch size, an intact canopy, regeneration of canopy species and an understorey dominated by native species. Other patches are much smaller, and occur as disturbed and degraded remnants, lacking a native understorey. A good condition remnant of this community is found to the west of Tenterfield in Study Area West (**Figure 7f**)

along the lower slopes and flats. At this location, the community is in good condition with a predominantly native understorey and regenerating overstorey. A small disturbed patch of this community occurs close to Tarban Road. This patch is highly modified with only a few scattered key canopy species remaining. Other small patches are located in west and east of Tenterfield.

Good condition patches of this community meet the criteria for inclusion within the TEC *White Box, Yellow Box, Blakely's Red Gum grassy woodland* listed under the TSC Act and also as the TEC *White Box – Yellow Box – Blakely's Red Gum grassy woodland and derived native grassland* listed under the EPBC Act. Lower quality disturbed remnants, and remnants with a small patch size only meet the criteria for inclusion as the TSC Act listed community, failing to meet the standards of the federal listing.

Cabbage Gum Grassy Woodland (CG)

This community correlates to the DECCW *Vegetation Types Database* community *Cabbage Gum Grassy woodland of the North Coast and New England Tablelands* in the Northern Rivers CMA. Dominant canopy species within this community are *Eucalyptus amplifolia* subsp. *amplifolia, E. amplifolia* subsp. *sessiliflora, E. tereticornis,* and *Angophora floribunda.*

Characteristic shrub species are *Acacia terminalis*, *A. linifolia*, and *Leptospermum* sp. The ground cover is dominated by grasses and sedges including: *Imperata cylindrica, Themeda australis, Juncus* sp. and *Lomandra longifolia.*

Weeds within this community are restricted to the existing transmission line and include: *Bidens* spp., Fleabane (*Conyza* spp.), Pimpernel (*Anagallis arvensis*), *Oxalis* spp.

This community occurs in two areas within Study Area East (**Figure 7h**). Both areas have been cleared in the past, and allowed to regenerate over the last 30 to 50 years. The area along Long Gully Road occurs as a narrow patch on the edge of a heavily cleared farming area is continuous with the vegetation on the hills to the east and is in good condition.

The other area occurs in a previously cleared gravel pit and is in good condition with moderate species diversity and low weed invasion. Some 'pioneer' species such *Acacia* sp. and *Imperata cylindrica* are still present within the community.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

Forest Red Gum/Swamp Box Open Forest (Disturbed) (FSd) and Forest Red Gum/Swamp Box Open Forest (FS)) and Forest Red Gum/Swamp Box Open Forest (Distrubed) (FSd)

Thieses community correlates to the DECCW *Vegetation Types Database* community *Forest Red Gum Swamp Box of the Clarence Valley Lowlands of the North Coast* in the Northern Rivers CMA. Dominant canopy species within this community are *Eucalyptus tereticornis, E. moluccana,* and *Lophostemon suaveolens.* The shrub layer is absent in this community and the ground layer is dominated by *Imperata cylindrica, Lomandra longifolia* and *Gahnia clarkei.*

Weed species that occur throughout the community are Cotton bush (*Gomphocarpus* spp.), Blackberry (*Rubus* spp.), *Senecio* spp. Scotch thistle (*Onopordum acanthium*), and *Juncus* sp.

During the field study, conducted by URS, it was noted that this community only occurs in alignment and Study Area East (**Figure 7i-l**) and is found in varying condition. Small remnant patches are found along permanent creek-lines and highly disturbed patches that have been cleared for grazing along the floodplains between Tabulam and Casino. In these highly disturbed patches only a few native

overstorey species are present (*Imperata cylindrica* and *Lomandra longifolia*) and the overstorey is dominated by pasture grasses.

Where this community occurs on floodplains it qualifies as the TEC *Sub-Tropical Coastal Floodplain Forest of the NSW North Coast Bioregion* listed under the TSC Act. It does not qualify as a TEC listed under the EPBC Act.

Fuzzy Box/Grey Box Grassy Woodland (Disturbed) (FGBd)

This community occurs as severely degraded remnants, and does not correlate to and community descriptions contained within the DECCW Vegetation Types Database in the Border Rivers/Gwydir CMA. All that remains in these patches of vegetation are sporadic canopy species including: Eucalyptus conica and E. microcarpa. The shrub layer is absent and the ground layer consists of a few pasture grasses and an array of weeds such as Scotch thistle (Onoporodum acanthium).

This community occurs in a few patches of vegetation on the flats west of Tenterfield in Study Area West (**Figure 7f**). This woodland community is highly disturbed due to agricultural clearing and moderate intensity grazing.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

Inland Grey Box Tall Grassy Woodland (Disturbed) (Id)

The floristic association of this community most closely matches that of Inland Grey Box tall grassy woodland on clay soils in the Brigalow Belt South and Nandewar Bioregions as described by the DECCW *Vegetation Types Database* for the Border Rivers/Gwydir CMA. This community is noted as being dominated by *Eucalyptus microcarpa*, with main associated canopy species including *Angophora floribunda*, *E. melliodora* and *E. albens* (DECCW 2008). The community as described by DECCW (2008) is noted as being "*mainly confined to the Brigalow Belt South Bioregion with some occurrences further east in the Nandewar Bioregion*". The community as mapped by URS occurs to the north of the known distribution as described by DECCW (2008), however given the similarity of the vegetation observed by URS to the described floristic assemblage (as per DECCW 2008), the decision was made to classify this community as *Inland Grey Box Woodland (Disturbed)*.

Inland Grey Box Tall Grassy Woodland Inland Grey Box Woodland within the study area is located on clay/sand transistional zones, and the canopy species for this community include: *Eucalyptus microcarpa* with co-occurring species including *Angophora floribunda, E. albens, E. melliodora* and *E. eugenioides. Brachychiton populneus* subsp. *populneus*. was also a co-occuring dominant in the less disturbed patches of this community.

Dominant shrub species include: *Dodonaea viscosa, Bursaria spinosa subsp. spinosa, Cassinia quinquefaria* and *Notelaea microcarpa.*

In the less disturbed patches of this community the ground-storey is typically dominated by tussock grasses and forbs including: *Austrostipa scabra; Bothriochloa macra; Wahlenbergia stricta* and *Solanum parvifolium.* In areas where stock has overgrazed the understorey, tussock grasses are less prevalent and/or more difficult to identify given the chewed and desiccated remains of the grasses.

There are a number of weeds present within the community including Whiskey Grass (*Andropogon virginicus*), Fleabane (*Conzya* spp.) and African Love Grass (*Eragrostis curvula*).

This community occurs in Study Area West (**Figure 7d-e**) and is in fairly disturbed condition. Highly disturbed areas are the result of past clearing and heavy grazing. Typically stands are a mixture of

regrowth and scattered mature trees. Only the patches located within the travelling stock reserves along the Bruxner Highway have maintained a predominately native understorey. Where this community occurs it typically grades into White Box grassy woodland and occupies low lying areas.

This community as it occurs within the study area is found outside of the geographic distribution range as per the current EPBC Act TEC listing (Threatened Species Scientific Committee 2010; DEWHA 2010), thus the Commonwealth listing does not apply.

The TSC Act listing for the community is less geographically precise than that of the Commonwealth EPBC Act listing. However, following consultation with OEH, it was noted by OEH that the community as it occurs within the Project area fell outside of the mapped and known range of the TSC Act listed TEC (T. Soderquist, OEH, *pers co*mm. June 2011). Consequently, and with the agreement of OEH, the community has not been identified as the TEC *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions.*

Rough-barked Apple riparian forb/grass Open Forest (RRF)

This community correlates to the DECCW *Vegetation Types Database* community *Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion* in the Border Rivers/Gwydir CMA. Characteristic canopy species include: *Angophora floribunda* and *Eucalyptus blakelyi.* Co-occurring canopy species can include: *E. melliodora, E. macrorhyncha, E. bridgesiana* and *E. andrewsii*.

Typical shrub species include; *Notelaea microcarpa* var. *microcarpa,* and *Leptospermum polygalifolium* subsp. *transmontanum*.

As the community name suggests the ground layer is dominated by grasses and forbs including *Poa sieberiana* var. *sieberiana, Imperata cylindrica* var. *major, Lomandra longifolia* and *Calochlaena dubia.*

This community occurs at in the western most end of the line near the Dumaresq Switching Station (**Figure 7a**) and is in a moderate condition. The ground storey has been disturbed due to low intensity grazing and the overstorey is typically a combination of regrowth and scattered mature canopy trees.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

New England Peppermint/Fuzzy Box Woodland (Disturbed) (NEFd) and Fuzzy Box/Grey Box Grassy Woodland (Disturbed) (FGBd)

Given the severly disturbed nature of these mosacic patches of grassy woodland it is not possible to compare them directly to a DECCW *Vegetation Types Database* community in the Border Rivers/Gwydir CMA. All that remains in these patches of vegetation are sporadic canopy species including: *Eucalyptus nova-anglica, E. conica* and *E. microcarpa*. The shrub layer is absent and the ground layer consists of a few pasture grasses and an array of weeds such as Scotch thistle (*Onoporodum acanthium*).

This community occurs in a few patches of vegetation on the flats west of Tenterfield in Study Area West (**Figure 7f**). This woodland community is highly disturbed due to agricultural clearing and moderate intensity grazing.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

5 Biodiversity Assessment Results

White Box Grassy Woodland (Wb) and White Box Grassy Woodland (Disturbed) (WBd) and White Box Grassy Woodland (Wb)

This community correlates to the DECCW *Vegetation Types Database* community *White Box grassy woodland of the Nandewar and Briglow Belt South Bioregion* in the Border Rivers/Gwydir CMA. The characteristic canopy species is *Eucalyptus albens.* Other co-occurring canopy species can include; *Angphora floribunda, E. melliodora, E. melanophloia, Callitris glaucophylla* and *Brachychiton populneus* subsp. *populneus.*

Typical shrublayer species are *Cassinia laevis, Olearia elliptica, Acacia buxifolia, Alectryon oleifolius* subsp. *canescens* and *Alstonia constricta.*

The ground storey is dominated by western grassland species including; *Dichanthium sericeum* subsp. *sericeum, Themeda australis, Cymobogon refractus, Aristida ramosa* and *Austrostipa scabra* subsp. *scabra.*

This community occurs in large areas within Study Area West (**Figure 7a-g**) and is the dominant community in the lowlands of this region. The community is in varying condition due to agricultural activities. Historically the lowlands were heavily cleared for grazing land and as a result the community typically comprises of scattered mature canopy tress with varying levels of regeneration depending on grazing intensity and a predominately native understorey that is again heavily influenced by grazing activity.

This community qualifies as the TEC *White Box, Yellow Box, Blakely's Red Gum woodland* listed under the TSC Act. Large continuous patches of the community also qualify as the TEC *White Box – Yellow Box – Blakely's Red Gum grassy woodland and derived native grassland* listed under the EPBC Act.

GRASSLANDS

This vegetation formation is characterised by a complete or almost treeless overstorey and dominance by large perennial tussock grasses. In addition to the presence of tussock grasses, broad-leaved herbs are fairly common in the inter-tussock spaces. Another common feature of grasslands is their occurrence on heavy clay soils on flat alluvial terrain (Keith, 2004). One vegetation community was identified within this formation (**Table 5-1**).

Natural Grasslands on Basalt and Fine Alluvial Plains and Natural Grasslands on Basalt and Fine Alluvial Plains (NG) and Natural Grasslands on Basalt and Fine Alluvial Plains and Natural Grasslands on Basalt and Fine Alluvial Plains & White Box Grassy Woodland (NGWB)

Both of these communities correlate to the DECCW *Vegetation Types Database* community *Bluegrass - Redleg Grass - Common Woodruff clay plain grassland of northern Brigalow Belt South Bioregion* in the Border Rivers/Gwydir CMA. The characteristic canopy species are *E. albens, E. camaldulensis, Angphora floribunda* and *E. melanophloia.* Canopy species dominance varies according to the terrain, with *Eucalyptus camaldulensis* occuring more commonly along the alluvial plains close to creeklines, *Angphora floribunda* along the edges of the alluvial plains and *E. albens* and *E. melanophloia* on the lower slopes. Protective foliage cover in the grassland community is less then 10% with tree intervals occuring on average between 20 to 30 meters apart.

The primary difference between the grassland community and the grassland/grassy woodland community is the slight change in the degree of slope, the protective foliage cover which increases towards the grassy woodland transitional zones and the loss of the alluvial soils further up the slopes in the grassy woodland.

5 Biodiversity Assessment Results

The shrublayer was mostly absent with only a few scattered *Leptospermum brevipes* and *Melichrus urceolatus.* Some regeneration of the canopy species is also present.

The ground storey is dominated by western grassland species including; *Bothriochloa biloba*, *Bothriochloa decipiens Dichanthium sericeum* subsp. *sericeum, Cymobogon refractus, Austrodanthonia bipartite, Austrostipa aristiglumis, Aristida ramosea* and *Panicum decompositum.*

Both communities occur in one small patch within the western section of the alignment and study area (**Figure 7c)**. The condition of both communities is fairly good with a high diversity of species, minimal weed invasion (weeds are only present along the edges of the creekline) and limited physical disturbances.

These communities qualify as the TEC *Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern Queensland* listed as critically endangered under the EPBC Act.

SEMI ARID WOODLANDS (SHRUBBY SUB FORMATION)

This vegetation formation is typical of areas with less than 500m of rainfall per year. The canopy is dominated by eucalyptus, she oaks, wattles and cypress pines (Keith, 2004). Two vegetation community was identified within this formation (**Table 5-1**).

Silver-leaved Ironbark/White Cypress Pine Woodland (SW)

This community correlates to the DECCW *Vegetation Types Database* community *White Cypress Pine – Silverleaved Ironbark grassy woodland of the Nandewar Bioregion* in the Border Rivers/Gwydir CMA. Characteristic canopy species include: *Eucalyptus melanophloia, E. albens* and *Callitris glaucophylla.* Other co-occurring canopy species can include: *E. delbata* and *E. caleyi* subsp. *caleyi.*

Typical shrub layer species include; *Notelaea microcarpa* var. *microcarpa, Carissa ovata, Geijera parviflora* and *Olearia elliptica.*

The ground layer is dominated by grasses and forbs including *Austrostipa scabra* subsp. *scabra, Aristida ramosa, Austrostipa verticillata* and *Cymbopogon refractus.*

This community is the dominant community on the hills in the alignment and Study Area West (**Figure 7a-d**). It is generally in moderated condition with a lot of the cypress traditionally cleared to allow for grazing. In large areas the cypress is regenerating. Very few weed species were recorded within this community.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

Dirty Gum tall woodland (D)

This community correlates to the biometric community Dirty Gum tall woodland of alluvial sandy lenses (sand monkeys) mainly of the Darling Riverine Plain Bioregion (Benson, 2006) in the Border Rivers/Gwydir CMA.

Characteristic canopy species include *Eucalyptus chloroclada* and *Allocasuarina luehmannii*. No shrub layer was present given the highly cleared mid and overstorey layer. The ground layer is dominated by grasses and forbs including: *Austrostipa scabra subsp. scabra, Aristida ramose* and *Cymbopogon refractus*. *Hyparrhenia hirta*, a noxious weed was also fairly dominant in patches within this community.

This community occurs in a small area within Study Area West (**Figure 7d**). The community is in poor condition due to weed invasion and extensive canopy clearing as a result of past farming practices.

5 Biodiversity Assessment Results

WET SCLEROPHYLL FOREST (SHRUBBY FORMATION)

This vegetation formation is characterised by a high open tree canopy and a luxuriant understorey, composed of soft-leaved herbs (Keith, 2004). During the field study, conducted by URS, three vegetation communities were identified within this formation (**Table 5-1**).

Messmate/Brown Barrel Grassy Open Forest (MB)

This community is described and mapped by NPWS (1999) and correlates to the biometric community *Messmate – Brown barrel grassy open forest of the North Coast and New England Tablelands* in the Northern Rivers CMA. Characteristic canopy species include *Eucalyptus obliqua, E. fastigata, E. nobilis* and *Lophostemon confertus*.

Dominant shrub layer species include; *Acacia melanoxylon, Banksia serrata,* and *B. oblongifolia.* Ground cover species included *Imperata cylindrica, Themeda australis* and *Pteridium esculentumm.*

The dominant weed within this community was Whiskey Grass (*Andropogon virginicus*).

This community is restricted to Study Area East (**Figure 7g-h**) and is in good condition. The community was primarily found on sloping hillsides that have not been cleared for grazing. The understorey showed signs of previous disturbance, however there are very few weed species present.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

Spotted Gum/Brush Box Moist Forest (SB)

This community is described and mapped by NPWS (1999) and correlates to the biometric community *Spotted Gum - Brush Box moist forest of ranges of the southern Clarence Valley of the North Coast* within the Northern Rivers CMA. Characteristic canopy species are *Corymbia variegata* and *Lophostemon confertus.*

Dominant shrub species include: *Allocasuarina torulosa, Trochocarpa laurina, Cissus antarctica, Breynia oblongifolia, Rubus parvifolius* and *Psychotria loniceroides*.

Primary ground species include: *Dianella caerulea, Imperata cylindrica* var. *major, Doodia aspera, Glycine clandestina, Lomandra longifolia, Cissus hypoglauca, Pratia purpurascens, Eustrephus latifolius, Gymnostachys anceps,* and *Hardenbergia violacea*.

This community is restricted to Study Area East (**Figure 7h-i**) and occurs in good condition. All strata layers are intact and no weed species were identified.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

Sydney Blue Gum Open Forest (SBG)

This community is described and mapped by NPWS (1999) and correlates to the biometric community *Sydney Blue Gum open forest of the northern ranges of the North Coast* within the Northern Rivers CMA. Characteristic canopy species include: *Eucalyptus. saligna, Lophostemon confertus, E. microcorys* and *Angophora subvelutina.* Dominant shrub species are *Acacia maidenii, A. irrorata*, and *Trochocarpa laurina*. Primary ground cover species include: *Imperata cylindrica* var. *major, Lepidosperma laterale, Poa labillardierei, Themeda australis, Doodia aspera, Lomandra longifolia, Desmodium varians, Oplimenus aemulus, Dianella caerulea* and *Sorghum leiocladum.*

This community is restricted to Study Area East (**Figure 7h**) and is in relatively good condition. No weeds were mapped within this community.

This community does not qualify as a TEC listed under either the TSC or EPBC Acts.

AQUATIC ECOLOGICAL COMMUNITIES

Aquatic communities within the study area include all waterways, lakes, wetlands and ephemeral drainage lines, which have been classified according to flow characteristics and the relative importance of the waterway as potential fish habitat (**Table 3-1**). Key waterways in the study area are mapped in **Figure 3** and **7**. Further details and associated mapping can be found regarding water classification within **Appendix E, Surface Water and Hydrology, Volume 2** of this EA.

A broad overview of the existing condition of the three major river basins through which the Project traverses is discussed within the **Appendix E, Surface Water and Hydrology Assessment** of this **EA.** This characterisation is based upon the Assessment of River Condition (ARC) submitted to the National Land and Water Resources Audit Office in 2001. The two main components of the ARC were features of the environment (ARCE) and the aquatic biota (ARCB). The Border Rivers, Clarence River and Richmond River basins were all assessed for ARCE as 'Moderately Modified' and for the ARCB, as 'Significantly Impaired'. In short, the aquatic habitat within the study area is considered to be poor to moderate given the level of disturbance within the surrounding riparian and woodland communities.

Some sections of the waterways in Study Area West form part of the TEC, *Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* (AECDR) as listed under the FM Act.

5.2.2 Threatened Flora Species

Database searches indicated that 195 threatened species listed under State and Commonwealth legislation are predicted to occur within the alignment (**Section 5.1.1**). Of the total 195 species predicted to occur, 88 of those species are listed on both the TSC Act and EPBC Act. Based on detailed habitat assessments presented in **Appendix F**, of these species, one is listed under the FM Act, 69 species listed under the TSC Act and 47 listed under the EPBC Act, are assumed to occur within the study area (**Table 5-2**). Assessment of Significance (AOS) and 'Significant Impact Criteria' (SIC), where applicable, for these species were undertaken and are included as **Appendix I** and **J**, respectively.

Whilst targeted flora surveys were carried out in spring and early summer to maximise the number of species flowering, some threatened species are naturally cryptic, or have limited flowering periods and hence may not have been detected. In addition to this, the Alignment and off easement access tracks cover more than 350km, and it was not logistically possible to conduct targeted surveys along the entire length. Survey locations were selected on the basis of representative vegetation, aspect, soils, terrain, and the vegetation connectivity across the broader study area. Such selection ensured that consideration was given to all areas where survey access or coverage was limited and ensured that additional surveys were undertaken in corresponding representative areas.

As such detailed habitat assessments and a precautionary approach have been used. If the species was not detected during field surveys but the project area supports suitable habitat and is within the species distribution, it has been assumed that the species has the potential to occur within the area and therefore to be affected by the Project.

5 Biodiversity Assessment Results

Table 5-2 Threatened Flora Predicted to Occur Within the Project Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	AOS Required	SIC Required
Acacia macnuttiana	MacNutt's Wattle	Vulnerable	Vulnerable	Required	Required
Acalypha eremorum	Acalypha	Endangered	-	Required	Not Required
Almaleea cambagei	Torrington Pea	Endangered	Vulnerable	Required	Required
Angophora exul	Gibraltar Rock Apple	Endangered	-	Required	Not Required
Angophora robur	Sandstone Rough-barked Apple	Vulnerable	-	Required	Not Required
Archidendron hendersonii	White Laceflower	Vulnerable	-	Required	Not Required
Arthraxon hispidus	Hairy Jointgrass	Vulnerable	Vulnerable	Required	Required
Arthropteris palisotii	Lesser Creeping Fern	Endangered	-	Required	Not Required
Astrotricha roddii	Rod's Star Hair	Endangered	Endangered	Required	Required
Babingtonia granitica	Granite Babingtonia	Vulnerable	Vulnerable (currently listed as Kardomia granitica)	Required	Not Required
Belvisia mucronata	Needle-leaf Fern	Endangered	-	Required	Not Required
Boronia granitica	Granite Boronia	Vulnerable	Endangered	Required	Required
Cadellia pentastylis	Ooline	Vulnerable	Vulnerable	Required	Required
Caladenia atroclavia	Black-clubbed Spider-orchid	-	Endangered	Not Required	Required
Callistemon linearifolius	Netted Bottlebrush	Vulnerable	-	Required	Not Required
Callistemon pungens		-	Vulnerable	Not Required	Required
Callitris baileyi	Bailey's Cypress Pine	Endangered	-	Required	Not Required
Callitris oblonga	Pygmy Cypress Pine	Vulnerable	Vulnerable	Required	Required
Centranthera cochinchinensis	Swamp Foxglove	Endangered	-	Required	Not Required
Clematis fawcettii	Northern Clematis	Vulnerable	Vulnerable	Required	Required
Corchorus cunninghamii	Native Jute	Endangered	Endangered	Required	Required
Cryptostylis hunteriana	Leafless Tongue-orchid	Vulnerable	Vulnerable	Required	Required
Cynanchum elegans	White-flowered Wax Plant	Endangered	Endangered	Required	Required
Dendrobium melaleucaphilum	Spider orchid	Endangered	-	Required	Not Required
Desmodium acanthocladum	Thorny Pea	Vulnerable	Vulnerable	Required	Required
Dichanthium setosum	Bluegrass	Vulnerable	Vulnerable	Required	Required
Digitaria porrecta	Finger Panic Grass	Endangered	Endangered	Required	Required
Endiandra hayesii	Rusty Rose Walnut	Vulnerable	Vulnerable	Required	Required
Eucalyptus caleyi subsp. ovendenii	Ovenden's Ironbark	Vulnerable	Vulnerable	Required	Required
Eucalyptus glaucina	Slaty Red Gum	Vulnerable	Vulnerable	Required	Required

5 Biodiversity Assessment Results

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	AOS Required	SIC Required
Eucalyptus nicholii	Narrow-leaved Black Peppermint	Vulnerable	Vulnerable	Required	Required
Eucalyptus rubida subsp. barbigerorum	Blackbutt Candlebark	Vulnerable	Vulnerable	Required	Required
Eucalyptus scoparia	Wallangarra White Gum	Endangered	Vulnerable	Required	Required
Eucalyptus tetrapleura	Square-fruited Ironbark	Vulnerable	Vulnerable	Required	Required
Euphrasia orthocheila subsp. peraspera	Tenterfield Eyebright	Endangered	-	Required	Not Required
Geijera paniculata	Axe-Breaker	Endangered	-	Required	Not Required
Geodorum densiflorum	Pink Nodding Orchid	Endangered	-	Required	Not Required
Goodenia macbarronii	Narrow Goodenia	-	Vulnerable	Not Required	Required
Gossia fragrantissima	Sweet Myrtle	Endangered	Endangered	Required	Required
Grammitis stenophylla	Narrow-leaf Finger Fern	Endangered	-	Required	Not Required
Grevillea beadleana	Beadle's Grevillea	Endangered	Endangered	Required	Required
Hibbertia marginata	Bordered Guinea Flower	Vulnerable	Vulnerable	Required	Required
Homoranthus binghiensis	Binghi Homoranthus	Endangered	-	Required	Not Required
Homoranthus lunatus	Crescent-leaved Homoranthus	Vulnerable	Vulnerable	Required	Required
Lepidium peregrinum	Wandering Pepper Cress	Endangered	Endangered	Required	Required
Leucopogon confertus	Torrington Beard-heath	Endangered	Endangered	Required	Required
Lindsaea incisa	Slender Screw Fern	Endangered	-	Required	Not Required
Macadamia tetraphylla	Rough-shelled Bush Nut	Vulnerable	Vulnerable	Required	Required
Marsdenia longiloba	Slender Marsdenia	Endangered	Vulnerable	Required	Required
Melaleuca irbyana	Weeping Paperbark	Endangered	-	Required	Not Required
Muehlenbeckia costata	Scrambling Lignum	Vulnerable	-	Required	Not Required
Myrsine richmondensis	Ripple-leaf Muttonwood	Endangered	Endangered	Required	Required
Niemeyera whitei	Rusty Plum	Vulnerable	-	Required	Not Required
Oldenlandia galioides	Sweet False Galium	Endangered	-	Required	Not Required
Owenia cepiodora	Onion Cedar	Vulnerable	Vulnerable	Required	Required
Persicaria elatior	Tall Knotweed	Vulnerable	Vulnerable	Required	Required
Phebalium glandulosum subsp. eglandulosum	Rusty Desert Phebalium	Endangered	Vulnerable	Required	Required
Phebalium whitei		-	Vulnerable	Not Required	Required
Phyllanthus microcladus	Brush Sauropus	Endangered	-	Required	Not Required
Plectranthus nitidus	Nightcap Plectranthus	Endangered	Endangered	Required	Required
Polygala linariifolia	Native Milkwort	Endangered	-	Required	Not Required
Pomaderris notata	McPherson Range Pomaderris	Vulnerable	-	Required	Not Required

5 Biodiversity Assessment Results

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	AOS Required	SIC Required
Prostanthera staurophylla sensu stricto	Torrington Mint-bush	Endangered	Vulnerable	Required	Required
Rapanea sp. Richmond River (J.H.Maiden & J.L.Boorman NSW 26751)	Purple-leaf Muttonwood, Lismore Muttonwood	-	Endangered	Not Required	Required
Rotala tripartita		Endangered	-	Required	Not Required
Rutidosis heterogama	Heath Wrinklewort	Vulnerable	Vulnerable	Required	Required
Sarcochilus hartmannii	Hartman's Sarcochilus	Vulnerable	Vulnerable	Required	Required
Senna acclinis	Rainforest Cassia	Endangered	-	Required	Not Required
Sophora fraseri	Brush Sophora	Vulnerable	Vulnerable	Required	Required
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable	Vulnerable	Required	Required
Tephrosia filipes	Tephrosia filipes	Vulnerable	-	Required	Not Required
Thesium australe	Austral Toadflax	Vulnerable	Vulnerable	Required	Required
Tinospora smilacina	Tinospora Vine	Endangered	-	Required	Not Required
Triplarina imbricata	Creek Triplarina	Endangered	Endangered	Required	Required
Tylophora woollsii	Cryptic Forest Twiner	Endangered	Endangered	Required	Required

Surveys targeted these potentially occurring threatened species in all areas of suitable habitat within the project area with the following species identified and their location mapped (**Figure 9a**):

- Caley's Ironbark *(Eucalyptus caleyi* subsp. *ovendenii*); and
- Bluegrass *(Dichanthium setosum)*

One further threatened species Ooline (*Cadellia pentastylis)* was observed outside of the proposed alignment and access track footprint (**Figure 9a**) and therefore this species would not be directly impacted by the Project. This species has however been located within the study area and was therefore assessed under NSW and Commonwealth assessment guidelines, which appear in **Appendix I and J.**

According to DEC (2005), species profile for the *Eucalyptus caleyi* subsp. *ovendenii*, the species occurs west of Tenterfield on the New England Tablelands of NSW on the property 'Moorabinda' station. The footprint of the easement and access tracks are located within this property. Targeted surveys for the species were undertaken across the property. However, given the size of the property, the URS ecologists were unable to walk the entire alignment. No mature trees of the species were observed during surveys of the property (March 2010). Two immature ironbarks that resemble the species were located and recorded in the GPS unit in close proximity to the line (**Figure 9a)**. The identification of these immature trees could not be confirmed given the lack of fruits or buds. It is noted that the two immature ironbarks displayed alternative leaf positioning, whereas the only other ironbarks present on the property (Silver-leaved Ironbark (*Eucalyptus melanophloia*)) demonstrate opposite leaf positioning throughout the juvenile and adult life-stages (Botanic Gardens Trust, 2010). A number of associated species for *Eucalyptus caleyi* subsp. *ovendenii* were present on the property including White Box (*Eucalyptus albens*) and *Eucalyptus melanophloia* (DEC, 2005). A precautionary

approach has been adopted in this situation and this assessment assumes these individuals are the threatened species. The occurrence of mature trees within the alignment and access track footprint would need to be confirmed during targeted pre-clearance assessments. Pre-clearance assessments would need to be undertaken in spring during the species flowering period.

Dicanthium setosum was also observed in scattered patches on the same property (**Figure 9**) within the community Natural Grasslands on Basalt and Fine Alluvial Plains (**Figure 7c**). Known specimens were observed within the alignment. Targetted Pre-clearance assessments would be required to determine the full extent of this species within the alignment and along access tracks.

5.2.3 Threatened Populations

No threatened flora populations were predicted to occur within the alignment or the associated access tracks. No threatened flora populations were recorded during field surveys.

5.2.4 Threatened Ecological Communities

The identification of TECs within the alignment was based on existing vegetation mapping, URS field surveys, the NSW and Commonwealth Scientific Committee Determinations and DECCW *Vegetation Types Database* (2008). Nine TECs were identified during database searches as potentially occurring within the broader study area and project area.

Detailed surveys identified a total of five TECs: three listed under the TSC Act, two listed under the EPBC and one Aquatic Ecological Community listed under the FM Act, within the project area. **Table 5-3** lists the identified and mapped TECs within the alignment, showing their listing and relevant extent within the project area and adjoining lands. AOS and SIC, where applicable, for these communities were undertaken and are included as **Appendix I** and **J**, respectively.

Table 5-3 Threatened Ecological Communities Known to Occur Within the Project Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	AOS Required	SIC Required
Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River	Darling River EEC	Endangered Ecological Community (FM Act)	-	Required	Not Required
Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	Sub-tropical Coastal Floodplain Forest	Endangered Ecological Community	-	Required	Not Required
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast; Sydney Basin and South East Corner Bioregions	Swamp sclerophyll forest on coastal floodplains	Endangered Ecological Community	-	Required	Not Required

5 Biodiversity Assessment Results

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	AOS Required	SIC Required
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Box Gum Woodland	Endangered Ecological Community	Critically Endangered Ecological Community	Required	Required
Natural Grasslands on Basalt and Fine-textured Alluvial Plains of northern New South Wales and southern Queensland	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	-	Critically Endangered Ecological Community	-	Required

Four TECs listed under the TSC Act were recorded in close proximity to the alignment and would be considered when conducting pre-clearing assessments. These are:

- Fuzzy Box Woodland on Alluvial Soils of the South Western Slopes, Darling Riverine Plains and Briglow Belt south Bioregions;
- *Cadellia pentastylis* (Ooline) community in the Nandewar and Briglow Belt south Bioregions;
- New England Peppermint (*Eucalyptus nova-anglica*) Woodland on Basalts and Sediments in the New England Tableland Bioregion; and
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

As these communities would not be impacted by the Project, they are not discussed any further in this report.

The distribution of TECs within the project area and adjoining lands is mapped in **Figure 8** and a description of the community is provided below.

Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River (AECDR)

This community occurs on the floodplains in alignment west (**Figure 8a-b**) and correlates to the waterways mapped in alignment and Study Area West referred to as *Aquatic Ecological Community of the Lowland Darling River* (**Figure 7a-e**). This community does not include any terrestrial vegetation.

Within Study Area West this community encompasses two permanent waterways, the Dumaresq and Mole River as well as all associated tributaries, flow diversions, anabranches, and the floodplains of the Darling River. In general, this community is surrounded by cleared farmland and disturbed patches of remnant River Red Gum Riverine Woodlands and River Oak Riparian Woodland.

AECDR is a TEC as listed under the NSW FM Act, and is defined as:

"a aquatic ecological community that includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, anabranches, flow diversions to anabranches and floodplains of the Darling River within NSW."

5 Biodiversity Assessment Results

Habitat condition

The condition of this community is variable within Study Area West as it has been impacted by erosion and weed invasion. These terrestrial impacts are likely to influence the integrity and condition of the aquatic community, contributing to aquatic impacts such as: eutrophication, sedimentation, pollution and overall loss of biodiversity. Large areas of the surrounding vegetation have been cleared for agriculture and the community is known to have an abundance of non-native fish species within its waterways. These waterways have also been over-fished for the past 100 years or more. Many aquatic habitats along the waterways are now degraded, and many native species have experienced declines in their numbers and distribution, some to the point where they are now listed as threatened (NSW DPI 2006, Threatened Species Unit, 2007). Given these external influences, the community is likely to be in poor to moderate condition across Study Area West.

Habitat features

Despite the condition of the community the waterways provide habitat resources comprising of deep channels, pools, wetlands, gravel beds, rocky banks, fringing vegetation and floodplains. The complex river morphology is likely to provide a multitude of habitats that play a critical role in the life cycles of the species associated with the community. Numerous native finfish, amphibians, insects, porifera and rotifera are known to inhabit this community. These species assemblages in themselves provide food sources for other species occurring within and externally to the community.

Description of regional/local corridors

This community occurs as free-flowing waterways with large patches of riparian woodland occurring along the banks. The community provides corridors for mobile terrestrial and aquatic fauna in the areas west of the ranges where much of the surrounding landscaped has been cleared for farming (**Figure 8a-b**).

Sub-tropical coastal floodplain forest

This community occurs in remnant floodplain vegetation in alignment east (**Figure 8f**). During the field study, conducted by URS, it was noted that the community occurs in various conditions; typically it is degraded as a result of past clearing and current agricultural practices. The canopy layer ranges from isolated mature trees surrounded by regenerating species to stands of immature individuals. The understorey and midstorey are typically dominated by weeds. This community correlates to Forest Red Gum/Swamp Box Open Forest mapped in **Figure 7l.**

Canopy species composition within the TEC is highly variable (DEC 2005). The most widespread and abundant dominant trees are Forest Red Gum (*Eucalyptus tereticornis*), Grey Ironbark (*E. siderophloia*) and Pink Bloodwood (*Corymbia intermedia*).

Sub Tropical Coastal floodplain Forest is a TEC as listed under the NSW TSC Act, and is defined as:

"*an ecological community associated with clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. The structure of the community may vary from tall open forest to woodlands. Typically these forests and woodlands form mosaics with other floodplain forest communities and treeless wetlands, and they often fringe treeless floodplain lagoons or wetlands with semi-permanent standing water.*" (NSW Scientific Committee 2004a)

Density of strata layers

Within the alignment, canopy species have an average foliage projective cover (FPC) of 50%, with a midstorey dominated by weeds including Lantana (*Lantana* sp.), Cotton Bush (*Gomphocarpus* spp), Tobacco bush (*Nicotiana glauca*) Senecio sp. and Scotch thistle (*Onoporodum acanthium*). The understorey was dominated by weedy forbs with and sparse coarse woody debris.

Habitat condition

This community is typically regrowth or disturbed remnant patches, with a midstorey and understorey dominated by weeds and is therefore in moderate to poor condition. Despite this, the community is still considered to form part of the TEC. According to the *Sub-tropical Coastal Floodplain Forest: Identification Guidelines for Endangered Ecological Communities* (DECC 2007) even heavily disturbed and modified sites are still form important remnants of the community.

Habitat features

This community provides limited habitat in the form of hollow bearing trees, stags, and fallen timber. However the weedy understorey provides habitat in the form of dense thickets of vegetation for foraging and nesting.

Description of regional/local corridors

Sub Tropical Coastal floodplain Forest within alignment east occurs as isolated remnants providing little connectivity within the landscape. It has been heavily impacted by clearing and grazing and is surrounded by cleared farmland (**Figure 8f**).

Swamp Sclerophyll forest on coastal floodplains

This community occurs on the floodplains in alignment east (**Figure 8e-f**) and correlates to the vegetation communities mapped as Swamp Box Swamp Forest and Swamp Box/Swamp Mahogany Swamp Forest (Intergrade) (**Figure 7g-l**). This community is dominated by Swamp Mahogany (*Eucalyptus robusta*) and Swamp Box (*Lophostemon suaveolens*). Where it occurs the community exists as isolated remnants surrounded by cleared farmland. As a result of historical clearing and current agricultural activities the community is in moderate condition. The community typically has a weedy understorey and midstorey.

Swamp Sclerophyll Forest on Coastal Sub Tropical Coastal floodplain Forest is a TEC as listed under the NSW TSC Act, and is defined as:

"*the ecological community associated with clay-loams and sandy loams, on waterlogged and periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and sedimentation by channelled and overbank stream flow with an average recurrence interval of 100 years or less. Swamp Sclerophyll Forest on Coastal Floodplains generally occurs below 20m elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates"* (NSW Scientific Committee 2004).

Density of strata layers

Within the alignment canopy species have an average FPC of 50%, with a midstorey dominated by *Melaleuca* spp. The understorey is dominated by forbs and herbs including *Imperata cylindrica*, *Gahnia clarkei*, and *Juncus* sp.

5 Biodiversity Assessment Results

Habitat condition

Community condition varies from moderate to poor across the project area, with large areas of this community having been cleared for agriculture and only isolated remnants remaining. Typically these remnants have seen a reduction in overstorey diversity and thus the understorey is dominated by pasture grasses. The one exception to this is where the community occurs adjacent to large patches of Forest Red Gum/Grey Box/Swamp Box Open Forest and is in a moderate condition.

Habitat features

This community provides habitat resources for a range of species including hollow bearing trees, fallen timber, nesting and foraging sites and leaf litter.

Description of regional/local corridors

Swamp Sclerophyll Forest within alignment east occurs as isolated remnants with little connectivity across the landscape. The community has been heavily impacted by clearing and grazing and is surrounded by cleared farmland (**Figure 8e-f**).

Natural Grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland, as defined under the EPBC Act

Natural grasslands on basalt and fine-textured alluvial plains (Natural grasslands) as defined by the Threatened Species Scientific Committee (2008), was mapped at one location within alignment west (**Figure 8b**). This TEC correlates to the vegetation communities mapped as Natural grasslands on basalt and fine-textured alluvial soils and Natural grasslands on basalt and fine-textured alluvial soil/ White Box Grassy Woodland which have been mapped within Study Area West (**Figure 7c**). These communities have been mapped together as the *Natural grasslands on basalt and fine-textured alluvial soil/White Box Grassy Woodland community* appears to be a transitional community between the grasslands and grassy woodland.

The community is described as:

"*native grasslands typically composed of perennial native grasses. They are found on soils that are fine textured (often cracking clays) derived from either basalt or alluvium on flat to low slopes (< 1 degree). A tree canopy is usually absent, but when present, comprises ≤10% Projective foliage cover*." (Threatened Species Scientific Committee, 2008).

To qualify as EPBC Act listed Natural Grasslands, the community must (as a minimum) meet the requirements outlined in the criteria below:

- Distribution mainly in the Darling Downs of southern Queensland and the Liverpool Plains and Moree Plains of northern NSW. Occurrence is mainly associated with fine textured, often cracking clay soils derived from either basalt or alluvium.
- Occurrence on landforms that is typically flat to very low slopes (less than 5 percent/1 degree).
- Tree canopy usually absent to sparse, comprising less than 10% crown cover.
- The ground layer is typically dominated by perennial native grasses and contains 3 or more of the key community listed grass species.

5 Biodiversity Assessment Results

The Project is located in a region between the Darlng Downs and Moree Plains,. The area of vegetation mapped within the alignment qualified as EPBC Act condition Natural Grassland due to the presence of five of the indicative tussock grass species and the presence of cracking alluvial soils on a terrain from flat floodplains to lower slope (less then 5 degree slope). Further the canopy for the community was also recorded as less then 10%.

Within Study Area West, this community had only minor weed infestations. During the field study it was noted that of the weeds present, many species were annual, and do not pose a threat to the health of the community, as they are not highly invasive or vigorous. The weed species present are likely to have been carried into the community via water during high flood events, given that weeds were only present within the floodplain area.

There is a potential for this grassland community to occur in one other location along Mole River approximately 1km south-east of AP18 along the river edges (**Figure 7d**). This would need to be assessed during targeted pre-clearance assessments.

Density of strata layers

The canopy within this community had a Foliage Percent Cover (FPC) of approximately 5 to 10% in some patches and 0% in others, with a shrub-layer that was mostly absent except for the occasional scattered shrub or sparse patch of overstorey regeneration. Canopy species were generally mature and spaced approximately 20 to 30m apart in some patches and completely absent in others, with signs of regeneration in localised patches.

Habitat condition

The intact and diverse tussock grasses and herbs have enabled a quality community condition. This community has not been cleared for agriculture in the past and it does not appear to have been heavily grazed. Only minimal weeds are present.

Habitat features

This community had a high density of hollow bearing trees in areas with localised canopy trees, large amounts of fallen timber at the base of fallen trees, and a reasonable cover of leaf litter in the same areas. Reedy Creek a few meters to the east of the grassland also provides abundant habitat features in the form of large hollows in mature Red River Gums (*Eucalyptus camaldulensis*), rocky outcrops, feed trees such as River Oak (*Casuarina cunninghamiana*), running water and fringe vegetation along the stream. The tussock grass understorey is also likely to provide suitable foraging and shelter habitat for a number of reptiles, insects and parrot species.

Description of regional/local corridors

The community occurs within alignment west in one location on the lower slopes and on alluvial flats around Reedy Creek. It is reasonably connected with other communities in this area via vegetation along the creek line and large patches of Box Gum Woodland that intersect with the well vegetated foothills to the south, south-east and north-east of the alignment. (**Figure 7a-d**).

White Box, Yellow Box, Blakely's Red Gum woodland as defined under the TSC Act

White Box – Yellow Box – Blakely's Red Gum Woodland (Box-Gum Woodland) as defined by the TSC Act occurs throughout much of the study area (**Figure 8a-c**). The definition of the community is quite broad, and encompasses woodland even when it occurs in a degraded state. This TEC correlates to two communities mapped within the alignment (**Figure 7a-g**), these are:

- Blakely's Red Gum/White Box Grassy Woodland; and

- White Box Grassy Woodland.

TSC Act Box-Gum Woodland is described by the NSW Scientific Committee final determination as including:

"*those woodlands where the characteristic tree species include one or more of the following species in varying proportions and combinations - Eucalyptus albens (White Box), Eucalyptus melliodora (Yellow Box) or Eucalyptus blakelyi (Blakely's Red Gum). Grass and herbaceous species generally characterise the ground layer. In some locations, the tree overstorey may be absent as a result of past clearing or thinning and at these locations only an understorey may be present. Shrubs are generally sparse or absent, though they may be locally common*." (NSW Scientific Committee, 2002)

Density of strata layers

Within the alignment the canopy of this community averaged around 30% FPC, in areas with remnant canopy. The midstorey was generally absent, apart from occasional eucalypt saplings or scattered *Acacia* spp. and *Cassinia* spp. individuals. The understorey ranged from a dense cover of exotic or native species, to areas of bare ground, as a result of either livestock movement or clearing for pasture/crop species. Understorey species were varied across each community patch, depending on the past disturbances and condition of the patch. Characteristic native tussock grass species included *Austrostipa* sp., *Astrodanthonia* sp., *Aristrida* sp., *Themeda australis,* and *Microlaena stipoides.* Native herbs and forbs include *Glycine clandestine*, *Hydrocotyle peduncularis, Pratia purpurascens, Wahlenbergia sp., Bulbine bulbosa, Calotis sp* and *Brachyscome sp.* Exotic species are also common in the understorey including *Eragrostis curvula, Rubus sp.* and *Andropogon virginicus.*

Box Gum woodland within the alignment was generally found to have a moderately dense understorey, composed of a mixture of native and exotic species.

Habitat condition

The TSC Act definition of the Box-Gum Woodland TEC can include the following conditions, summarised by the NSW NPWS:

"*Multi-aged overstorey with a grassy, herb-rich understorey":* Remnants in this condition are very scarce and are generally confined to travelling stock reserves, roadside vegetation, cemeteries, some national parks and the occasional private property.

"Partially cleared/thinned stands with a mixture of native and exotic understorey species": This condition is far more common than the above; however its long term future is often insecure due to inadequate regeneration of overstorey species. Often current management (e.g. set-stocking) is inconsistent with tree regeneration.

"Stands where E. albens, E. melliodora, or E. blakelyi have been killed and other species dominate the canopy": This condition occurs in woodlands where the characteristic trees occur in conjunction with *Callitris glaucophylla*. The understorey is often in reasonable to very good condition.

"Grasslands (secondary or derived grasslands), where the tree overstorey has been removed and only the Box-Gum Woodland understorey is present": This condition is likely to be reasonably common in some areas and is likely to be relatively easy to rehabilitate if appropriate management strategies are implemented.

"Degraded remnants that have few, if any, native species in the understorey": This condition is typical of Box-Gum Woodland where agricultural practices have been more intensive (e.g. pasture improvement over long periods)."

5 Biodiversity Assessment Results

Additionally, NPWS adds that:

"*Depending on the local extent and condition of Box-Gum Woodland, isolated box or gum trees scattered across a paddock may also form part of the TEC. However, for isolated Box-Gum Woodland trees to be considered part of the TEC, it must be considered that the site, under appropriate management, would respond to assisted natural regeneration*."

Within the alignment, the community occurred in a range of conditions, from good condition, with an intact canopy (either one or a combination of *E. albens, E. melliodora,* or *E. blakelyi*), and a predominantly native understorey composed of tussock grasses and a range of herbs, to severely degraded, with canopy trees over an introduced understorey and a history of severe disturbance associated with agricultural practices. Canopy species occurred in a range of combinations and densities at different sites within the alignment. Within the alignment, this community had minor to moderate weed infestations. Several areas had perennial weed species, which can be more invasive and harder to control than annual species, and may also pose a greater threat to the community. Weed species within this community also included agricultural weeds as a result of proximity to cropped paddocks and roadsides. In general the mid-storey was absent within the community, with only a few scattered *Acacia* and *Cassinia* species present.

The Box-Gum Woodland as defined by the EPBC Act (discussed below) also meets the requirements for Box-Gum Woodland as defined by the TSC Act, and is included in area calculations where relevant. However, TSC Act listed Box Gum Woodland does not always qualify as EPBC Act Box Gum Woodland

This community is renowned for the presence of a large number of hollow bearing trees and fallen timber, which provide critical habitat for a number of species. Within the alignment, even in disturbed and degraded remnants, hollows were recorded in high densities throughout this community, and a number of fauna species were observed nesting within these hollows. Although some areas had limited understorey as a result of past and current agricultural practices, where this community occurred, it provided significant habitat for a number of species and was considered to be of moderate condition.

Habitat features

Features of this community include a high density of hollow bearing trees, stags, fallen timber with hollows and flowering eucalypt species.

Description of regional/local corridors

Within the study area Box-Gum Woodland occurs in relatively large patches along the lower hills and lowlands, often connecting within the riparian woodlands (**Figure 8a-c**), therefore providing some contiguous connection throughout the landscape.

White Box – Yellow Box – Blakely's Red Gum woodland and derived native grassland as defined under the EPBC Act

White Box – Yellow Box – Blakely's Red Gum Woodland (Box-Gum Woodland) as defined by the EPBC Act was mapped at a number of locations within alignment west (**Figure 8a-c**). This community correlates predominantly to White Box Grassy Woodland mapped within the study area (**Figure 7a-g**).

5 Biodiversity Assessment Results

The community is described as having:

"a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of E. albens, E. melliodora or E. blakelyi" (Threatened Species Scientific Committee, 2006.

To qualify as EPBC Act listed Box-Gum Woodland, the community must, as a minimum, meet the requirements outlined in the flowchart pictured in **Chart 5-1** below.

The areas mapped within the alignment qualified as EPBC Act condition Box-Gum woodland due to the presence of Box-Gum canopy species, a predominantly native understorey, the large size of the stand, the occurrence of more than 20 mature trees per hectare and regeneration of dominant overstorey eucalypts.

Within the alignment, this community had only minor weed infestations. Of the weeds present, many species were annual, and do not pose a threat to the health of the community, as they are not highly invasive or vigorous. The weed species present are likely to have been carried into the community via stock, wind and/or water.

Density of strata layers

The canopy within this community had an FPC of approximately 20%, with a midstorey comprised of scattered shrubs (with one approximately every 10-20m). Canopy species were generally mature and spaced approximately 7.5m apart, with signs of regeneration. There are more than 12 native understorey shrubs, herbs, ferns and other species present within the remnant patches of the community including *Olearia elliptica*, *Wahlenbergia stricta*, *Lomandra longifolia*, *Glycine clandestine*, *Pratia purpurascens*, *Desmodium varians*, *Cheilanthes sieberi*, *Cassinia laevis*, *Dianella longifolia*, *Gahnia aspera*, *Geranium solanderi*, *Lomandra filiformis*, and *Lomandra longifolia.* Other important species such as *Themeda australis* and *Poa sieberiana* were also present.

Habitat condition

The dominance of mature intact canopy species in each of the sites within this community correlates to a high density of standing tree hollows, with additional habitat provided by stags and fallen timber. This community is in good condition with patch sizes well over 0.1 ha, as per the minimum requirements for the community (DEH, 2006). The intact tussock grasses and herb layer in this community demonstrates its healthy condition.

Habitat features

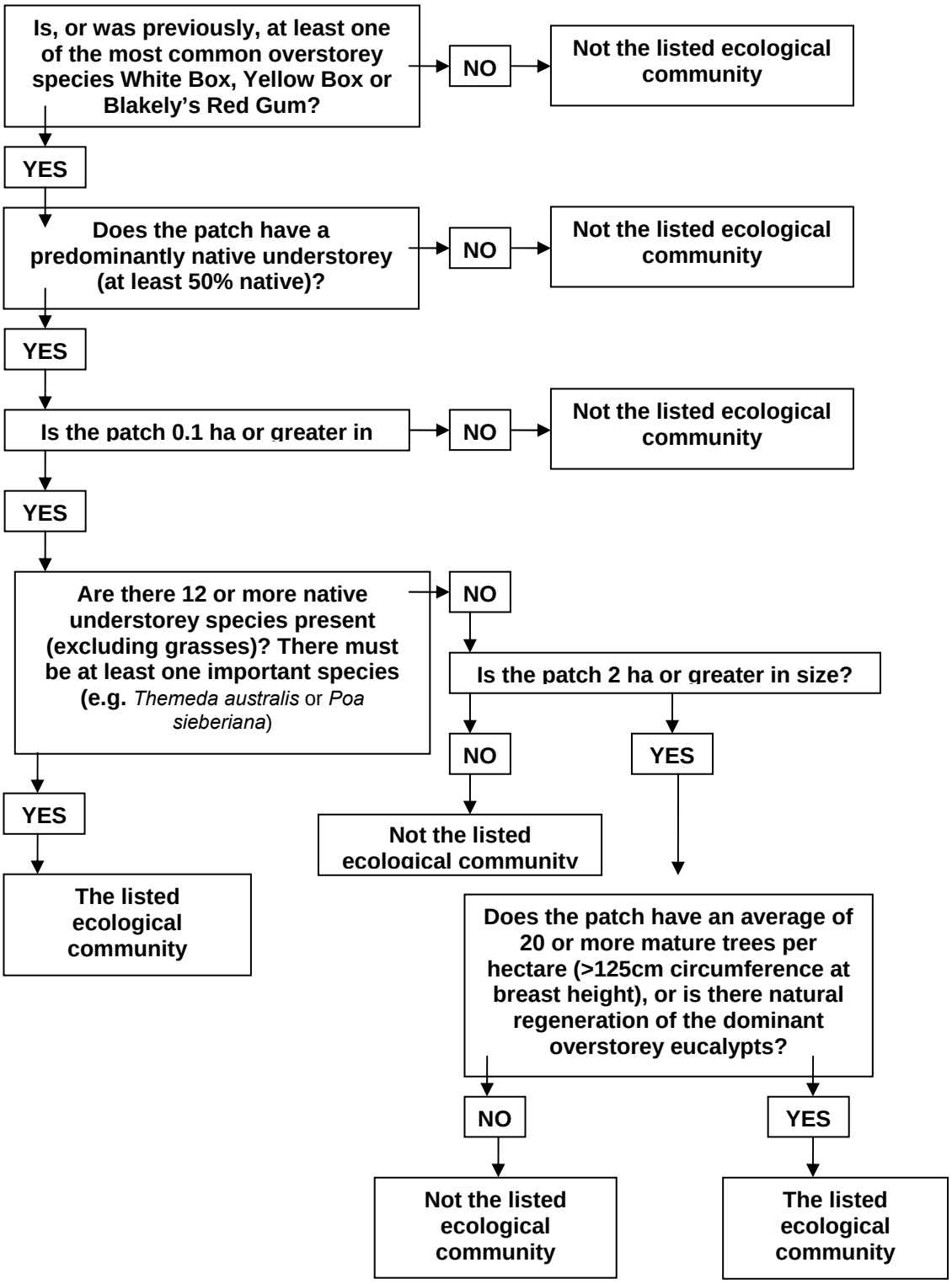
This community had a high density of hollow bearing trees, large amounts of fallen timber, and a reasonable cover of leaf litter throughout. The intact canopy also provides suitable foraging habitat for a number of arboreal species.

Description of regional/local corridors

Box-Gum Woodland, as listed under the EPBC Act within alignment west, occurs on the lower slopes and flats and is poorly connected with other communities. Generally this community occurs as small or large isolated patches. In some instances it is weakly connected to riparian corridors (**Figure 8a-c**).

5 Biodiversity Assessment Results

Chart 5-1 Minimum requirements for a community to be classed as EPBC Act condition Box-Gum Woodland (DEH 2006)



5.2.5 Noxious Weeds

The NSW *Noxious Weeds Act 1993* (NW Act) provides for the declaration of noxious weeds in local government areas and specifies that landowners and occupiers must control noxious weeds according to the control category specified in the Act.

A total of 110 noxious weeds, declared by I&I NSW across the five Local Government Areas within the project area were identified through the desktop review process. Fourteen declared noxious weeds for five Local Government Areas were identified and recorded through field survey along the alignment and access tracks. Noxious weeds are listed below and **Table 5-4** shows which vegetation formation they were recorded in. The noxious weeds included:

- African Lovegrass (*Eragrotis curvula*);
- Bathurst Burr (*Xanthium spinosum*);
- Blackberry (*Rubus fruticosus*);
- Cats Claw Creeper (*Macfadyena unguis-cati*);
- Cardoon (*Cynara cardunculus*);
- Coolati Grass (*Hyparrhenia hirta*);
- Common Prickly Pear (*Opuntia stricta*);
- Green Cestrum (*Cestrum parqui*);
- Lantana (*Lantana camara*);
- Oxalis spp.;
- Paterson's curse (*Echium plantagineum*);
- Silver-leaved Night Shade (*Solanum elaeagnifolium);*
- Tiger Pear (*Opuntia aurantiaca*); and
- Tree of Heaven (*Ailanthis altissima*).

A full list of noxious weeds per LGA area is provided in **Appendix L**. Targetted pre-clearance assessments for noxious weeds would be undertaken prior to any construction works. The declared noxious weeds list for each LGA would be used during this assessment to assist with mapping.

Table 5-4 Noxious Weeds Recorded Within Each Stratification Unit

Scientific Name	Common Name	Vegetation Formation
Eragrostis curvula	African Lovegrass	Dry Sclerophyll Forest (shrub/grass sub-formation)
		Forested Wetland
		Grassy Woodland
Xanthium spinosum	Bathurst Burr	Semi Arid Woodland (shrub/grass sub-formation)
Rubus armeniacus (discolor)	Blackberry	Grassy Woodland
Rubus fruticosus sp. agg.	Blackberry complex	Dry Sclerophyll Forest (shrubby sub-formation),
		Grassy Woodland
Cynara cardunculus	Cardoon	Forested Wetland
Macfadyena unguis-cati	Cat's Claw Creeper	Forested Wetland
Hyparrhenia hirta	Coolati Grass	Grassy Woodlands, Grasslands (disturbed)

5 Biodiversity Assessment Results

Scientific Name	Common Name	Vegetation Formation
Opuntia stricta	Common Prickly Pear	Dry Sclerophyll Forest (shrubby sub-formation)
		Dry Sclerophyll Forest (shrub/grass sub-formation)
		Forested Wetland
		Grassy Woodland
		Semi Arid Woodland (shrubby subformation)
Senecio madagascariensis	Fireweed	Dry Sclerophyll Forest (shrubby sub formation)
		Grassy Woodland
Cestrum parqui	Green Cestrum	Forested Wetland
Lantana camara	Lantana	Grassy Woodland
Oxalis pes-caprae	*Oxalis* sp.	Grassy Woodland
Echium plantagineum	Paterson's Curse	Forested Wetland
Solanum elaeagnifolium	Silver-leaved Night Shade	Grassy Woodlands
		Dry Sclerophyll Forest (shrub/grass sub-formation)
Opuntia aurantiaca	Tiger Pear	Forested Wetland
		Grassy Woodland
		Semi Arid Woodland (shrubby subformation)
Ailanthus altissima	Tree of Heaven	Forested Wetland
		Semi Arid Woodland (shrubby subformation)

5.2.6 Fauna

Fauna Species

A total of 168 fauna species were recorded during field surveys of the project area. The majority of these were native species common to woodland and forest communities within the region a full species list is provided in **Appendix H**.

5.2.7 Threatened Fauna Species

Database searches indicated that 156 threatened species listed under State and Commonwealth legislation are predicted to occur within the study area (**Section 5.1.2**). Of the 156 species predicted to occur, three species are listed on both the FM Act and EPBC Act, and 30 are listed on both the TSC Act and EBPC Act. Based on detailed habitat assessments presented in **Appendix F**, of these species seven listed under the FM Act, 88 listed under the TSC Act and 18 listed under the EPBC Act are assumed to occur within the project area (**Table 5-6**). AOS and SIC, where applicable, for these species were undertaken and are included as **Appendix I** and **J**, respectively.

Thirteen threatened species were identified during field survey within the study area; the locations of recordings are shown on **Figure 9a** and **b** and **Table 5-5** below:

5 Biodiversity Assessment Results

Table 5-5 Threatened Fauna Species Recorded at Study Area

Common Name	Scientific Name
Brown Treecreeper (eastern subsp.)	*Climacteris picumnus victoriae*
Diamond Firetail	*Stagonopleura guttata*
Eastern Bentwing Bat	*Miniopterus schreibersii oceanensis*
Eastern Cave Bat	*Vespadelus troughtoni*
Grey Crowned Babbler	*Pomatostomus temporalis*
Little Bentwing-Bat	*Miniopterus australis*
Little Lorikeet	*Glossopsitta pusilla*
Olive Whistler	*Pachycephala olivacea*
Powerful Owl	*Ninox sternua*
Rufous Bettong	*Aepyprymnus rufescens*
Squirrel Glider	*Petaurus norfolcensis*
Turquoise Parrot	*Neophema pulchella*
Yellow- belllied Sheathtail Bat	*Saccolaimus flavientris*

In addition to surveys undertaken, a number of landowners reported recent anecdotal sightings of threatened species on their properties. These sightings have been mapped on **Figure 9a** and **b** and include Diamond Firetail, Grey Crowned Babbler, Brush-tailed Phascogale (*Phascogale tapoatafa*), Spotted-tailed Quoll (*Dasyurus maculates*), Turquoise Parrot and Speckled Warbler (*Chthonicola sagittata*).

Whilst targeted fauna surveys were carried out in spring and early summer to maximise the potential of detecting species, some threatened species are naturally cryptic, or have limited activity periods and might not have been detected. In addition to this the alignment covers more than 200km and it was not logistically possible to conduct targeted surveys along the entire length. As such, detailed habitat assessments and the precautionary principal have been used. If the species was not detected during field surveys but the alignment supports suitable habitat and is within the species distribution, it has been assumed that the species has the potential to occur within the area.

Table 5-6 Threatened Fauna Predicted to Occur Within The Project Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	AOS Required	SIC Required
Aepyprymnus rufescens	Rufous Bettong	Vulnerable	-	Required	N/A
Amaurornis olivaceus	Bush-hen	Vulnerable	-	Required	N/A
Anseranas semipalmata	Magpie Goose	Vulnerable	-	Required	N/A
Botaurus poiciloptilus	Australasian Bittern	Vulnerable	-	Required	N/A
Burhinus grallarius	Bush Stone-curlew	Endangered	-	Required	N/A
Cacophis harriettae	White-crowned Snake	Vulnerable	-	Required	N/A
Calyptorhynchus banksii banksii	Red-tailed Black-Cockatoo (coastal subspecies)	Critically Endangered	-	Required	N/A
Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	Endangered (only the South Australian sub-species)	Required	N/A

5 Biodiversity Assessment Results

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	AOS Required	SIC Required
Cercartetus nanus	Eastern Pygmy-possum	Vulnerable	-	Required	N/A
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Vulnerable	Required	Required
Chalinolobus nigrogriseus	Hoary Wattled Bat	Vulnerable	-	Required	N/A
Circus assimilis	Spotted Harrier	Vulnerable	-	Required	N/A
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Vulnerable	-	Required	N/A
Coeranoscincus reticulatus	Three-toed Snake-tooth Skink	Vulnerable	Vulnerable	Required	Required
Coracina lineata	Barred Cuckoo-shrike	Vulnerable	-	Required	N/A
Cyclopsitta diophthalma coxeni	Coxen's Fig-Parrot	Critically Endangered	Endangered	Required	Required
Daphoenositta chrysoptera	Varied Sittella	Vulnerable	_	Required	N/A
Dasyornis brachypterus	Eastern Bristlebird	Endangered	Endangered	Required	Required
Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable	Endangered	Required	Required
Ephippiorhynchus asiaticus	Black-necked Stork	Endangered	-	Required	N/A
Erythrotriorchis radiatus	Red Goshawk	Critically Endangered	-	Required	N/A
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable	-	Required	N/A
Geophaps scripta	Squatter Pigeon	Endangered	-	Required	N/A
Glossopsitta pusilla	Little Lorikeet	Vulnerable	-	Required	N/A
Grantiella picta	Painted Honeyeater	Vulnerable	-	Required	N/A
Grus rubicunda	Brolga	Vulnerable	-	Required	N/A
Hieraaetus morphnoides	Little Eagle	Vulnerable	-	Required	N/A
Hoplocephalus bitorquatus	Pale-headed Snake	Vulnerable	-	Required	N/A
Hoplocephalus stephensii	Stephens' Banded Snake	Vulnerable	-	Required	N/A
Irediparra gallinacea	Comb-crested Jacana	Vulnerable	-	Required	N/A
Ixobrychus flavicollis	Black Bittern	Vulnerable	-	Required	N/A
Kerivoula papuensis	Golden-tipped Bat	Vulnerable	-	Required	N/A
Lathamus discolor	Swift Parrot	Endangered	Endangered	Required	Required
Limosa limosa	Black-tailed Godwit	Vulnerable	-	Required	N/A
Litoria brevipalmata	Green-thighed Frog	Vulnerable	-	Required	N/A
Litoria piperata	Peppered Frog	Critically Endangered	Vulnerable	Required	Required
Litoria subglandulosa	Glandular Frog	Vulnerable	-	Required	N/A
Lophoictinia isura	Square-tailed Kite	Vulnerable	-	Required	N/A
Maccullochella peelii peelii	Murray Cod, Cod, Goodoo	-	-	-	Required
Macropus dorsalis	Black-striped Wallaby	Endangered	-	Required	N/A
Macropus parma	Parma Wallaby	Vulnerable	-	Required	N/A
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Vulnerable	-	Required	N/A
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Vulnerable	-	Required	N/A

5 Biodiversity Assessment Results

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	AOS Required	SIC Required
Menura alberti	Albert's Lyrebird	Vulnerable	-	Required	N/A
Miniopterus australis	Little Bentwing-bat	Vulnerable	-	Required	N/A
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Vulnerable	-	Required	N/A
Mixophyes balbus	Stuttering Frog	Endangered	Vulnerable	Required	Required
Mixophyes iteratus	Giant Barred Frog	Endangered	Endangered	Required	Required
Mogurnda adspersa	Purple Spotted Gudgeon	Endangered	-	Required (FM Act)	N/A
Monarcha leucotis	White-eared Monarch	Vulnerable	-	Required	N/A
Mormopterus beccarii	Beccari's Freetail-bat	Vulnerable	-	Required	N/A
Mormopterus eleryi	Hairy-nosed Freetail Bat	Endangered	-	Required	N/A
Mormopterus norfolkensis	Eastern Freetail-bat	Vulnerable	-	Required	N/A
Myotis macropus	Large-footed Myotis	Vulnerable	-	Required	N/A
Neophema pulchella	Turquoise Parrot	Vulnerable	-	Required	N/A
Ninox connivens	Barking Owl	Vulnerable	-	Required	N/A
Ninox strenua	Powerful Owl	Vulnerable	-	Required	N/A
Nyctimene robinsoni	Eastern Tube-nosed Bat	Vulnerable	-	Required	N/A
Nyctophilus bifax	Eastern Long-eared Bat	Vulnerable	-	Required	N/A
Nyctophilus timoriensis (South-eastern form)	Greater Long-eared Bat	Vulnerable	Vulnerable	Required	Required
Pachycephala olivacea	Olive Whistler	Vulnerable	-	Required	N/A
Petaurus australis	Yellow-bellied Glider	Vulnerable	-	Required	N/A
Petaurus norfolcensis	Squirrel Glider	Vulnerable	-	Required	N/A
Petrogale penicillata	Brush-tailed Rock-wallaby	Endangered	Vulnerable	Required	Required
Petroica boodang	Scarlet Robin	Vulnerable	-	Required	N/A
Petroica phoenicea	Flame Robin	Vulnerable	-	Required	N/A
Phascogale tapoatafa	Brush-tailed Phascogale	Vulnerable	-	Required	N/A
Phascolarctos cinereus	Koala	Vulnerable	-	Required	N/A
Philoria loveridgei	Loveridge's Frog	Endangered	-	Required	N/A
Philoria pughi	Philoria pughi	Endangered	-	Required	N/A
Philoria richmondensis	Philoria richmondensis	Endangered	-	Required	N/A
Planigale maculata	Common Planigale	Vulnerable	-	Required	N/A
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Vulnerable	-	Required	N/A
Potorous tridactylus	Long-nosed Potoroo	Vulnerable	Vulnerable	Required	Required
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	Vulnerable	-	Required	N/A
Pseudomys oralis	Hastings River Mouse	Endangered	Endangered	Required	Required
Pteropus alecto	Black Flying-fox	Not listed	-	Required	N/A
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Vulnerable	Required	Required
Ptilinopus magnificus	Wompoo Fruit-Dove	Vulnerable	-	Required	N/A
Ptilinopus regina	Rose-crowned Fruit-Dove	Vulnerable	-	Required	N/A

5 Biodiversity Assessment Results

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	AOS Required	SIC Required
Ptilinopus superbus	Superb Fruit-Dove	Vulnerable	-	Required	N/A
Pyrrholaemus saggitatus	Speckled Warbler	Vulnerable	-	Required	N/A
Rostratula australis	Australian Painted Snipe	Endangered	Vulnerable	Required	Required
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Vulnerable	-	Required	N/A
Scoteanax rueppellii	Greater Broad-nosed Bat	Vulnerable	-	Required	N/A
Stagonopleura guttata	Diamond Firetail	Vulnerable	-	Required	N/A
Stictonetta naevosa	Freckled Duck	Vulnerable	-	Required	N/A
Syconycteris australis	Common Blossom-bat	Vulnerable	-	Required	N/A
Thylogale stigmatica	Red-legged Pademelon	Vulnerable	-	Required	N/A
Turnix maculosa	Red-backed Button-quail	Vulnerable	-	Required	N/A
Tyto capensis	Grass Owl	Vulnerable	-	Required	N/A
Tyto novaehollandiae	Masked Owl	Vulnerable	-	Required	N/A
Tyto tenebricosa	Sooty Owl	Vulnerable	-	Required	N/A
Underwoodisaurus sphyrurus	Border Thick-tailed Gecko	Vulnerable	Vulnerable	Required	Required
Vespadelus troughtoni	Eastern Cave Bat	Vulnerable	-	Required	N/A
Xanthomyza phrygia	Regent Honeyeater	Endangered	Endangered	Required	Required

5.2.8 Threatened Populations

Database searches indicated that two threatened populations listed under State legislation are predicted to occur within the study area. Based on detailed habitat suitability presented in **Appendix F**, both of these populations are assumed to occur within the alignment and study area. Details are provided in **Table 5-7** below.

Table 5-7 Threatened Populations Predicted to Occur Within the Project Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	AOS Required	SIC Required
Adelotus brevis - endangered population	Tusked Frog population in the Nandewar and New England Tableland Bioregions	Endangered Population	-	Required	-
Ambassis agassizii	Olive Perchlet	Endangered Population (FM Act)	-	Required	-

An AOS for these populations was undertaken and is included as **Appendix I**.

5.2.9 Fauna Habitat

Habitat assessments were conducted in representative habitat across the study area to evaluate habitat quality and assess the potential presence of threatened species not directly observed during field surveys. Biophysical features considered in assessing habitat included:

- native diversity of flora;
- structural and floristic diversity of vegetation layers;
- level of shelter, breeding, roosting, and nesting resources available;
- presence of mature hollow bearing trees;
- exfoliated bark, feed trees and shrubs;
- fauna movement corridors;
- position in the landscape, connectivity or value as a habitat corridor;
- presence of rocky outcrops or partially buried rocks; and
- Presence, size and ecological integrity of remnant communities.

The following vegetation formations were identified across the study area:

- Dry Sclerophyll Forest (shrub/grass);
- Dry Sclerophyll Forest (shrubby);
- Forested Wetlands;
- Glassland;
- Grassy Woodlands;
- Semi Arid Woodlands (shrubby formation); and
- Wet Sclerophyll Forest (shrubby formation).

Fauna habitat for each vegetation formation is discussed below.

Dry Sclerophyll Forests (shrub/grass formation)

This formation is comprised of 17 vegetation communities (**Table 5-1**) and occurs on the ranges and lowlands within alignment east (**Figures 7a-g**). The stratification unit is comprised of forest communities and provides habitat for a range of species.

The canopy is typically comprised of a range of age classes with good structural diversity. Mature canopy trees and/or significant habitat trees occur throughout the stratification unit; however they are less common in areas that have been heavily logged or selectively cleared for agriculture. The mid-storey is dominated by weeds or native shrubs, providing foraging and roosting habitat for a range of species, particularly birds and invertebrates (**Plate 5-1**).

5 Biodiversity Assessment Results

Plate 5-1 Dry Sclerophyll Forest (shrub/grass formation)

This stratification unit forms part of the habitat corridor that crosses the ranges and forms part of the Great Eastern Ranges Initiative, providing an important migratory pathway for fauna and flora species.

The floral and structural diversity in this community and its connectivity to other woodland areas increase its value as habitat for many woodland birds, reptiles, mammals and amphibians. Two threatened species were recorded during surveys within this vegetation formation; *Rufous Bettong* and Little Bentwing-bat (**Figure 9**). Previous threatened fauna records show a number of threatened species have been recorded within this unit, particularly around Drake. These species are primarily birds and mammals (**Figure 5a**).

The formation is comprised of a range of nectar bearing trees, some of the more common trees include *Corymbia maculata*, *Eucalyptus propinqua*, *E.*, *C. intermedia*, *E. siderophloia*, *E. crebra*, *E. eugenioides* and *E. campanulata*. These species all provide potential habitat for threatened birds and mammals that feed on nectar including, but not restricted to the Squirrel Glider, Swift Parrot and Black-chinned Honey-eater.

A number of common woodland species were recorded within this stratification unit including the Common Koel (*Eudynamys scolopacea*), Crested Shrike-tit (*Falcunculus frontatus*), Australian Magpie (*Gymnorhina tibicen*), Wonga Pigeon (*Leucosarcia melanoleuca*), Yellow-faced Honeyeater (*Lichenostomus chrysopsl*), Variegated Fairywren (*Malurus lamberti*), Bell Miner (*Manorina melanophrys*) and Lewin's Honeyeater (*Meliphaga lewinii*) (**Appendix H**).

Throughout the formation there is a moderate ground cover comprised of exotic species with a reasonable diversity and abundance of native grasses and herbs. Native grasses and herbs are an important food source for many native species, but the quality of this food source is significantly reduced in heavily grazed areas.

The quality of the substrate within this formation varied significantly depending on the level of weed invasion and disturbance history. There was a moderate amount of coarse woody debris and leaf litter was patchy throughout. In some areas there was significant rocky outcrops and rock fragments within or adjacent to the alignment. These features are likely to provide foraging and roosting habitat for a range of invertebrates, reptiles and small mammals.

Dry Sclerophyll Forest (shrubby formation)

This formation is comprised of three vegetation communities (**Table 5-1**) and occurs within alignment west (**Figure 7**). The stratification unit occurs on the lower slopes and ranges and grades into grassy woodlands in the lowlands. The formation is comprised of forest and woodland communities and provides habitat for a range of species.

During the field surveys, two threatened species were recorded within this stratification unit. These are the Squirrel Glider and Powerful Owl (**Figure 9**).

The canopy is typically comprised of a range of age classes with good structural diversity. Mature canopy trees and/or significant habitat trees occur thought out the stratification unit, however they are less common in areas that have been heavily cleared for agriculture and regularly burnt. Overstorey regeneration is significantly impacted by fire regime and a greater frequency and intensity of fires is decreasing canopy recruitment in areas adjacent to Bald Rock National Park and Wilderness Areas north of Tenterfield (**Figure 1a**). The mid-storey is dominated by native shrubs, providing foraging and roosting habitat for a range of species, particularly birds and invertebrates (**Plate 5-2**).

Plate 5-2 Dry Sclerophyll Forest (shrubby formation)

5 Biodiversity Assessment Results

This formation forms part of the habitat corridor that crosses the ranges north of Tenterfield, providing an important migratory pathway for fauna and flora species.

The floral and structural diversity in this community and its connectivity to other woodland areas increase its value as habitat for many woodland birds, reptiles, mammals and amphibians. A number of threatened species are known to use this vegetation formation, particularly because it is connected to large areas of national park and protected wilderness.

The vegetation formation is comprised of a range of nectar bearing trees including *E dealbata*, *Es blakelyi*, *E youmanii* and *E. melliodora*. These species all provide potential habitat for threatened birds and mammals that feed on nectar including, but not restricted too the Swift Parrot (*Lathamus discolour)* and Eastern Pygmy Possum *(Cercartetus nanus).*

A number of common woodland species were recorded within this stratification unit including the Brown Thornbill (*Acanthiza pusilla*), Wedge-tailed Eagle (*Aquila audax*), Black-faced Cuckoo-shrike (*Coracina novae-hollandiae*), White-winged Chough (*Corcorax melanorhamphos*), Eastern Yellow Robin (*Eopsaltria australis*), Australian Magpie (*Gymnorhina tibicen*), Yellow-faced Honeyeater (*Lichenostomus chrysops*), Superb Fairywren (*Malurus cyaneus*), Black-faced Monarch (*Monarcha melanopsis*), Olive-backed Oriole (*Orilus sagittatus*), Golden Whistler (*Pachycephala pectoralis*) and Little Friarbird (*Philemon citreogularis*) (**Appendix H**).

Throughout the vegetation formation there is a moderate ground cover comprised of exotic species with a reasonable diversity and abundance of native grasses and herbs. Native grasses and herbs are an important food source for many native species, but the quality of this food source is significantly reduced in heavily grazed areas.

The quality of the substrate within this community varied significantly depending on the level of weed invasion and disturbance history. There was a moderate amount of coarse woody debris and leaf litter was patchy throughout. In some areas there was significant rocky outcrops and rock fragments within or adjacent to the alignment. These features are likely to provide foraging and roosting habitat for a range of invertebrates, reptiles and small mammals.

Feral dogs and Dingoes are known to be a problem within this vegetation formation as they move down from the ranges after disturbance events like fire.

Forested Wetlands

This vegetation formation is comprised of four vegetation communities (**Table 5-1**) and occurs within Study Area West and East (**Figure 7**). The vegetation formation occurs along waterways and grades into grassy woodlands or sclerophyll forests out from waterways. The vegetation formation is comprised of forest and woodland communities and provides habitat for a range of species, particularly those dependant on water.

Three threatened species were recorded within this vegetation formation. These were the Diamond Firetail, Brown Tree-Creeper and Grey Crowned Babbler (**Figure 9**).

The canopy is typically comprised of a limited range age classes with limited structural complexity. Forested wetlands occur on some of the most fertile soils in the region and as a result have been heavily cleared for intensive agriculture. The canopy is typically comprised of scattered mature individuals and some regenerating over-storey species. Mature canopy trees and/or significant habitat trees occur thought out the vegetation formation, however they are scattered and dependant on how

complete past clearing has been. Where the vegetation formation occurs as riparian vegetation the community rarely extends more than 15m from creek lines. The mid-storey is dominated by weeds providing some structural complexity and foraging and roosting habitat for a range of species, particularly birds and invertebrates (**Plate 5-3** and **5-4**).

Plate 5-3 Forested Wetlands (alignment west)

Plate 5-4 Forested Wetlands (alignment east)

This formation forms part of continuous habitat corridors that connect waterways within the region. These corridors provide an important migratory pathway for fauna and flora species.

This vegetation formations connectivity to other woodland areas and proximity to water increase its value as habitat for many woodland birds, reptiles, mammals and amphibians. A number of threatened species are known to use this vegetation formation for roosting, foraging and breeding (**Figures 5a** and **5b**).

The vegetation formation is comprised of a range of nectar bearing trees including, River Red Gum, Swamp Box and Water Gum. These species all provide potential habitat for threatened birds and mammals that feed on nectar including the Squirrel Glider and Swift Parrot.

A number of common woodland species were also recorded, during field the study, within this stratification unit including the Cattle Egret (*Bubulcus ibis*), Sulphur-crested Cockatoo (*Cacatua galerita*), Galah (*Cacatua roseicapilla*), Black-fronted Dotterel *(Elseyornis melanops*), Australian Wood Duck (*Chenonetta jubata*), White-browed Tree-creeper (*Climacteris affinis*), Grey Shrike-thrush (*Colluricincla harmonica*), White-throated Treecreeper (*Cormobates leucophaea*), Pied Butcherbird (*Cracticus nigrogularis*), Little Egret (*Egretta garzetta*), Eastern Yellow Robin (*Eopsaltria australis*) Dollarbird (*Eurystomus orientalis*), Peaceful Dove (*Geopelia placidia*) and Brown Gerygone (*Gerygone mouki*) (**Appendix H**).

Throughout the vegetation formation there is a moderate ground cover comprised of exotic species with a reasonable diversity and abundance of native grasses and herbs. Native grasses and herbs are an important food source for many native species, but the quality of this food source is significantly reduced in heavily grazed areas and weed infested areas.

The quality of the substrate within this community varied significantly depending on the level of weed invasion and disturbance history. There was a moderate amount of coarse woody debris and leaf litter was patchy throughout. These features are likely to provide foraging and roosting habitat for a range of invertebrates, reptiles and small mammals.

Feral cats were observed using Forested Wetlands. Feral cats are known to feed on native birds and small mammals.

Grasslands

This vegetation formation is comprised of two vegetation communities (**Table 5-1**) and occurs on the lower slopes and alluvial plains in the western alignment. This is a minor vegetation formation in the western alignment as it has a very restricted geographical range within the study area and has largely been cleared for agriculture (**Figure 7**). The vegetation formation is comprised of natural grasslands and open woodland transitional zones and provides habitat for a range of species.

Two threatened species were recorded within this vegetation formation during surveys. These are the Grey Crowned Babbler and Brown Treecreeper.

In areas were the canopy occurs, it is typically comprised of a range of age classes with good structural diversity. Mature canopy trees and/or significant habitat trees occur thought out the vegetation formation, however they are less common in areas that have been heavily logged or selectively cleared for agriculture. The mid-storey is very sparse, if not totally absent, in both communities and where it does occur it is comprised of scattered acacias and native shrubs like *Leptospermum sp.* providing foraging and roosting habitat for a range of species, particularly birds and invertebrates.

5 Biodiversity Assessment Results

Plate 5-5 Natural Grasslands

This vegetation formation occurs as an isolated remnant surrounded by Grassy Woodland and Forested Wetlands along the River. This vegetation formation has maintained good connectivity to larger vegetation corridors across the ranges and along water ways (**Plate 5-6**).

The floral and structural diversity in this community, its abundance of hollow bearing trees and limited distribution increase its value as habitat for many woodland birds, reptiles, mammals and amphibians. The recording of threatened species during field surveys and previously from DECCW records within this vegetation formation indicate the continued presence of threatened species within these vegetation communities (**Figure 4a, 5a** and **Figure 9a**).

The vegetation formation has a range of nectar bearing trees including *Eucalyptus albens*, *E. floribunda*, *E. melanophloia* and *E. tereticornis*. These species all provide potential habitat for threatened birds and mammals that feed on nectar including the Turquoise Parrot and Squirrel Glider.

A number of common woodland species were also recorded within this stratification unit including the Galah (*Cacatua roseicapilla*), Ground Cuckoo-shrike (*Coracina maxima*), Australian Raven (*Corvus coronoides*), Laughing Kookaburra (*Dacelo novaeguineae*) Nankeen Kestrel (*Falco cenchroides*), Magpie-lark (*Grallina cyanoleuca*), Crested Pigeon (*Ocyphaps lophotes*), Red Rumped Parrot (*Pesphotus haematonotus*), and Willy Wagtail (*Rhipidura leucophrys*) (**Appendix H**).

Grassy Woodland

This vegetation is comprised of nine vegetation communities (**Table 5-1**) and occurs on the lower slopes and ranges in the western alignment. This is one of the most dominant vegetation formations in the western alignment and has largely been cleared for agriculture (**Figure 7**). The vegetation formation is comprised of open forest and woodland communities and provides habitat for a range of species.

5 Biodiversity Assessment Results

Five threatened species were recorded within this vegetation formation during URS surveys; these are the Turquoise Parrot, Diamond Firetail, Grey Crowned Babbler and Brown Treecreeper.

The canopy is typically comprised of a range of age classes with good structural diversity. Mature canopy trees and/or significant habitat trees occur thought out the vegetation formation, however are less common in areas that have been heavily logged or selectively cleared for agriculture. The mid-storey is non-existent in most communities, where it does occur it is comprised of scattered acacias and native shrubs like *Gerijera parviflora,* providing foraging and roosting habitat for a range of species, particularly birds and invertebrates (**Plate 5-5**).

Plate 5-6 Grassy Woodland

This vegetation formation typically occurs as isolated remnants surrounded by cleared farm land. In a number of cases it has limited connectivity to larger vegetation corridors across the ranges and along water ways.

The floral and structural diversity in this community, its abundance of hollow bearing trees and limited distribution increase its value as habitat for many woodland birds, reptiles, mammals and amphibians. A number of threatened species were recorded within this vegetation formation during surveys and previous records indicate the continued presence of threatened species within these vegetation communities (**Figure 4a, Figure 5a, Figure 9a** and **b**).

The vegetation formation is comprised of a range of nectar bearing trees including White Box, Blakely's Red Gum, Rough Barked Apple, Cabbage Gum, Yellow Box, Forest Red Gum, and Thin-leaved Stringybark. These species all provide potential habitat for threatened birds and mammals that feed on nectar including the Black-chinned Honey-eater and Painted Honey-eater.

A number of common woodland species were also recorded within this stratification unit including the Australasian Pipit (*Aanthus novaeseelandiae*), Wedge-tailed Eagle (*Aquila audax*), Galah (*Cacatua roseicapilla*), Ground Cuckoo-shrike (*Coracina maxima*), Australian Raven (*Corvus coronoides*), Laughing Kookaburra (*Dacelo novaeguineae*) Nankeen Kestrel (*Falco cenchroides*), Magpie-lark (*Grallina cyanoleuca*), Crested Pigeon (*Ocyphaps lophotes*), Red Rumped Parrot (*Pesphotus haematonotus*), and Willy Wagtail (*Rhipidura leucophrys*) (**Appendix H**).

5 Biodiversity Assessment Results

Throughout the vegetation formation there is a moderate ground cover comprised primarily of native grasses and herbs with very few weeds. Native grasses and herbs are an important food source for many native species, but the quality of this food source is significantly reduced in heavily grazed areas.

The quality of the substrate within this community was typically good. There was a moderate amount of coarse woody debris and leaf litter throughout. In some areas there was significant rocky outcrops and rock fragments within or adjacent to the alignment, particularly in areas west of Tenterfield. These features are likely to provide foraging and roosting habitat for a range of invertebrates, reptiles and small mammals.

Semi Arid Woodland (shrubby sub formation)

This vegetation formation is comprised of two vegetation communities (**Table 5-1**) and occurs on the upper slopes and ranges in alignment west. This is the dominant vegetation formation that covers the ranges in alignment west (**Figure 7**). The vegetation formation is comprised of a cypress pine woodland community and a small section of Dirty Gum Woodland provides habitat for a range of species.

One threatened species, the Little Bentwing-bat, was recorded in this formation during surveys.

The canopy is typically comprised of a range of age classes with good structural diversity. Very few significant habitat trees occur thought out the vegetation formation as the canopy is dominated by Cypress Pine and this species does not develop hollows. The dense cover provided by the Cypress provides foraging habitat for a number of birds, reptiles and mammals that take refuge in the cover. The mid-storey is non-existent in most areas and where it does occur pine has been selectively logged out of the community (see **Plate 5-7**).

Plate 5-7 Semi Arid Woodland (shrubby sub-formation)

5 Biodiversity Assessment Results

This vegetation formation typically occurs as large connected patches across the ranges, fragmented by cleared farmland in the valleys.

The dense canopy cover, rocky substrate and connectivity increase this vegetation formations value as habitat for many birds, reptiles and mammals. Previous records indicate the continued presence of threatened species within this vegetation formation (**Figure 5**).

The vegetation formation only has a few nectar bearing trees, these include: *E. floribunda*, *E. melanophloia* and *Callitris glaucophylla* providing foraging habitat for threatened birds like the Black-chinned Honey-eater, and Grey-crowned Babbler. Rough bark on cypress pines also provides significant foraging habitat for invertebrates and threatened birds including the Speckled Warbler, Brown Treecreeper and Hooded Robin.

During the field studies, a number of common species were recorded within this stratification unit including the Australian King-Parrot (*Alisterus scapulairs*), Great Egret (*Ardea alba*), White-faced Heron (*Ardea novae-hollandiae*), Sulphur-crested Cockatoo (*Cacatua galerita*), Galah, Yellow-tailed Black Cockatoo (*Calyptorhynchus funereus*), Black-faced Cuckoo-shrike (*Coracina novae-hollandiae*), White-winged Chough (*Corcorax melanorhamphos*), Australian Raven, Pied Butcherbird (*Cracticus nigrogularis*), Laughing Kookaburra, Magpie-lark (*Grallina cyanoleuca*), Australian Magpie (*Gymnorhina tibicen*), White-winged Triller (*Lalage tricolor (sueurii)*) and White-plumed Honeyeater (*Lichenostomus penicillatus*) (**Appendix I**).

Throughout the vegetation formation there is a moderate ground cover comprised primarily of native grasses, herbs and sedges with very few weeds. Native grasses and herbs are an important food source for many native species.

The quality of the substrate within this community was typically good. There was a moderate amount of coarse woody debris and leaf litter throughout, and significant rocky outcrops and rock fragments. These features are likely to provide foraging and roosting habitat for a range of invertebrates, reptiles and small mammals.

Wet Sclerophyll Forest (shrubby formation)

This vegetation formation is comprised of three vegetation communities (**Table 5-1**) and occurs in the wetter parts of the ranges in alignment and Study Area East (**Figure 7**). The vegetation formation is comprised of open forest and moist forest communities and provides habitat for a range of species.

No threatened species were recorded in this vegetation formation during field surveys.

The canopy is typically comprised of a range of age classes with good structural diversity. Mature canopy trees and/or significant habitat trees occur throughout the vegetation formation. However, they are less common in areas that have been heavily logged or selectively cleared for agriculture. The mid-storey is dominated by common weeds and scattered natives providing limited foraging and roosting habitat for a range of species, particularly birds and invertebrates (**Plate 5-8**).

5 Biodiversity Assessment Results

Plate 5-8 Wet Sclerophyll Forest (shrubby formation)

This vegetation formation typically occurs as small patches of significant habitat corridors that cross the ranges and form part of the Great Eastern Ranges Initiative.

The floral and structural diversity in this community, its proximity to water and the presence of nectar bearing trees increase its value as habitat for many woodland birds, reptiles, mammals and amphibians. Whilst no threatened species were recorded within this vegetation formation during surveys, previous records indicate the continued presence of threatened species within this vegetation formation (**Figure 5**).

The vegetation formation is comprised of a range of nectar bearing trees including *Eucalyptus fastigata, Lophostemon confertus* and *Corymbia maculata.* These species all provide potential habitat for threatened birds and mammals that feed on nectar including the Squirrel Glider and Yellow-bellied Glider (*Petaurus australis*).

Throughout the vegetation formation there is a moderate ground cover comprised primarily of weeds with a few native grasses and herbs. Native grasses and herbs are an important food source for many native species. However within this vegetation formation they are outcompeted by weeds.

The quality of the substrate within this community was typically good. There was a moderate amount of coarse woody debris and leaf litter throughout. These features are likely to provide foraging and roosting habitat for a range of invertebrates, reptiles and small mammals.

Aquatic habitats

Freshwater wetlands are an important habitat for aquatic and terrestrial flora and fauna. They provide feeding spawning and/or nursery areas for many species of freshwater fish and birds. The wetlands support a diversity of plant communities including trees, rushes, reeds and floating and submerged aquatic plants. They also function as natural food migration devices acting as sponges. They absorb and recycle nutrients, and act as filters for improving water quality (DPI, 2007). When floodplains are

inundated, nutrients are released, plankton blooms develop and aquatic invertebrates thrive. Fish spawning success and larval survival increase. Recharge and flushing of floodplain wetland systems allows movement of fish in and out of inundated floodplain habitats.

There are a number of ephemeral and perennial creek lines, classified as a category 1 2 or 3 waterway according to I&I NSW guidelines (**Table 3-1)** that traverse the study area (**Figure 3** and **Apendix E, Surface Water and Hydrology, Volume 2, EA** mapping). In sections of alignment east, to the east of the ranges, these creek lines are typically associated with perennial wetlands and provide significant habitat for water birds, reptiles, amphibians and migratory species. Crossing over the ranges in alignment east and into alignment west these creek lines become more ephemeral except where they are regulated and associated with limited riparian vegetation and floodplains. These creek lines provide important habitat for a range of threatened species. However, habitat quality varies significantly depending on past disturbance and water quality. Creek lines within alignment west, several of which are associated with the AECDR, have been heavily used for cropping, grazing and recreation and, as a result, the fringing riparian vegetation has been cleared in a number of sections. Despite this, water courses throughout alignment west provide important habitat for threatened and common fauna species.

All water courses throughout the alignment are likely to provide habitat for micro bats given the close proximity to intact woodland and hollow bearing trees.

Other habitat resources

The DEC (2004) draft guidelines for threatened species surveys identify ‘special habitats’ (e.g. hollow bearing trees, rocky outcrops and cliffs etc.) that are likely to support specific fauna assemblages. These resources may be significant for threatened species.

Tree hollows are of particular significance for native fauna as diurnal or nocturnal shelter sites, for: rearing young, feeding, thermoregulation and to facilitate movement within ‘home ranges’ and dispersal. An estimated 15% of all terrestrial vertebrate fauna in Australia are dependent upon tree hollows and for many of these species the relationship is obligate, i.e. no other habitat resource represents an adequate substitute (Gibbons and Lindenmayer, 2002).

Habitat resources within the project area have been assessed as part of the flora and fauna habitat assessment surveys. This included tree hollows, fallen timber; debris and leaf litter quality. These habitat features have not been mapped. Other habitat resources such as cliffs, caves, steep areas and boulder areas have been mapped (**Figure 9**). Hollow-bearing trees and fallen timber would need to be mapped throughout the project area during targeted pre-clearance assessments.

Whilst across the alignment the density of hollows is relatively high, the Grassy Woodland and Dry Sclerophyll Forests (shrub/grass sub formation) vegetation formations contain the highest density of mature hollow-bearing trees and stags. Where woodland communities have been cleared for agriculture there are still a number of old growth habitat trees, occurring as isolated paddock trees. These trees are generally of a mature age class and support high quality hollows. Hollow-bearing paddock trees may provide suitable diurnal roost sites for tree-roosting microbats and birds.

There were substantial amounts of rocky outcrops, boulder piles and caves within the study area in the hills and ranges in the western and Study Area East. These habitat resources are important habitat for reptiles and small mammals, including threatened microbats.

Koala Habitat

Primary and secondary koala habitat within the alignment has been mapped in **Figure 10.** 26ha of primary and 96ha of secondary habitat would be directly impacted by the Project. Results of scat searches are provided in **Appendix H**.

5.2.10 Invasive Species

Invasive species were prevalent within the study area, with Foxes (*Vulpes vulpes*), Cats (*Felis catus*) and Rabbits (*Oryctolagus cuniculus*) observed on numerous occasions throughout the survey period. Evidence of three other common invasive species was also observed during surveys, comprising of Wild Dogs (*Canis familiaris*), Goats (*Capra hircus*) and Pigs (*Sus scrofa*). Foxes, Cats and Rabbits were most often observed along the edge of residential roads, existing access tracks, farm tracks and the existing easement in Study Area East.

All of the aforementioned species are listed as contributing to KTPs listed under both the TSC Act and EPBC Act.

5.2.11 Critical Habitat

Critical habitat is listed on the register of Critical Habitat (DECCW 2010) and is maintained by the Director-General, DECCW and/or I&I NSW within the project area. The NSW National Parks and Wildlife Service is responsible for the identification of critical habitat within NSW. Critical habitat is an area of land that is crucial to the survival of particular threatened species, populations or ecological communities.

There are no areas of recommended or declared critical habitat that are relevant to the alignment or the surrounding locality.

5.2.12 Key Threatening Processes

NSW listed Key Threatening Processes

A key threatening process (KTP) is defined under the TSC Act as ‘a threatening process specified in Schedule 3’ of the Act. A threatening process is defined as ‘a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities’. **Table 5-8** outlines the key threatening processes that are listed in NSW and their relevance to this Project.

Examples of the following KTPs listed under NSW legislation was observed during field surveys within the study area. Currently in alignment east, the presence of these KTPs may be the result of TransGrid operational activities along the existing 132kV easement. However there are also other existing disturbances within alignment east, such as agricultural practices, residential development, traffic movement along the Bruxner Highway that may contribute to these KTPs. The construction and operational Project activities have the potential to augment or influence KTP impacts across alignment west and east (**Table 5-8**). The likely or potential Project impacts relating to these processes are discussed in **Section 6.1.7** and the mitigation measures to ameliorate theses impacts are discussed in **Section 7.2**.

5 Biodiversity Assessment Results

Table 5-8 Key Threatening Processes Listed in NSW

Key Threatening Process	Relevance to Project Y / N
Alteration of habitat following subsidence due to long wall mining	N
Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands	Y
Human-caused Climate Change	Y
Bushrock removal	Y
Clearing of native vegetation	Y
Competition and grazing by the feral European rabbit	Y
Competition and habitat degradation by Feral Goats, *Capra hircus* Linnaeus 1758	Y
Competition from feral honeybees	Y
Death or injury to marine species following capture in shark control programs on ocean beaches	N
Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments	N
Forest Eucalypt dieback associated by over-abundant psyllids and Bell Miners	N
Ecological consequences of high frequency fires	Y
Herbivory and environmental degradation caused by feral deer	N
Importation of red imported fire ants into NSW	N
Infection by *Psittacine circoviral* (beak and feather) disease affecting endangered *Psittacine* species	N
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Y
Infection of native plants by *Phytophthora cinnamomi*	Y
Introduction of the large earth bumblebee (*Bombus terrestris*)	N
Invasion and establishment of Scotch broom (*Cytisus scoparius*)	Y
Invasion and establishment of the Cane Toad (*Bufo marinus*)	Y
Invasion, establishment and spread of *Lantana (Lantana camara L.sens. Lat)*	Y
Invasion of native plant communities by bitou bush and boneseed	N
Invasion of native plant communities by exotic perennial grasses	Y
Invasion of the yellow crazy ant (Anoplolepis gracilipes)	N
Loss of Hollow-bearing trees	Y
Loss and/or degradation of sites used for hill-topping by butterflies	Y
Predation and hybridisation of Feral *Dogs, Canis lupus familiaris*	Y
Predation by the European red fox	Y
Predation by feral cats	Y
Predation by the plague minnow (*Gambusia holbrooki*)	Y
Predation by the ship rat (*Rattus rattus*) on Lord Howe Island	N
Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)	Y
Removal of dead wood and dead trees	Y
Invasion and establishment of exotic vines and scramblers	Y
Invasion of native plant communities by African Olive *Olea europea L.sunsp. cuspidate* (Wall ex G.Don Ciferri)	Y

5 Biodiversity Assessment Results

Commonwealth Listed Key Threatening Processes

Key threatening processes (KTP) listed under the EPBC Act are outlined in **Table 5-9.**

Evidence of the following KTPs listed under Commonwealth legislation were observed during field surveys within the study area. The presence of these KTPs is not as a result of TransGrid activities. However, the proposed works would potentially augment and/or influence of these processes.

Table 5-9 Key Threatening Processes Listed under Commonwealth Legislation

Key Threatening Process	Relevance to Project Y / N
Competition and land degradation by rabbits	Y
Competition and land degradation by unmanaged goats	Y
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	Y
Incidental catch (bycatch) of Sea Turtle during coastal otter-trawling operations within Australian waters north of 28 degrees South	N
Incidental catch (or bycatch) of seabirds during oceanic longline fishing operations	N
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	Y
Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris	N
Invasion of northern Australia by Gamba Grass and other introduced grasses	N
Land clearance	Y
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.	Y
Loss of biodiversity and ecosystem integrity following invasion by the yellow crazy ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean	N
Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases	Y
Predation by European red fox	Y
Predation by exotic rats on Australian offshore islands of less than 1000km^2 (100,000 ha)	N
Predation by feral cats	Y
Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs	Y
Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species	N
The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*).	Y
The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, *Solenopsis invicta* (fire ant)	N

6

Biodiversity Impact Assessment

6.1 Threatened Species, Populations and Ecological Communities

6.1.1 NSW Assessments of Significance (AOS)

Assessments of Significance (AOS) were undertaken to assess the potential impacts of the Project on NSW protected threatened biota pursuant to s.5A of the EP&A Act. AOSs are provided in **Appendix I**. In general major project developments do not use AOSs for the assessment of impacts under NSW legislation given there is no specific requirement for AOSs to be completed for Part 3A Projects. However, these assessments were still undertaken and are considered an effective way to determine whether the Project may impact NSW threatened biota of the project area. For the NSW AOSs, the degree of impact considered the broader principals of 'maintain or improve', as required for biodiversity assessments under Part 3A Projects to strengthen their relevance for this Project.

Species have been assessed individually or as groups of similar species based on taxonomic similarity or habitat specialisation (NPWS Threatened Species Management, 1996). Information on species descriptions and distribution used to assess habitat suitability was obtained from DECCW threatened species community profiles. Refer to **Appendix I** for AOS. Outcomes of the AOSs and the relative impacts to NSW threatened biodiversity has been scaled according to the following definitions outlined below:

None: The results of the AOS indicate that the Project would not have an impact on the species, population or ecological community.

Potential: The results of the AOS indicate that the Project has the potential to impact on the species or the associated habitat for the species, population and community.

Adverse: The results of the AOS indicate that the Project would have an adverse impact on the species or the associated habitat for the species, population and community.

Mitigation measures have been developed for potential or adversely impacted species in **Section 7** of the Biodiversity report.

6.1.2 Commonwealth Significant Impact Criteria Assessment

The potential impact of the Project on threatened biota listed under the EPBC Act has been assessed using the DEWHA (2009) 'Matters of National Environmental Significance, 'Significant Impact Criteria' (SIC) assessment guidelines. Under Commonwealth legislation an action is considered to have a significant impact on a species if there is a real chance or possibility that it would:

- lead to long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect critical habitat to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a threatened species becoming established in the species habitat;
- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

Outcomes of the SICs and the relative impact on species have been defined as either having a significant or non-significant impact. Assessment outcomes are outlined below and can be found in **Appendix J.**

This Project has been confirmed as a 'controlled action' because it is likely to have a significant impact on threatened communities listed under the EPBC Act. Given this, SEWPAC has provided its requirements for environmental assessment under the EPBC Act to the NSW DoP. These have been issued to the proponent as Supplementary DGRs to accompany the DGRs submitted by the NSW DoP under the EP&A Act (**Appendix A**). These DGRs have been addressed throughout the report and within the SICs provided in **Appendix J**.

6.1.3 Threatened Flora

69 threatened flora species listed under the TSC Act and 47 threatened flora species listed under the EPBC Act were assessed as having potential to occur within the project area based on suitable habitat, geographical location and available mapping data (**Appendix F** and **Section 5.2**). An AOS and SIC of the Project related impacts on each of the species listed under the TSC Act and under the EPBC Act has been undertaken (**Appendices I** and **J,** respectively). The outcome of these assessments is presented in **Table 6-1.** The Project is expected to have an impact on a number threatened flora species. The scale of potential impacts to each species is summarised in **Table 6-1** and detailed in **Appendices I** and **J**.

Table 6-1 Threatened Flora Assessment Outcomes

Scientific Name	Common Name	AOS Outcome	SIC Outcome
Acacia macnuttiana	MacNutt's Wattle	Potential	Not Significant
Acalypha eremorum	Acalypha	None	N/A
Almaleea cambagei	Torrington Pea	None	Not Significant
Angophora exul	Gibraltar Rock Apple	None	N/A
Angophora robur	Sandstone Rough-barked Apple	None	N/A
Archidendron hendersonii	White Laceflower	None	N/A
Arthraxon hispidus	Hairy Jointgrass	None	Not Significant
Arthropteris palisotii	Lesser Creeping Fern	None	N/A
Astrotricha roddii	Rod's Star Hair	None	Not Significant
Babingtonia granitica	Granite Babingtonia	None	N/A
Belvisia mucronata	Needle-leaf Fern	None	N/A
Boronia granitica	Granite Boronia	None	Not Significant
Cadellia pentastylis	Ooline	Potential	Not Significant
Caladenia atroclavia	Black-clubbed Spider-orchid	N/A	Not Significant
Callistemon linearifolius	Netted Bottlebrush	None	N/A
Callistemon pungens	-	N/A	Not Significant
Callitris baileyi	Bailey's Cypress Pine	None	N/A
Callitris oblonga	Pygmy Cypress Pine	None	Not Significant
Centranthera cochinchinensis	Swamp Foxglove	None	N/A

6 Biodiversity Impact Assessment

Scientific Name	Common Name	AOS Outcome	SIC Outcome
Clematis fawcettii	Northern Clematis	None	Not Significant
Corchorus cunninghamii	Native Jute	None	Not Significant
Cryptostylis hunteriana	Leafless Tongue-orchid	None	Not Significant
Cynanchum elegans	White-flowered Wax Plant	None	Significant
Dendrobium melaleucaphilum	Spider orchid	None	N/A
Desmodium acanthocladum	Thorny Pea	None	Not Significant
Dichanthium setosum	Bluegrass	Adverse	Not Significant
Digitaria porrecta	Finger Panic Grass	None	Not Significant
Endiandra hayesii	Rusty Rose Walnut	None	Not Significant
Eucalyptus caleyi subsp. ovendenii	Ovenden's Ironbark	Adverse	Significant
Eucalyptus glaucina	Slaty Red Gum	None	Not Significant
Eucalyptus nicholii	Narrow-leaved Black Peppermint	None	Not Significant
Eucalyptus rubida subsp. barbigerorum	Blackbutt Candlebark	None	Not Significant
Eucalyptus scoparia	Wallangarra White Gum	None	Significant
Eucalyptus tetrapleura	Square-fruited Ironbark	None	Not Significant
Euphrasia orthocheila subsp. peraspera	Tenterfield Eyebright	None	N/A
Geijera paniculata	Axe-Breaker	None	N/A
Geodorum densiflorum	Pink Nodding Orchid	None	N/A
Goodenia macbarronii	Narrow Goodenia	N/A	Not Significant
Gossia fragrantissima	Sweet Myrtle	None	Significant
Grammitis stenophylla	Narrow-leaf Finger Fern	None	N/A
Grevillea beadleana	Beadle's Grevillea	None	Not Significant
Hibbertia marginata	Bordered Guinea Flower	None	Not Significant
Homoranthus binghiensis	Binghi Homoranthus	None	N/A
Homoranthus lunatus	Crescent-leaved Homoranthus	None	Not Significant
Lepidium peregrinum	Wandering Pepper Cress	Potential	Significant
Leucopogon confertus	Torrington Beard-heath	None	Not Significant
Lindsaea incisa	Slender Screw Fern	None	N/A
Macadamia tetraphylla	Rough-shelled Bush Nut	None	Not Significant
Marsdenia longiloba	Slender Marsdenia	None	Not Significant
Melaleuca irbyana	Weeping Paperbark	None	N/A
Muehlenbeckia costata	Scrambling Lignum	None	N/A
Myrsine richmondensis	Ripple-leaf Muttonwood	None	Significant
Niemeyera whitei	Rusty Plum	None	N/A
Oldenlandia galioides	Sweet False Galium	None	N/A
Owenia cepiodora	Onion Cedar	None	Not Significant

6 Biodiversity Impact Assessment

Scientific Name	Common Name	AOS Outcome	SIC Outcome
Persicaria elatior	Tall Knotweed	None	Not Significant
Phebalium glandulosum subsp. eglandulosum	Rusty Desert Phebalium	None	Not Significant
Phebalium whitei	-	N/A	Not Significant
Phyllanthus microcladus	Brush Sauropus	None	N/A
Plectranthus nitidus	Nightcap Plectranthus	None	Not Significant
Polygala linariifolia	Native Milkwort	None	N/A
Pomaderris notata	McPherson Range Pomaderris	None	N/A
Prostanthera staurophylla sensu stricto	Torrington Mint-bush	None	Not Significant
Rapanea sp. Richmond River (J.H.Maiden & J.L.Boorman NSW 26751)	Purple-leaf Muttonwood, Lismore Muttonwood	N/A	Significant
Rotala tripartita	-	None	N/A
Rutidosis heterogama	Heath Wrinklewort	None	Not Significant
Sarcochilus hartmannii	Hartman's Sarcochilus	None	Not Significant
Senna acclinis	Rainforest Cassia	None	N/A
Sophora fraseri	Brush Sophora	Potential	Not Significant
Syzygium hodgkinsoniae	Red Lilly Pilly	None	Not Significant
Tephrosia filipes	Tephrosia filipes	None	N/A
Thesium australe	Austral Toadflax	None	Not Significant
Tinospora smilacina	Tinospora Vine	None	N/A
Triplarina imbricata	Creek Triplarina	None	Not Significant
Tylophora woollsii	Cryptic Forest Twiner	None	Significant

6.1.4 Threatened Ecological Communities

A total of five TECs were assessed as having potential to occur within the project area based on suitable habitat, available mapping data and the presence of characteristic and associated species (**Appendix F** and **Table 6-2**). Of these TECs, three are listed under the TSC Act, one is listed under the FM Act and two are listed under the EPBC Act. Box Gum Woodland is listed under both TSC and EPBC Acts. AOS and SIC assessments of the impact of the Project on each of these threatened communities has been undertaken (**Appendices I** and **J**). The scale of potential impacts to each community is summarised in **Table 6-2** and detailed in **Appendices I** and **J**.

6 Biodiversity Impact Assessment

Table 6-2 Threatened Ecological Community Assessment Outcomes

Scientific Name	Common Name	AOS Outcome	SIC Outcome
Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River	Darling River EEC	Adverse	N/A
Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	Sub-tropical Coastal Floodplain Forest	Adverse	N/A
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast; Sydney Basin and South East Corner Bioregions	Swamp sclerophyll forest on coastal floodplains	Adverse	N/A
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Box Gum Woodland	Adverse	Significant
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	N/A	Significant

Project related impacts on TECs and their associated flora species within the project area would occur during both construction and operation of the transmission line. These impacts would include both direct (e.g. vegetation clearing and habitat removal and fragmentation) and indirect impacts (e.g. edge effects and changes in surface runoff and drain patterns). Each impact type is discussed in **Section 6.1.7** and **6.1.8**. Specifically, TECs would be directly impacted by the clearing of vegetation and the associated habitat within them. A maximum and minimum clearing estimate (refer to **Section 4.3**) for TECs has been provided in **Table 6-3** to demonstrate these impacts. The calculations provided account for any associated access tracks, structures and the proposed easement. No TECs would be cleared for the proposed Tenterfield 330kV Substation works.

Constrained clearing and maintenance practices enables the ground layer and mid storey to be maintained to a height of approximately 4m when they occur outside of the structure and access track footprints according to the TransGrid's Easements and Access Track Maintenance Policy (GM AS L1 002) (**Appendix C, TransGrid Policies, Volume 2, EA**). Therefore it is likely that the maximum clearing estimates provided in **Table 6-3** is an overestimate of the likely clearing amounts.

The outcome of the Commonwealth Significant Impact Criteria (SIC) assessment of clearing impacts is that the Project is considered to have a significant impact on two of the TECs identified within the alignment and Study Area West (**Table 6-2**):

- Natural Grasslands on Basalt and Alluvial Plains in Northern NSW and Southern Queensland; and
- White Box, Yellow Box, Blakely's Red Gum Grassy Woodland.

The Project is considered to have a significant impact on these communities because of their limited distribution within the region and the extent of clearing that would be required by the Project (**Table 6-3**). Both of these communities have already been significantly cleared within the region and further clearing of these communities is likely to reduce their regional viability (**Appendices I** and **J**).

6 Biodiversity Impact Assessment

The outcome of the State AOSs with respect to clearing impacts is that the Project is considered to have an adverse impact on four of the TECs identified within alignment and Study Area West (**Table 6-2**):

- Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River;
- Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion;
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast; Sydney Basin and South East Corner Bioregions; and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

The Project would require a minimum clearing of 12 ha and a maximum of 91 ha of TECs. These figures exclude the minimum and maximum clearing estimates for un-surveyed wooded vegetation of 9.44ha and 51.52ha respectively. Areas of un-surveyed wooded vegetation have been included in the clearing totals as a precautionary measure. Whilst unlikely in all instances, at this stage it is assumed that this vegetation may be a TEC. The basis for these calculations is provided in **Table 6-3**, below.

The TSC Act listed TECs within the alignment and Study Area East typically occur as fragmented patches of degraded forests and woodlands bordered by cleared farm land. The main impact of the Project on TECs in the alignment east study area is an increase in edge effects, primarily weed invasion. Both Sub-tropical coastal floodplain forest and Swamp Sclerophyll forest on coastal floodplain occur in the study area associated with alignment east.

The TEC AECDR only occurs in the study area associated with alignment west. Given that this TEC includes all abiotic and biotic aspects of the riparian area, impacts are not restricted solely to vegetation clearing. The Project does not include the physical removal of any terrestrial based vegetation associated within the community. However, the Project has been assessed as having an adverse impact as it would cause:

- potential modification to the flow of number of waterways given the requirement to upgrade and installation of a number of waterway crossings;
- potential limitation of the movement of some fish, reptiles, amphibians and insects known to occur in the community given the installation and upgrade of water crossings; and
- potential increases in sedimentation, erosion and pollution impacts within the community given the works required to upgrade or install new waterway crossings.

However, a number of mitigation measures have been recommended (**Section 7**) to address these impacts.

Table 6-3 Clearing Estimates for Threatened Ecological Communities

Threatened Ecological Community	Min Area (Ha)	Max Area (Ha)
AECDR^	0	0
Sub-tropical Coastal Floodplain Forest	1.42	11.20
Box Gum Woodland (TSC Act and EPBC Act)	5.52	47.85
Box Gum Woodland (TSC Act)	4.17	27.80
Swamp Sclerophyll Forest	0.04	0.82
Natural Grassland	0.43	3.46
TEC Total	**11.58**	**91.13**
Un-Surveyed Wooded Vegetation	9.44	51.52
Clearing Total	**21.02**	**142.75**

^ *Aquatic community with no terrestrial vegetation, hence there would be no clearing impacts*

**areas of un-surveyed wooded vegetation have been included in this table as a precautionary measure. At this stage it is assumed that this vegetation may be a TEC.*

6.1.5 Threatened Fauna

94 threatened fauna species listed under the TSC Act, one under the FM Act and 18 threatened fauna species listed under the EPBC Act were assessed as having potential to occur within the project area based on suitable habitat, geographical location and available mapping data (**Appendix F** and **Section 5.2**). An AOS and SIC assessment of the Project related impacts on each of the species listed under the TSC Act and EPBC Act has been undertaken (**Appendices I** and **J,** respectively). The outcome of these assessments is presented in **Table 6-4.** The Project is expected to have a significant impact on five threatened fauna species. The scale of potential impacts to each community is summarised in **Table 6-4** and detailed in **Appendices I** and **J**.

Table 6-4 Threatened Fauna Assessment Outcomes

Scientific Name	Common Name	AOS Outcome	SIC Outcome
Aepyprymnus rufescens	Rufous Bettong	Potential	N/A
Amaurornis olivaceus	Bush-hen	None	N/A
Anseranas semipalmata	Magpie Goose	None	N/A
Botaurus poiciloptilus	Australasian Bittern	None	N/A
Burhinus grallarius	Bush Stone-curlew	None	N/A
Cacophis harriettae	White-crowned Snake	Potential	N/A
Calyptorhynchus banksii banksii	Red-tailed Black-Cockatoo (coastal subspecies)	None	N/A
Calyptorhynchus lathami	Glossy Black-Cockatoo	Potential	N/A
Cercartetus nanus	Eastern Pygmy-possum	Potential	N/A
Chalinolobus dwyeri	Large-eared Pied Bat	Potential	Not significant
Chalinolobus nigrogriseus	Hoary Wattled Bat	Potential	N/A
Circus assimilis	Spotted Harrier	None	N/A
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Potential	N/A
Coeranoscincus reticulatus	Three-toed Snake-tooth Skink	Potential	Significant

6 Biodiversity Impact Assessment

Scientific Name	Common Name	AOS Outcome	SIC Outcome
Coracina lineata	Barred Cuckoo-shrike	None	N/A
Cyclopsitta diophthalma coxeni	Coxen's Fig-Parrot	None	Not significant
Daphoenositta chrysoptera	Varied Sittella	None	N/A
Dasyornis brachypterus	Eastern Bristlebird	None	Not significant
Dasyurus maculatus	Spotted-tailed Quoll	Potential	Not significant
Ephippiorhynchus asiaticus	Black-necked Stork	Potential	N/A
Erythrotriorchis radiatus	Red Goshawk	Potential	N/A
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Potential	N/A
Geophaps scripta	Squatter Pigeon	None	N/A
Glossopsitta pusilla	Little Lorikeet	Potential	N/A
Grantiella picta	Painted Honeyeater	Adverse	N/A
Grus rubicunda	Brolga	None	N/A
Hieraaetus morphnoides	Little Eagle	None	N/A
Hoplocephalus bitorquatus	Pale-headed Snake	Potential	N/A
Hoplocephalus stephensii	Stephens' Banded Snake	Potential	N/A
Irediparra gallinacea	Comb-crested Jacana	None	N/A
Ixobrychus flavicollis	Black Bittern	None	N/A
Kerivoula papuensis	Golden-tipped Bat	Potential	N/A
Lathamus discolor	Swift Parrot	None	Not significant
Limosa limosa	Black-tailed Godwit	None	N/A
Litoria brevipalmata	Green-thighed Frog	Potential	N/A
Litoria piperata	Peppered Frog	Potential	Significant
Litoria subglandulosa	Glandular Frog	Potential	N/A
Lophoictinia isura	Square-tailed Kite	None	N/A
Maccullochella peelii peelii	Murray Cod, Cod, Goodoo	-	Not significant
Macropus dorsalis	Black-striped Wallaby	None	N/A
Macropus parma	Parma Wallaby	None	N/A
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Adverse	N/A
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Adverse	N/A
Menura alberti	Albert's Lyrebird	None	N/A
Miniopterus australis	Little Bentwing-bat	Potential	N/A
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Potential	N/A
Mixophyes balbus	Stuttering Frog	Potential	Not significant
Mixophyes iteratus	Giant Barred Frog	Potential	Significant
Mogurnda adspersa	Purple Spotted Gudgeon	None	N/A
Monarcha leucotis	White-eared Monarch	None	N/A
Mormopterus beccarii	Beccari's Freetail-bat	Potential	N/A
Mormopterus eleryi	Hairy-nosed Freetail Bat	None	N/A
Mormopterus norfolkensis	Eastern Freetail-bat	Potential	N/A
Myotis macropus	Large-footed Myotis	Potential	N/A
Neophema pulchella	Turquoise Parrot	Adverse	N/A
Ninox connivens	Barking Owl	None	N/A
Ninox strenua	Powerful Owl	Potential	N/A
Nyctimene robinsoni	Eastern Tube-nosed Bat	Potential	N/A

6 Biodiversity Impact Assessment

Scientific Name	Common Name	AOS Outcome	SIC Outcome
Nyctophilus bifax	Eastern Long-eared Bat	Potential	N/A
Nyctophilus timoriensis (South-eastern form)	Greater Long-eared Bat	Potential	Significant
Pachycephala olivacea	Olive Whistler	Potential	N/A
Petaurus australis	Yellow-bellied Glider	Potential	N/A
Petaurus norfolcensis	Squirrel Glider	Adverse	N/A
Petrogale penicillata	Brush-tailed Rock-wallaby	None	Not significant
Petroica boodang	Scarlet Robin	None	N/A
Petroica phoenicea	Flame Robin	None	N/A
Phascogale tapoatafa	Brush-tailed Phascogale	Potential	N/A
Phascolarctos cinereus	Koala	Potential	N/A
Philoria loveridgei	Loveridge's Frog	Potential	N/A
Philoria pughi	Philoria pughi	Potential	N/A
Philoria richmondensis	Philoria richmondensis	Potential	N/A
Planigale maculata	Common Planigale	None	N/A
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Adverse	N/A
Potorous tridactylus	Long-nosed Potoroo	None	Not significant
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	None	N/A
Pseudomys oralis	Hastings River Mouse	None	Not significant
Pteropus alecto	Black Flying-fox	None	N/A
Pteropus poliocephalus	Grey-headed Flying-fox	Potential	Not significant
Ptilinopus magnificus	Wompoo Fruit-Dove	None	N/A
Ptilinopus regina	Rose-crowned Fruit-Dove	None	N/A
Ptilinopus superbus	Superb Fruit-Dove	None	N/A
Pyrrholaemus saggitatus	Speckled Warbler	Adverse	N/A
Rostratula australis	Australian Painted Snipe	None	Not significant
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Potential	N/A
Scoteanax rueppellii	Greater Broad-nosed Bat	Potential	N/A
Stagonopleura guttata	Diamond Firetail	Adverse	N/A
Stictonetta naevosa	Freckled Duck	None	N/A
Syconycteris australis	Common Blossom-bat	None	N/A
Thylogale stigmatica	Red-legged Pademelon	None	N/A
Turnix maculosa	Red-backed Button-quail	None	N/A
Tyto capensis	Grass Owl	None	N/A
Tyto novaehollandiae	Masked Owl	Potential	N/A
Tyto tenebricosa	Sooty Owl	Potential	N/A
Underwoodisaurus sphyrurus	Border Thick-tailed Gecko	Potential	Significant
Vespadelus troughtoni	Eastern Cave Bat	Potential	N/A
Xanthomyza phrygia	Regent Honeyeater	Potential	Not significant

Migratory Fauna

Section 5A of the EP&A Act has been addressed for those species of fauna that might occur in the study area on a transient, seasonal or migratory basis. Factors considered in determining the significance of potential impacts on migratory species included the regional significance of habitat within the alignment and study area, any existing habitat degradation including weed invasions and agricultural impacts, and the linear nature of vegetation clearing. Based on the assessments of significance and the significant EPBC Act impact criteria assessment the Project is ***not likely*** to impact on any migratory species listed under the TSC or EPBC Acts.

6.1.6 Threatened Populations

One threatened fauna population listed under the TSC Act and one listed under FM Act were assessed as having potential to occur within the project area based on the presence of suitable habitat, geographical location and available mapping data (**Appendix F** and **Section 5.2**). There is no EPBC Act listed threatened fauna populations predicted or known to occur within the study area. An AOS of the Project related impacts on each of known populations has been undertaken (**Appendix I**). The outcome of these assessments is presented in **Table 6-5.** The Project is not expected to have a significant impact on either of these populations (**Table 6-5**).

Table 6-5 Threatened Population Assessment Outcomes

Scientific Name	Common Name	AOS Outcome	SIC Outcome
Adelotus brevis - endangered population	Tusked Frog population in the Nandewar and New England Tableland Bioregions	Potential	N/A
Ambassis agassizii	Olive Perchlet	None	N/A

6.1.7 Key Threatening Processes

The Project could potentially cause or result in an increase in the impact of a number of key threatening processes (KTPs) listed under both the TSC and EPBC Act (refer to **Section 5.2.12**) on threatened biota. These KTPs are addressed throughout the **Section 7.2 Mitigation Measures,** please refer to this section for details. Of particular concern are the following KTPs:

- alteration to the natural flow regimes of rivers, streams, floodplains & wetlands;
- clearing of native vegetation;
- bushrock removal;
- competition and grazing of feral European rabbits;
- ecological consequences of high frequency fires;
- Human-caused Climate Change;
- invasion and establishment of exotic vines and scramblers;
- infection of frogs by amphibian chytrid causing the disease *chytridiomycosis*;
- infection of native plants by *Phytophthora cinnamomi;*
- invasion of native communities by exotic perennial grasses;
- invasion, establishment and spread of *Lantana*;
- loss and/or degradation of sites used for hill-topping butterflies;
- loss of hollow-bearing trees;
- predation by feral cats;
- removal of dead wood and dead trees;

- competition and habitat degradation by feral goats;
- competition from feral honeybees;
- invasion and establishment of Scotch Broom;
- invasion and establishment of the Cane Toad;
- predation and hybridisation of feral dogs;
- predation by the European red fox;
- Predation by the plague minnow;
- Predation, habitat degradation, competition and disease transmission by feral pigs; and
- Invasion of native plant communities by African Olive.

These KTPs relative to the Project are discussed in detail below.

Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands

DEC (2005b) describes this threatening process as an alteration to natural flow regimes, reducing or increasing flows, altering seasonality of flows, changing the frequency, duration, magnitude, timing, predictability and variability of flow events, altering surface and subsurface water levels and changing the rate of rise or fall of water levels.

A number of human processes have been identified as the cause of changes in natural flow regimes, one of which may be relevant to the impact of the Project: diversion of flows by structures or extraction. It is expected that some minor creek crossings would be required for heavy vehicles during construction of the transmission line. It is likely that either temporary or more permanent structures may need to be built across ephemeral creeks to enable the passage of vehicles to structure locations. The construction of such structures within waterways in the project area may alter or divert the natural flow of the creek when it is flowing.

By altering the natural flow of creeks, there is potential to affect riparian vegetation such as River Red Gum communities and water-dependant fauna species (frogs, dragonflies, and fish).

The design has minimised the number of creek crossings wherever possible. In situations where this is not possible, a number of mitigation measures have been recommended (**Section 7**).

The Project has the potential to directly influence this KTP given the aforementioned Project impacts.

Clearing of native vegetation

Native vegetation is defined as plant communities, comprising primarily indigenous species and includes canopy trees (where present), understorey, ground cover and below ground biomass (roots, bulbs and the seed bank) (DEC, 2005b). Native vegetation provides some of the following functions within ecosystems:

- provision and resources for food, shelter, nesting and breeding;
- maintenance of interactions between species (e.g. predator – prey relationships, the spread of genes through migration, mutualism, competition etc);
- nutrient cycling, filtering and retention of nutrients;
- carbon storage;
- water cycling and storage;
- maintenance of soil processes;
- maintenance of catchment scale hydrological and geochemical processes; and
- maintenance of landscape scale ecological processes.

6 Biodiversity Impact Assessment

Clearing, as defined by DECCW and SEWPAC, refers to the destruction of a sufficient proportion of one or more strata (layers) within a stand or stands of native vegetation. The clearing of native vegetation is significant not only to threatened species, populations and communities, but to common native species as well. The impacts of clearing native vegetation include:

- destruction of habitat causing a loss of biodiversity, occasionally resulting in total extinction of species, populations or loss of local genotypes and sometimes resulting in the outbreak of disease;
- isolation of populations resulting in limited gene flow between small fragmented populations, reduced potential to adapt to environmental change and loss or severe modification of the interactions between species;
- riparian zone degradation, such as bank erosion leading to sedimentation that affects aquatic communities;
- disturbed habitat which facilitates the establishment and spread of exotic or pioneering species which may displace locally native species; and
- the loss of leaf litter, removing habitat for a wide variety of vertebrates and invertebrates.

Impacts on vegetation communities would occur during construction and operation of the Project. TransGrid also has a statutory responsibility to maintain adequate clearance between transmission line conductors and vegetation (**Appendix C, TransGrid Policies Volume 2, EA**). Impacts of the Project on vegetation would include pruning and clearing of canopy trees and shrubs that grow in the required safety clearance zones around conductors and poles/towers. This would most commonly mean occasional slashing of the shrub layer beneath conductors within the alignment.

It is important to note that vegetation in gullies, whose mature development would not infringe safe electrical clearances or create a substantial risk of bushfire ignition and forced outages, would be retained along the easement. Vegetation retained within the easement would provide for fauna movement corridors.

Vegetation in the alignment would be maintained to allow TransGrid to access the line for ongoing routine maintenance. In addition to this, there would be the requirement for the construction of off-easement access tracks for construction and to provide access for ongoing maintenance. Where possible off-easement access tracks would use existing roads. However, some new tracks would be required.

Clearing estimates and the condition of vegetation communities impacted by the proposed development are shown in **Table 6-7.** The criteria used to establish vegetation condition is provided in **Table 6-6**. Definition of vegetation cover was based on Specht (1981) and the DECCW (2010) National Vegetation Interim Type Standard. Vegetation condition was determined throughout the survey effort and is described in **Section 5.2.1**.

6 Biodiversity Impact Assessment

Table 6-6 Condition Vegetation Communities

Vegetation Condition	Condition Definition
Poor	Less then 10% native cover Greater than 50% weed cover Communities were isolated and/or fragmented Low level of habitat resources identified
Moderate	Less then 50% native cover Between 10-50% weed cover Communities with minor to moderate connection within the landscape Moderate level of habitat resources identified
Good	Greater than or equal to 50% native cover Between 0-10% weed cover Communities were well connected within the landscape High level of habitat resources identified

Adapted from DECCW National Vegetation Interim Type Standard 2010

Table 6-7 Clearing Estimates and Condition of Vegetation Communities

Vegetation Formation	Vegetation Community	TEC	Vegetation Condition (Poor/Moderate/Good)	Min (ha)	Max (ha)
Dry Sclerophyll Forest (shrub/grass sub formation)	Dirty Gum/White Cypress Pine/Silver-leaved Ironbark Open Forest (Integrades)	-	Poor to moderate	9.42	9.42
	Flood Gum/Grey Ironbark Tall Open Forest (Disturbed)	-	Poor	0.35	0.35
	Forest Red Gum Grassy Open Forest	-	Good	0.27	0.27
	Forest Red Gum/Broad-leaved Apple Dry Open Forest	-	Good	2.40	2.40
	Forest Red Gum/Pink Bloodwood Open Forest	-	Good	3.75	3.75
	Grey Gum/Grey Ironbark Open Forest	-	Moderate to good	2.37	2.37
	Grey Ironbark/Grey Gum/New England Blackbutt Open Forest (Intergrades)	-	Moderate to good	0.71	0.71
	Ironbark Wattle Woodland (Disturbed)	-	Poor	0.83	0.83
	Narrow-leaved Ironbark Dry Open Forest	-	Good	3.98	3.98
	New England Blackbutt Dry Heathy Open Forest on Granites	-	Good	27.14	27.14
	New England Stringybark Open Forest	-	Good	0.48	0.48
	New England Stringybark/Peppermint/Grey Ironbark/Grey Gum Open Forest (Intergrades)	-	Good	3.21	3.21
	Spotted Gum/Grey Box /Grey Ironbark Open Forest	-	Moderate to good	3.41	3.41
	Spotted Gum/Grey Ironbark/Dry Open Forest	-	Moderate to good	1.05	1.05
	Spotted Gum/Grey	-	Moderate to good	1.31	1.31

6 Biodiversity Impact Assessment

Vegetation Formation	Vegetation Community	TEC	Vegetation Condition (Poor/Moderate/Good)	Min (ha)	Max (ha)
	Ironbark/Narrow-leaved Ironbark Open Forest				
	Spotted Gum/Grey Ironbark/Pink Bloodwood Open Forest	-	Moderate to good	12.60	12.60
	Spotted Gum/Grey Ironbark/Thin-leaved Stringybark Dry Open Forest	-	Moderate to good	4.45	4.45
	Spotted Gum/Thin-leaved Stringybark/Pink Bloodwood Open Forest	-	Moderate to good	2.85	2.85
	Thin-leaved Stringybark/Broad-leaved Apple Open Forest	-	Moderate	0.58	0.58
Dry Sclerophyll Forest (shrubby sub formation)	Grey Box - Narrow-leaved Ironbark - White Cypress Pine Open Forest	-	Moderate to good	2.78	2.78
	Tumbledown Red Gum/Blakely's Red Gum/Pine Shrubby Open Forest	-	Good	27.15	27.15
	Tumbledown Red Gum/Blakely's Red Gum/Pine Shrubby Open Forest (Disturbed-Regrowth)	-	Poor to moderate	27.16	27.16
	Youman's Stringybark/Yellow box/Blakely's Red Gum Woodland (Intergrades)	-	Moderate	7.62	7.62
Forested Wetland	River Oak Riparian Woodland	-	Moderate	0.73	0.73
	River Red Gum Riverine Woodland	-	Moderate	4.17	4.17
	River Red Gum Riverine Woodlands (Disturbed)	-	Poor to moderate	1.38	1.38
	Swamp Box Swamp Forest (Disturbed)*	Swamp Sclerophyll Forest	Poor	0.11	0.82
	Swamp Box/Swamp Mahogany Swamp Forest (Integrades)*	Swamp Sclerophyll Forest	Moderate	0.04	0.82
	Water Gum/Forest Red Gum Riparian Woodland	-	Moderate to good	0.05	0.05
Grassland	Natural Grasslands on Basalt and Fine Textured Alluvial Soils & White Box Grassy Woodland†	Natural Grasslands	Good	0.24	2.77
	Natural Grasslands on Basalt and Fine Textured Alluvial Soils†	Natural Grasslands	Good	0.20	0.69
Grassy Woodland	Blakely's Red Gum/Grey Box/Rough Barked Apple Grassy Woodland*	Box Gum Woodland	Moderate to good	0	0.16
	Blakely's Red Gum/Grey Box/Rough Barked Apple Grassy Woodland* (Disturbed)	Box Gum Woodland	Poor	0	0.72
	Blakely's Red Gum/Grey Box/Rough-barked Apple Grassy Woodland†*	Box Gum Woodland	Good	0.60	4.48
	Blakely's Red Gum/White Box Grassy Woodland* (Regeneration)	Box Gum Woodland	Moderate	0.03	0.04
	Blakely's Red Gum/White Box Grassy Woodland* / †*	Box Gum Woodland	Moderate	0.88	4.91
	Cabbage Gum Grassy Woodland	-	Moderate to good	0.87	0.87
	Forest Red Gum/Swamp Box Open Forest (Disturbed)*	Sub-tropical Coastal	Poor	0.05	0.84

6 Biodiversity Impact Assessment

Vegetation Formation	Vegetation Community	TEC	Vegetation Condition (Poor/Moderate/Good)	Min (ha)	Max (ha)
		Floodplain Forest			
	Forest Red Gum/Swamp Box Open Forest*	Sub-tropical Coastal Floodplain Forest	Moderate	1.34	9.53
	Fuzzy Box/Grey Box Grassy Woodland (Disturbed)	-	Poor	1.48	1.48
	Inland Grey Box Tall Grassy Woodland (Disturbed)	-	Moderate	15.45	15.45
	Rough-barked Apple riparian forb/grass open forest	-	Moderate	0.12	0.12
	White Box Grassy Woodland (Disturbed)*	Box Gum Woodland	Moderate	3.60	23.59
	White Box Grassy Woodland†*	Box Gum Woodland	Moderate to good	4.58	41.75
Semi Arid Woodlands (shrubby sub formation)	Dirty Gum Tall Woodland	-	Poor	12.00	12.00
	Silver-leaved Ironbark/White Cypress Pine Woodland	-	Moderate	105.10	105.10
Wet Sclerophyll Forest (shrubby formation)	Messmate/Brown Barrel Grassy Open Forest	-	Good	2.52	2.52
	Spotted Gum/Brush Box Moist Forest	-	Good	0.15	0.15
	Sydney Blue Gum Open Forest	-	Good	0.10	0.10
Exotic	Exotic Riparian Vegetation	-	Poor	1.17	1.17
Unknown	Un-Surveyed Wooded Vegetation	-	Unknown	9.44	51.52
Indicative Vegetation Clearing Total				**312.29**	**433.81**

† = TEC listed under the EPBC Act

** = TEC listed under the NSW TSC Act*

To best reflect the impact on vegetation communities, indicative clearing calculations are presented as two separate components (minimum and maximum clearing scenarios) based on level of impact (refer to **Section 4.3**). The calculations provided account for estimated clearing for access tracks, structures and the proposed easement. No switching or substations have been included in the clearing calculations. All works for the existing switching or substations would be contained within the current footprint and the new Tenterfield 330kV Substation footprint is restricted to a modified cleared paddock (**Figure 7g**).

As mentioned in **Section 4.2.7** some areas within the proposed alignment and along access tracks were not accessible during field surveys due to private land owner access constraints and wet weather access issues. Consequently, there is an area of between 9 and 52 ha of wooded vegetation that remains unmapped, but that would potentially be impacted by the project.

It is likely that the clearing of vegetation with regards to the Project would have short-term and long-term impacts on threatened species and ecological communities. The level of impact would reflect the capacity of these species and communities to adapt, migrate/disperse and/or find suitable habitat in adjacent areas. Flora species or their habitat would be impacted in various ways dependant on the species responses to disturbances such as intermittent clearing for maintenance.

6 Biodiversity Impact Assessment

Flora impacts include, but are not restricted to:

- fragmentation;
- species habitat loss; and
- physical and genetic isolation.

The removal of vegetation classified as a TEC is likely to have a negative impact on the overall occurrence of these communities on a local, regional and national scale. However, the extent of the impact would be reduced by implementing reduced clearing in areas where there are TECs. However, final impacts would depend on the condition, size and connection of the community with other ecological communities. The impact of clearing native vegetation on TECs within the area is considered within the AOS/SICs in **Appendices I** and **J**.

In general the Project is not likely to have a significant impact on TECs within alignment east and associated access tracks because the existing transmission line and tracks already fragment these communities. TECs within alignment east typically occur as fragmented patches of degraded forests and woodlands bordered by cleared farm land (**Section 5.2.1**). The main impact of the Project on TECs in alignment east is an increase in edge effects, primarily weed invasion.

In contrast the Project is considered likely to have a significant impact on TECs within alignment west. TECs within alignment west typically occur as continuous patches of vegetation that have previously been cleared for grazing but are showing substantial regeneration. The largest impacts would be on the following TECs:

- Box Gum Woodland; and
- Natural Grasslands.

For fauna species, the degree of short term impacts would depend upon the extent of clearing and the ability, or inability, of individuals to migrate to alternative suitable local habitats. More importantly the clearing of habitat resources along with vegetation is likely to have a greater long-term impact on locally occurring threatened fauna. The loss of habitat resources such as hollow bearing trees, rocks, and fallen timber can have a compounding effect on the lifecycle of current and future populations that are dependant on such resources for survival. The impacts of clearing of native vegetation and associated habitat loss are considered for threatened flora and fauna species predicted or known to occur within the alignment in detail in **Appendix J**.

These clearing related impacts have been considered throughout the assessment process using the principle of avoid, mitigate and offset. Avoidance was the first priority, during the route selection stage of the Project (URS 2009) All attempts were made to select an alignment that avoided TECs and threatened species habitat as much as possible as well as common vegetation communities, particularly in areas with the greatest connectivity at a landscape level. Any clearing impacts that could not be avoided would be mitigated with ameliorative measures (**Section 7**) and/or offset, if the biodiversity values of affected areas cannot be maintained or improved through these measures.

No threat abatement plans have been prepared for KTPs. However 21 recovery strategies have been recommended under the TSC Act, one of which relates to the Project: ‘investigate opportunities for management agreements with Public Authorities’ (DECCW, 2009b).

The Project is likely to directly influence and augment this KTP given the aforementioned biodiversity impacts.

Bushrock removal

Bushrock removal is the removal of natural surface deposits of rock from rock outcrops or areas of native vegetation. Bushrock provides an important habitat, refuge, and nesting sites for a number of threatened and other flora and fauna species (DECCW, 2009a).

Threatened species that are listed under the TSC Act and EPBC Act that are known or predicted to occur within alignment and study area, and that are adversely affected by bush rock removal are:

- Spotted-tailed Quoll;
- Border Thick-tailed Gecko; and
- *Boronia granitica.*

The Project would require the removal of bush rock for construction of the transmission line. In particular the installation of structures and access tracks would require complete clearing to ground level. Removal of bush rock would be determined on a case by case basis depending on the vegetation, terrain, and soils. Significant amounts of bush rock are found in Grassy Woodland, Semi-Arid Woodlands, and Dry Sclerophyll Forest (shrub/grass) formations in across the project area.

No threat abatement plans have been prepared for this KTP under the TSC Act. However a number of threat abatement priorities have been listed. Of these there is only one relevant to the Project: *'in consultation with industry groups and other public authorities, investigate options for reducing the impact of bushrock removal on biodiversity through incentive schemes, regulation and/or the development of codes of practice'* (DECCW, 2009a).

The Project is likely to directly influence and augment this KTP given the aforementioned biodiversity impacts.

Competition and grazing by the feral European rabbit

Rabbits (*Oryctoagus cuniculus*) have established populations all across southern Australia occupying approximately 4.5 million km^2 (DECCW, 2009c). Grazing and burrowing rabbits have potential to cause major erosion problems, reduce recruitment and survival rate of native plants and alter entire landscapes. The impact of rabbits across Australia threatens the survival of a number of threatened flora and fauna listed under both the TSC Act and EPBC Act.

The Project would require the establishment and maintenance of a 60-90m easement from Dumaresq Switching Station to Lismore Substation. The maintenance of this easement would promote the establishment of an artificial grassland providing additional habitat for rabbits and potentially increasing population numbers within the region.

A threat abatement plan for competition and land degradation by rabbits has been prepared under the EPBC Act. Only one objective is relevant to the Project; *'Promote the maintenance and recovery of native species and ecological communities that are affected by rabbit competition and land degradation'* (DEWHA, 2008a). Eleven priority threat abatement strategies have been identified under the TSC Act; none of these are relevant to the Project.

The Project is likely to augment this KTP given the aforementioned biodiversity impacts.

Ecological consequences of high frequency fires

The long-term survival of flora and fauna as a result of repeated fire is dependant on the species ability to maintain life cycle processes and the maintenance of vegetation structure over time as habitat for fauna species. High intensity, frequent fires have the ability to interrupt life cycle processes and alter vegetation structure (DECCW, 2009n). Threatened species predicted or known to occur within alignment and study area that are directly threatened by fire regimes include:

- *Acacia macnuttiana;*
- *Almaleea cambagei;*
- *Boronia granitica;*
- *Boronia repandra;*
- *Calitris oblonga;*
- *Eucalyptus nicholii;*
- *Grevillea beadleana;*
- *Homaranthus lunatus;*
- Eastern Bristlebird;
- Rufus Bettong;
- Spotted-tailed Quoll;
- Squirrel Glider.
- White-crowned Snake (*Cacophis harriettae*);
- Three-toed Snake-tooth Skink (*Coeranoscincus reticulates*);
- Pale-headed Snake (*Hoplocephalus bitorquatus*); and
- Stephens' Banded Snake (*Hoplocephalus stephensii*).

Construction and maintenance of the Project has the potential to impact on local fire regimes in two main ways. Establishment of the proposed easement would act as a fire break, potentially limiting the extent of ground fires and some crown fires. Construction and maintenance of the proposed line also has the potential to increase fire frequency. During the construction and maintenance phase fire hazards may be caused by the following components:

- fuel storage on site for plant equipment;
- fuel contained within plant equipment and other vehicles;
- fuel contained within hand operated equipment (e.g. chainsaw)
- stump grinding;
- slashing and mulching;
- cigarette butts left from smokers; and
- vehicles traversing long, dry grass.

During the operational phase, fire hazards may be caused by electrical sparks from a conductor or the earth wire could ignite vegetation should it contact the transmission line.

The NSW Rural Fire Service developed a ‘Planning for Bushfire Protection’ report (2001) and an amended report in 2006 to assist councils, developers and planners to reduce the potential of fire risks/hazards during planning, construction and operational work phases of new developments. Some of the most relevant recommendations that are outlined in this report include:

- fire protection zones (asset protection zones);
- isolation zones for fuel storage; and

- preliminary consideration of construction and design in fire-prone areas (e.g. bushland) so that new infrastructure is only located in an area that is separated a minimum distance from the edge of vegetation.

TransGrid has developed a Bush Fire Risk Management Plan (FMP) and it is included as Chapter 4 of their Network Management Plan 2009-2014 (www.transgrid.com.au). The FMP lists numerous strategies and measures to minimise fire risks.

A detailed bush fire assessment has been prepared for the Project and is presented in **Chapter 16** of the EA.

There is currently no threat abatement plan prepared for this KTP under the TSC Act. Seven priority abatement actions have been identified, none of which are relevant to the Project (DECCW 2009n).

The Project may exacerbate fire frequency within the study area as such the Project is likely to augment this KTP.

Human-caused Climate Change

There is evidence that modification of the environment by humans may result in future climate change (NSW Scientific Committee 2009). Human induced activities as a result of energy use, industrial processes, solvent and other product use, agriculture, land use change and forestry, and waste cause greenhouse gas emissions (DECCW, 2009p). Such anthropogenic change to climate may occur at a faster rate than has previously occurred naturally. Climate change may involve both changes in average conditions and changes to the frequency of occurrence of extreme events (NSW Scientific Committee 2009). Projections of future changes in climate in NSW include increasing temperatures and temperature extremes, increasingly severe droughts, rising sea levels, possible decreasing rainfall, regional flooding and reduced water availability in the Murray-Darling Basin (DECCW, 2010b).

The distribution of most species, populations and communities is determined by climate and many species would be adversely affected unless populations were able to move across the landscape (DECCW, 2009p). Additionally, the risk of fire may increase in some areas as the climate changes and decrease in others, with consequent changes to the species composition and structure of ecological communities (DECCW, 2009p). The response of organisms to future climate change (however caused) is likely to differ from that in the past because it will occur in a highly modified landscape in which the distribution of natural communities is highly modified (NSW Scientific Committee, 2009).

The Project would contribute to the release of greenhouse gases into the atmosphere through the operation of mobile plant and transport vehicles and through clearance of vegetation, for a full investigation of the potential impacts of Project please refer to **Chapter 15 Air Quality**. A maximum amount of approximately 382ha of native vegetation would be removed as part of the Project. The clearing of this vegetation will diminish the carbon uptake and storage function of the area. In addition, as vegetation is cleared, it would release greenhouse gases into the atmosphere as it decays. Habitat fragmentation would also be increased in some areas as a result of this vegetation clearing.

The Project has the potential to result in a slight increase to this KTP through an increase in habitat fragmentation and through clearing of vegetation. However, given the existing fragmentation throughout the region, and provided recommended mitigation measures are adopted, it is considered unlikely that the Project would result in a significant increase to this KTP in the region.

Additionally, increased energy efficiency is discussed in **Chapter 15, Air Quality**, **Section 15.2.3**, of the **EA**. The Project is considered likely to increase the overall energy efficiency of electricity transfer within the relevant regions and a number of mitigation measures as well as an offset package have been stipulated to ameliorate Project impacts relating to vegetation clearing loss (**Section 7.2.1** and **7.3.3**).

The Project may augment this KTP given the aforementioned biodiversity impacts.

Invasion and establishment of exotic vines and scramblers

A number of exotic vines and scrambler have become established in NSW and are having a significant adverse effect on biodiversity. They smother native vegetation and seedlings, preventing recruitment, especially in riparian areas (DECCW, 2009e). A number of threatened species known or predicted to occur within alignment are threatened by the establishment of exotic vines and scramblers, these are:

- Davidsonia jerseyana;
- Davidsonia johnstonii;
- Desmodium acanthocladum;
- Diploglottis campbelli;
- *Gossia (Austromytrus) fragrantissima;*
- *Isoglossa eranthemoides;*
- *Tinospora tinosporides; and*
- Golden-tipped bat (*Kerivoula papuensis*).

Construction and maintenance of the Project has the potential to increase the spread and establishment of exotic vines and scrambles due to disturbance and spread of seeds. The transmission line would require the removal of native vegetation facilitating the establishment of fast growing, competitive exotic species. Where exotic vines and scramblers are already present within the alignment there is potential for these species to be spread via construction vehicles and natural dispersal into cleared areas.

There is currently no threat abatement plan for this KTP prepared under the TSC Act. However there are a number of threat abatement strategies that have been listed, none of these are relevant to the Project.

The Project is likely to directly influence and augment this KTP given the aforementioned biodiversity impacts.

Infection of frogs by amphibian chytrid causing the disease chytridiomycosis

Chtridiomycosis is a fatal disease of amphibians and is caused by the chytrid *Batrachochytrium dendrobatidis*. The disease has the potential to be fatal for all native species of amphibian. The pathogen is water borne and therefore stream-associated species and high altitude species are most at risk. The Giant Barred Frog is predicted to occur within alignment and study area and is assumed to be threatened by chytridiomycosis (DECCW, 2009f).

The Project has the potential to increase the spread of chytridiomycosis through the movement of vehicles and staff across waterway sand broader catchment areas.

A threat abatement plan for this KTP has been developed under the EPBC Act (DEWHA 2006). Five objectives have been identified in the plan, one of which relates to the Project*; 'Prevention of pathogen spread*'. In addition to this, six priority actions have been identified under the TSC Act, none of these are relevant to the Project (DECCW 2009f).

The Project has the potential to augment this KTP given the aforementioned biodiversity impacts.

6 Biodiversity Impact Assessment

Infection of native plants by Phytophthora cinnamomi

Phytophthora cinnamomi is a soil borne pathogen that spreads in plant roots in warm, moist conditions. It infects a large range of species, resulting in reduced growth rates or death (DECCW, 2009g).

Phytophthora cinnamomi does not directly impact any threatened or common species known or predicted to occur within alignment and study area. There is, however the potential for the Project to increase the spread of the pathogen through movement of construction vehicles given that there are several areas of vegetation known to have *P. cinnamomi* infestations in close proximity to the project area.

Two threatened species known or predicted to occur within alignment and study area are growing in the vicinity of known *P. cinnamomi* infestations. These species may be adversely affected by *P. cinnamomi* either because of direct infestation or degradation of habitat. These species include: *Hibbertia marginata* and *Leucopogon confertus.* The likely impacts to these species are discussed in the assessment of significance for each (**Appendix I**).

A threat abatement plan has been prepared under the EPBC Act (EA, 2001) for *Phytophthora cinnamomi*. Five objectives have been identified in the plan. None of these are relevant to the Project. Twenty key abatement priorities have been identified under the TSC Act (DECCW, 2009g and 2008a), of these one relates to the Project: managing the spread of *P. cinnamomi* by humans. A Weed Management Plan would be developed as part of the CEMP and would include specific measures for the minimisation, management, mitigation and monitoring of noxious/ environmental weeds within all work areas, including the easement (**Section 7**).

The Project has the potential to augment this KTP given the aforementioned biodiversity impacts.

Invasion of native plant communities by exotic perennial grasses

Exotic perennial grasses are those that are not native to NSW and have a life-span of more than one growing season. More than a hundred species of exotic perennial grasses occur in NSW (DECCW, 2009o). Exotic grasses grow vigorously often forming a complete monoculture replacing native grasses and wildflower species. They have the ability to tolerate heavy drought, grazing and many herbicides (DECCW, 2009o).

Within the alignment and along access tracks the TEC White Box, Yellow Box, Blakely's Red Gum woodland, which has a range of associated grasses as understorey, is threatened by invasion by exotic perennial grasses.

Construction and maintenance of the Project has the potential to increase the spread of exotic perennial grasses through the movement of vehicles in and out of affected areas.

No threat abatement plan has been prepared for this KTP under the TSC Act. However eleven abatement strategies have been identified. None of these actions relate to the Project (DECCW, 2009).

The Project is likely to directly influence and augment this KTP given the aforementioned biodiversity impacts.

6 Biodiversity Impact Assessment

Invasion, establishment and spread of Lantana

Lantana is in invasive weed that forms thickets of dense vegetation outcompeting native species and preventing recruitment (DECCW, 2009h). Lantana invades disturbed sites and communities including edges and canopy breaks in dense forest communities. A number of threatened species and communities listed under the TSC and EPBC Acts that are known or predicted to occur within alignment are considered threatened by the spread of *Lantana* include:

Flora

- *Bosistoa selwynii;*
- *Bosistoa transversa;*
- *Davidsonia johnstonii;*
- *Desmodium acanthocladum;*
- *Callistemon linearifolius;*
- *Endiandra hayesii;*
- *Eucalyptus caleyi subsp. ovendenii*
- *Eucalyptus glaucina;*
- *Belvisia mucronata;*
- *Isoglossa eranthemoides;*
- *Arthraxon hispidus;*
- *Marsdenia longiloba;*
- *Dichanthium setos*
- *Ochrosia moorei;*
- *Lepidium peregrinum;*
- *Owenia cepiodora;*
- *Oldenlandia galioides;*
- *Phyllanthus microcladus;*
- *Polygala linariifolia;*
- *Plectranthus nitidus;*
- *Rotala tripartite;*
- *Rhynchosia acuminatissima;*
- *Thesium australe;*
- *Senna acclinis;*
- *Phyllanthus microcladus;*
- *Sophora fraseri;*
- *Triplarina imbricate;*
- *Tinospora tinosporoides;*
- *Niemeyera whitei;*
- *Corchorus cunninghamii;*
- *Endiandra hayesii;*
- *Macadamia tetraphylla; and*
- *Owenia cepiodora.*

Fauna

- Eastern Bristle Bird.

Thratened Ecological Community

- Swamp Sclerophyll Forest on Coastal Floodplains TEC.

The Project has the potential to increase the spread and establishment of Lantana during construction and maintenance of the line through the movement of personnel and vehicles through infected areas.

No threat abatement plan has been prepared. However 12 priority abatement actions have been identified under the TSC Act. None of these are relevant to the Project.

The Project is likely to directly influence and augment this KTP given the aforementioned biodivesity impacts.

Loss and/or degradation of sites used for hill-topping by butterflies

Hill-topping is the behaviour in butterflies that can facilitate meeting of the sexes, with hill-tops being a focal mating point for some species.

According to NSW Scientific Committee for DECCW (2001):

6 Biodiversity Impact Assessment

"Hill-tops act as a focus for mating. Many butterfly species, especially in the families Hesperiidae, Papilionidae and Lycaenidae appear to be obligatory hill-toppers and tend to congregate on hill or ridge tops that are usually higher than the surrounding countryside. The nature of the sites varies and a site may be as small as a few square metres or may cover several hectares, or display minor or very marked topographic relief. The same sites are used year after year, whilst apparently similar nearby sites may not be used. Sites do not necessarily provide nectar food sources for the butterflies nor food plants for the next generation of caterpillars. Hill-top aggregations are essential for continuity of the reproductive cycle of some butterfly species, and hill-top sites may constitute vital focal points for such aggregations. The importance of hill-topping sites is out of proportion to their extent, so that a small area can be vital to the survival of species over a larger area (Smithers 1996). Hill-topping is often found in species which seasonally or habitually have low density populations and which have a greater need to facilitate male - female encounters, such as in the drier areas of NSW."

No hill-topping sites were identified during field surveys within the project area and no known sites occur within the footprint.

Given the seasonality and unknown qualities of these sites it cannot be assumed that these areas do not occur. Therefore using a precautionary approach, given that the Project would involve temporary and permanent clearing (along ridge tops and hills) there is potential for the loss of hill-topping sites for butterflies' within the Project area.

A threat abatement plan has not been prepared under the TSC Act. Seven priority abatement actions have been identified and one of these is relevant to the Project; 'Seek secure protection for key hill-topping sites' (DECCW 2009i).

The Project has the potential to impact this KTP.

Loss of hollow bearing trees

Tree hollows are cavities formed in the trunk or branches of a living or dead tree. Hollows occur primarily in old eucalyptus trees, the presence and size of hollows is directly correlated with tree trunk diameter. Hollows are used by a range of vertebrates and invertebrate species for different lifecycle stages and are considered to be a limiting factor for population growth in a number of threatened species. Most species that rely on hollows are highly selective and only use hollows of a particular diameter, aspect and shape. A number of threatened bird and arboreal mammal species that are known or predicted to occur within the alignment and study area; are dependant on hollows for critical lifecycle stages. These include, but are not restricted too:

- Brown Treecreeper;
- Little Lorikeet;
- Turquoise Parrot;
- Masked Owl;
- Eastern False Pipistrelle;
- Hoary Wattled Bat;
- Brush-tailed phascogale;
- Squirrel Glider;
- Glossy Black Cockatoo;
- Superb Parrot;
- Barking Owl;
- Powerful Owl;
- Eastern Freetail-bat;
- Little Bentwing-bat;
- Spotted-tailed Quoll; and
- Yellow-bellied Glider.

The Project would require the removal of native vegetation that would include some areas of hollow bearing trees.

No threat abatement plan has been prepared for the KTP. However, six priority actions have been identified under the TSC Act. None of these are relevant to the Project.

6 Biodiversity Impact Assessment

The Project is likely to directly influence and augment this KTP given the aforementioned biodiversity impacts.

Predation by feral cats

The feral cat is a common but elusive predator and occurs throughout Australia. Several threatened species that are predicted or known to occur within alignment are vulnerable to predation by feral cats. Species most vulnerable to predation by feral cats are birds and mammals within the critical weight range of 450-500g (DECCW, 2009k).

The establishment of the proposed easement has the potential to increase both the movement of feral cats through the landscape and cat predation rates. Cats are known to travel and hunt on vegetation boundaries such as transmission lines, urban interfaces and access tracks.

A threat abatement plan for this KTP has been prepared under the EPBC Act (DEWHA, 2008k). Four objectives have been identified in the plan and one of these is relevant to the Project; ‘promote the maintenance and recovery of native species and ecological communities that are affected by feral cat predation’ (DEWHA, 2008b). Eleven key abatement actions have been identified under the TSC Act. None of these are relevant to the proposed development.

The Project has the potential to indirectly augment this KTP given the aforementioned biodiversity impacts.

Predation by the European red fox

Since their introduction into Australia foxes have contributed to severe declines and extinctions of a suite of native fauna species, particularly among medium size ground dwelling and arboreal mammals and birds (DECCW, 2009l). There are a number of threatened bird and mammal species known or predicted to occur within the Project that are threatened by fox predation.

The establishment of the proposed easement has the potential to increase the movement of foxes through the landscape. Foxes are known to travel and hunt vegetation boundaries, and therefore are found in conjunction with transmission lines, urban interfaces and access tracks.

Threat abatement plans have been prepared for this KTP under both the TSC Act and EPBC Act. One objective is relevant from both plans to the Project: ‘promote the maintenance and recovery of native species and ecological communities that are affected by fox predation’.

The Project has the potential to indirectly augment this KTP given the aforementioned biodiversity impacts.

Removal of dead wood and dead trees

The removal of dead wood and dead trees includes the removal of forest and woodland waste after timber harvesting, collecting fallen timber for firewood, burning on site, mulching on site, the removal of fallen branches and litter as general tidy up and the removal of standing dead trees (DECCW, 2009m)

6 Biodiversity Impact Assessment

Dead wood and dead trees provide habitat for a wide variety of native animals and are important to the functioning of many ecosystems. The removal of dead wood can have a range of environmental consequences, including the loss of habitat and disruption of ecosystem processes and soil erosion (DECCW, 2009m). A number of threatened fauna that are known or predicted to occur within alignment and study area are threatened by the removal of dead wood, these include:

- Brown Treecreeper;
- Glossy Black Cockatoo;
- Little Lorikeet;
- Superb Parrot;
- Turquoise Parrot;
- Barking Owl;
- Masked Owl;
- Powerful Owl;
- Eastern False Pipistrelle;
- Eastern Freetail-bat;
- Hoary Wattled Bat
- Little Bentwing-bat;
- Brush-tailed phascogale;
- Spotted-tailed Quoll;
- Squirrel Glider; and
- Yellow-bellied Glider.

The Project would include the removal of dead standing trees to meet clearing requirements along a 205km easement, some of which requires establishment, and some of which involves the widening of an existing easement (**Appendix C, TransGrid Policies, Volume 2 EA**). Dead wood and timber can be placed adjacent to alignment following removal, reducing the loss of habitat provided by dead wood and trees (see **Section 7**). All dead wood and timber would need to be placed in adjacent vegetation in accordance with the coarse woody debris (CWD) management plan that would be developed by DECCW.

No threat abatement plan has been prepared for this KTP. However, DECCW has identified ten priority actions to abate the threat, of these however none relate to the Project (DECCW, 2009m).

The Project is likely to directly influence and augment this KTP given the aforementioned Project impacts.

Competition and habitat degradation by feral goats;

Feral goats are found across approximately 2 million square kilometres of mainland Australia and some offshore islands. Their impacts include a reduction in ground cover, an increase in the amount of bare ground, loss of soil nutrients and increased soil erosion (DEWHA, 2008d). These impacts can result in an overall degradation of habitat quality, especially where higher densities of goats are present.

Threatened species predicted or known to occur within the alignment and study area that are potentially threatened by competition and habitat degradation by feral goats include the Border Thick-tailed Gecko (*Underwoodisaurus sphyrurus*).

No threat abatement plan has been prepared for feral goats. However 12 threat abatement strategies have been identified under the TSC Act. None of these are relevant to the Project.

Given the current presence of feral goats in the alignment and study area, the Project is unlikely to augment this KTP.

Competition from feral honeybees;

Feral honeybees are introduced bees, *Apis mellifera*, which originally escaped from hives and have subsequently established in the wild, usually occupying tree hollows. They can impact on native fauna through competition for food (nectar, pollen) and nesting and roosting resources (tree hollows) (DEC, 2005a).

Threatened species predicted or known to occur within the alignment and study area that are potentially directly threatened by competition from feral honeybees include:

- Brush-tailed Phascogale;
- Squirrel Glider;
- Yellow-bellied Glider; and
- Glossy Black Cockatoo

No threat abatement plan has been prepared for feral honeybees. However 4 threat abatement strategies have been identified under the TSC Act. None of these are relevant to the Project.

The Project is unlikely to directly influence and augment this KTP given that feral honeybees are likely to be currently present within the alignment and study areas.

Invasion and establishment of Scotch Broom

Scotch broom (*Cytisus scoparius*) is a large shrub with bright yellow flowers. It occurs mainly in cool temperate regions, at high altitudes or along the edges of watercourses. It forms dense thickets that exclude native species, leading to its complete dominance of the understorey and eventually the canopy. These thickets also impede access, alter fire regimes and dominate the landscape (DECCW, 2008c). Thickets of Scotch broom also provide habitat for rabbits, foxes and feral pigs (DEC, 2005a).

A variety of threatened flora species predicted or known to occur within the alignment and study area may be directly threatened by competition from Scotch broom.

Construction and maintenance of the Project has the potential to increase the spread and establishment of exotic weeds due to disturbance and spread of seeds. The transmission line would require the removal of native vegetation with the potential to facilitate the establishment of fast growing, competitive exotic species. Where Scotch broom is already present within the alignment there is potential for this species to be spread via construction vehicles and natural dispersal into cleared areas.

No threat abatement plan has been prepared for Scotch broom. No threat abatement strategies have been developed for Scotch broom.

The Project has the potential to result in further spread of Scotch Broom.

Invasion and establishment of the Cane Toad;

Cane Toads (*Rhinella marina*) are large introduced ground-dwelling amphibians with a dry warty skin. The Cane Toad now occurs in Queensland, Northern Territory and New South Wales. Cane Toads eat a wide variety of prey, breed opportunistically and have a far greater fecundity than native anurans. Adult Cane Toads feed on a broad variety of small prey items including ground-dwelling arthropods, insects, frogs, small reptiles, mammals and birds. Cane Toads also have the potential to compete with native species for food and shelter. As all stages of the Cane Toad's lifecycle are poisonous, predators are susceptible to death by toxic ingestion (DSEWPC, 2010).

Threatened species predicted or known to occur within the alignment and study area that are potentially directly threatened by Cane Toads include:

- Peppered Tree Frog *(Litoria piperata)*;
- Stuttering Frog *(Mixophyes balbus)*;
- Giant Barred Frog *(Mixophyes iterates)*; and
- Spotted-tail Quoll *(Dasyurus maculatus maculates)*.

Construction and maintenance of the Project has the potential to increase the spread of Cane Toads by facilitating movement.

No threat abatement plan has been prepared. However 8 threat abatement strategies have been identified under the TSC Act. None of these are relevant to the Project.

The Project is likely to directly influence and augment this KTP given the aforementioned biodiversity impacts.

Predation and hybridisation of feral dogs;

Domestic Dogs (*Canis lupus familiaris*) first became feral in Australian ecosystems soon after the arrival of Europeans. Domestic Dogs can exert a high intensity of predation pressure on native fauna, especially medium to large macropods. The Dingo taxon is under serious decline as a consequence of hybridisation which may lead or has already led to the Dingo becoming threatened (DECCW, 2009p).

Threatened species predicted or known to occur within the alignment and study area that are potentially directly threatened by Domestic Dog predation include:

- Spotted-tailed Quoll (*Dasyurus maculatus maculatus*); and
- Koala (*Phascolarctos cinereus*).

Construction and maintenance of the Project has the potential to facilitate movement of feral dogs through the landscape.

No threat abatement plan has been prepared for feral dogs. No threat abatement strategies have been developed for feral dogs.

The Project is likely to directly influence and augment this KTP given the aforementioned biodiversity impacts.

Predation by the plague minnow;

Gambusia holbrooki (Plague Minnow), is a small freshwater fish originally introduced into Australia in the 1920s as an aquarium fish. After release into creeks around Sydney, *Gambusia holbrooki* became widespread in NSW. It is an aggressive and voracious predator of native fauna, particularly threatened frogs (DEC, 2005b).

Threatened species predicted or known to occur within the alignment and study area that are potentially directly threatened by the plague minnow include

- *Mogurnda adspersa;*
- *Ambassis agassizii;*
- *Maccullochella peelii peelii;*
- *Litoria piperata;*
- *Mixophyes balbus; and*
- *Mixophyes iteratus.*

Construction and maintenance of the Project has low potential to facilitate the spread of *Gambusia holbrooki.*

No threat abatement plan has been prepared. However 9 threat abatement strategies have been identified under the TSC Act. None of these are relevant to the Project.

The Project is unlikely to directly influence and augment this KTP.

Predation, habitat degradation, competition and disease transmission by feral pigs;

Feral pigs originated from domestic stock brought to Australia by the early European settlers. Feral pigs cause severe environmental degradation by:

- feeding selectively on plant communities;
- creating drainage channels in swamps;
- eroding soil and fouling watering points with their wallowing;
- eating frogs, reptiles, birds and small mammals; and
- spreading weeds and possibly disease (DECCW, 2008d).

Threatened species predicted or known to occur within the alignment and study area that are potentially directly threatened by the feral pig include:

- *Amaurornis olivaceus*; and
- *Turnix maculosa*.

Construction and maintenance of the Project has the potential to facilitate movement of Feral Pigs through the landscape.

No threat abatement plan has been prepared. However 11 threat abatement strategies have been identified under the TSC Act. None of these are relevant to the Project.

The Project is likely to directly influence and augment this KTP given the aforementioned biodiversity impacts.

Invasion of native plant communities by African Olive.

African Olive (*Olea europaea* subsp. *cuspidata*) is an introduced shrub or branched tree to about 12 m high. It is spread by bird-dispersed seed and vegetatively by cuttings and pieces. It is commonly found in roadsides, neglected land and on stream banks (Weeds Australia, nd).

Threatened Ecological Communities predicted or known to occur within the alignment and study area that are potentially directly threatened by the African Olive include:

- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast; Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest);
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland); and
- Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (Sub-tropical Coastal Floodplain Forest).

Construction and maintenance of the Project has the potential to increase the spread and establishment of exotic weeds due to disturbance and spread of seeds.

No threat abatement plan has been prepared for African Olive. No threat abatement strategies are currently able to be viewed.

The Project is unlikely to directly influence and augment this KTP.

6.1.8 Other Biodiversity Impacts

There are a number of impacts that the proposed development would have on local biodiversity that are not listed as threatening processes under State or Commonwealth legislation. These are discussed below.

Other Direct Impacts

The Project has the potential to cause one other direct impact; habitat fragmentation.

Habitat Fragmentation

Habitat corridors provide essential pathways for the movement of native flora and fauna. They play an important role in ensuring the long term genetic viability of species. Vegetation within the region is connected by significant north south vegetation corridors (**Figure 11**). There are large areas of remnant vegetation crossing the ranges in both Alignment West and East. Vegetated areas are found on private and public lands and create extensive vegetation corridors as they connect to national parks, wilderness areas and state forests within the region (**Figure 11**). Within recent years more than 25 landholders in the bioregion have entered in to voluntary conservation agreements, significantly increasing the area of protected vegetation and habitat connectivity (DECC, 2008).

There are large areas of protected native vegetation within the region in the form of national parks, state forests and wilderness areas (**Figure 11**). These include:

- Hogarth Range National Park;
- Mallanganee National Park and World Heritage Area;
- Richmond Range National Park;
- Cherry Tree and Cherry Tree West State Forest;
- Sugar Loaf State Forest;
- Bonalbo State Forest;
- Girard State Forest;
- Boonoo and Boorook State Forest;
- Basket Swamp National Park;
- Bald Rock National Park and Wilderness Area;
- Donny Brook State Forest and National Park;
- Cambridge Plateau Conservation Reserve;
- Gibraltar National Park; and
- Torrington National Park and Wilderness Area.

The areas listed above combine to provide significant habitat for flora and fauna species within northern NSW. The Project is being constructed in one of the most diverse regions in NSW, with many species represented within the alignment and study area occurring at the limits of their distribution (NPWS Northern Rivers Region, 2005).

On a regional scale these reserves, parks, forests and wilderness areas provide important linkages between vegetation communities from the coast, through the ranges and onto the western plains and from the northern tablelands to the north west slopes and plains (NPWS 2003, 2002).

6 Biodiversity Impact Assessment

The importance of vegetation across the ranges within Study Area East has been recognised with the establishment of the Eastern Ranges Initiative by the State government. The initiative is a collaborative program focused on the 1,200km NSW section of the great eastern ranges and includes land that is already fragmented by major roads and existing transmission lines. The key focus of the program is to support wise, effective management of native vegetation to improve environmental health. The initiative is supporting biodiversity by restoring and improving conservation and management of vegetation across all types of land use to provide the best available opportunities for species to move and adapt as the climate changes (Great Eastern Ranges, 2009).

The Project would impact habitat connectivity differently in Study Area East and West. The Study Area West works would require the establishment of the proposed easement through farmland and vegetation corridors (**Figure 7**). In Study Area East, works that would impact habitat connectivity are restricted to widening the existing 132kV, 45m easement to a 60m easement and clearing an additional 45m easement to create a 90m easement from Casino to Lismore.

The establishment of the proposed easement in Study Area West has the potential to significantly fragment habitat for a number of threatened and common species. Therefore throughout the initial "Scoping Project Surveys" wherever possible, placement of the transmission line in Study Area West has avoided fragmenting significant vegetation corridors (**Figure 11a**). The Great Eastern Ranges (2009) corridor identified by DECCW relevant to broader Study Area East is illustrated in **Figure 11b**. There are three other main vegetation corridors in Study Area West that would be fragmented by the Project. These are shown as areas A, B and C in **Figure 11a**. Study Area West corridors were identified using aerial satellite imagery. These areas are described below:

Area A: This section of the line would contribute to habitat fragmentation of lightly wooded corridors for 1.5km that connect areas of privately owned vegetation to Donnybrook State Forest. This vegetation is already fragmented by the dual carriage way Bruxner Highway 1.5km to the north.
Area B: This section of the line would contribute to habitat fragmentation of heavily wooded forests and woodland for 5km in privately owned land that connects to state forest and wilderness area to the north. This area is currently only slightly fragmented by farm tracks.
Area C: This section of the line would fragment lightly wooded vegetation corridors running south east/north west around the Mole River region for 1.5km. The vegetation in this area is currently only lightly fragmented by dirt roads and farm tracks.

The proposed widening of the existing easement in Study Area East is not considered to have a significant impact on vegetation connectivity within the region. Regional vegetation corridors that the existing transmission line passes through are already fragmented by roads and the transmission line. Widening the existing transmission line easement by 15m (7.5m either side) and establishment of a new 90m easement in degraded farm land between Casino and Lismore is not considered to significantly impact on the dispersal of most flora and fauna species within the region. However, there is potential for the alignment widening to impact on the dispersal of a few specialist fauna species including gliders, and increase the predation rate on species such as koalas, that would cross the easement on the ground, exposing them to predation by feral dogs, foxes and cats.

The Project has the potential to significantly increase habitat fragmentation within Study Area West and further restrict movement for a few specialist species in Study Area East. Mitigation measures to reduce and address this impact are provided in **Section 7**.

6 Biodiversity Impact Assessment

Indirect impacts

An indirect impact in relation to a development is defined as:

"A physical change in the environment may occur…which is not immediately related to the Project, but which is caused indirectly by the Project. If a direct physical change in the environment in turn causes another change in the environment, then the other change is an indirect change in the environment" (Oxford Reference Online, 2009).

Indirect impacts may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems (Oxford Reference Online, 2009).

Clearing of vegetation during construction of the Project would result in a number of secondary effects relating to edge effects, soil erosion, weed invasion and changes in surface runoff patterns. These impacts are discussed below.

Indirect impacts can be reduced through the application of mitigations measures pre, during and post works. These measures are discussed in **Section 7**.

Edge Effects

Edge effects are described as an ecological impact of two or more interfacing habitat types. Edge effects are inherent or natural in nature but can have negative impacts if they alter ecological processes. They also change habitat conditions (such as degree of humidity and exposure to light or wind) created at or near the boundary between areas, for example, between open areas and adjacent forest (Oxford Reference Online, 2009). In general, edge effects increase in relation to the dissimilarity between adjoining habitats.

Removal of vegetation induces edge effects, as it causes new environmental conditions to develop along the edges of cleared environments, in particular. The removal of vegetation generally promotes the invasion of exotic species and/or disturbance tolerant native plants. With the invasion of these new species, it often becomes difficult for native plant species to recolonise.

The clearing of vegetation may in turn promote the influx of pest species such as foxes or feral cats that use edges to stalk and ambush prey species. Native species such as owls also use edge environments for hunting.

In general, potential edge effects associated with transmission line easements can include the degradation of adjacent habitat through:

- changes in microclimate;
- changes in hydrology;
- changes in floristic composition and abundance;
- creation of new ecotones;
- alteration to the pattern and frequency of fire;
- invasion by exotic plant and animal species;
- increase in sedimentation;
- increase in tree dieback and impacts on root zone; and
- improved access for predators.

6 Biodiversity Impact Assessment

Edge effects vary between community types and abiotic effects are the most consistent indicator of edge effects, measuring less than or equal to 50m (Biosis, 2008) in most studies. For the purposes of this assessment it has been assumed that edge effects would occur in all vegetation formations up to 50m from the edge of the transmission line easement. **Table 6-8** shows the extent to which vegetation communities within the alignment would be impacted by edge effects using a 50m buffer. For the purposes of the calculating the edge effects, all communities with disturbed and/or regenerating vegetation patches within the study area, have been combined to form one community in **Table 6-8**.

Table 6-8 The Estimated Extent of Vegetation Communities within the Study Area that would be Impacted by Edge Effects

Vegetation Formation	Vegetation Community	Threatened Ecological Community	Area within the 50 m buffer (ha)
Dry Sclerophyll Forest (shrub/grass sub formation)	Dirty Gum-White Cypress Pine/Silver-leaved Ironbark Shrub/Grass open Forest (Intergrade)	-	13.85
	Forest Red Gum Grassy Open Forest	-	3.87
	Forest Red Gum/Broad-leaved Apple Dry Open Forest	-	15.30
	Forest Red Gum/Pink Bloodwood Open Forest	-	24.34
	Flood Gum/Grey Ironbark Tall Open Forest (Disturbed)		2.72
	Grey Gum/Grey Ironbark Open Forest	-	34.13
	Grey Ironbark/Grey Gum/New England Blackbutt Open Forest (Intergrade)	-	4.58
	Ironbark Wattle Woodland (Disturbed)	-	5.27
	Narrow-leaved Ironbark Open Forest	-	31.37
	New England Blackbutt Dry Heathy Open Forest on Granites	-	39.10
	New England Stringybark Open Forest	-	3.88
	New England Stringybark/Peppermint/Grey Ironbark/Grey Gum Open Forest (Intergrade)	-	20.36
	Spotted Gum/Grey Box /Grey Ironbark Open Forest	-	23.50
	Spotted Gum/Grey Ironbark Open Forest	-	11.11
	Spotted Gum/Grey Ironbark/Narrow-leaved Ironbark Open Forest	-	8.79
	Spotted Gum/Grey Ironbark/Pink Bloodwood Open Forest	-	87.53
	Spotted Gum/Grey Ironbark/Thin-leaved Stringybark Dry Open Forest	-	28.45
	Spotted Gum/Thin-leaved Stringybark/Pink Bloodwood Open Forest	-	19.42

6 Biodiversity Impact Assessment

Vegetation Formation	Vegetation Community	Threatened Ecological Community	Area within the 50 m buffer (ha)
Dry Sclerophyll Forest (shrubby sub formation)	Thin-leaved Stringybark/Broad-leaved Apple Open Forest	-	0.816
	Grey Box/Narrow-leaved Ironbark/White Cypress Pine Open Forest	-	3.80
	Tumbledown Gum/Blakely's Red Gum/Pine Shrubby Open Forest	-	83.62
Forested Wetland	Youman's Stringybark/Yellow Box/Blakely's Red Gum Woodland (Intergrade)	-	13.09
	River Red Gum Riverine Woodland	-	8.28
	River Oak Riparian Woodland	-	1.08
	Swamp Box Swamp Forest (Disturbed) #	Swamp Sclerophyll Forest	7.85
	Swamp Box/Swamp Mahogany Swamp Forest (Intergrade) #	Swamp Sclerophyll Forest	11.18
Grassy Woodland	Blakely's Red Gum/Rough Barked Apple/Red Stringybark Grassy Open Forest	-	1.37
	Blakely's Red Gum/White Box Grassy Woodland # ^	Box Gum Woodland	8.48
	Blakely's Red Gum/Grey Box Grassy Woodland (Disturbed)		0.83
	Blakely's Red Gum/Grey Box/Rough Barked Apple Grassy Woodland # ^	Box Gum Woodland	6.74
	Cabbage Gum Grassy Woodland	-	7.44
	Forest Red Gum/Swamp Box Open Forest#	Sub-tropical Coastal Floodplain Forest	49.04
	Inland Grey Box Tall Grassy Woodland (Disturbed)	-	23.23
	Rough-barked Apple riparian forb/grass Open Forest		0
	Fuzzy Box/Grey Box Grassy Woodland		1.53
	White Box Grassy Woodland # ^	Box Gum Woodland	105.53
Grasslands	Natural Grasslands on Basalt and Fine Alluvial Plains ^	Natural Grasslands	1.12
	Natural Grasslands on Basalt and Fine Textured Alluvial Soils & White Box Grassy Woodland ^	Natural Grasslands	4.71
Semi Arid Woodlands (shrubby sub formation)	Silver-leaved Ironbark/White Cypress Pine Woodland	-	154.43
	Dirty Gum Tall Open Forest	-	18.85
Wet Sclerophyll Forest	Messmate/Brown Barrel Grassy Open Forest	-	14.29
	Spotted Gum/Brush Box Moist Forest	-	0.99
	Sydney Blue Gum Open Forest	-	2.34
TOTAL			**908.21**

 # = TEC listed under the NSW TSC Act,^ = TEC Listed under the Commonwealth EPBC Act.

6 Biodiversity Impact Assessment

Changes in Drainage Patterns and Soil Erosion

Changes in drainage patterns or the natural flow regimes of rivers, streams, floodplains and wetlands are considered a KTP listed under Section 3 of the TSC Act. As such this indirect impact is discussed in detail in **Section 6.1.7**.

During the construction phase of the Project clearing of vegetation is likely to result in soil erosion and sedimentation of waterways if the exposed soils are not maintained with control measures such as matting.

A number of mitigation measures have been recommended to ameliorate this indirect impact (**Section 7**).

Changes in surface runoff

Surface runoff is described as:

"the water flow which occurs when soil is infiltrated to full capacity and excess water, from rain, snowmelt, or other sources flows over the land. This is a major component of the water cycle. When runoff flows along the ground, it can pick up soil contaminants such as petroleum, pesticides (in particular herbicides and insecticides), or fertilizers that become discharge or nonpoint source pollution" (Wikipedia Online definition, 2009).

It is expected that during the construction phase of the Project, the installation of structures, laydown sites for plant equipment and access tracks would require the removal of ground vegetation, soil and rocky outcrops. By removing these natural features it is expected that the natural surface runoff process in the alignment and easement may be temporarily or permanently altered. Natural features often influence the direction and flow of run-off.

In most cases, it is considered that the change in surface run-off would only be a temporary impact during the construction phase, as once works are completed it is expected that rock outcrops would be repositioned in their original location, ground vegetation would regenerate in most areas and top soil would be replaced.

7

Biodiversity Maintenance and Improvement

The following section identifies measures that prepare to avoid, mitigate and offset impacts on biodiversity values associated with the Project. This section has been structured according to the principals stated in DECC (2005) guidelines for Part 3A biodiversity assessments.

7.1 Impact Avoidance

Impacts on biodiversity have been avoided where possible, through the following means:

- a detailed route selection process was undertaken to identify and assess environmental constraints within the study area (*Constraints Identification and Preferred Corridor Report,* URS, 2009). The route selection process identified: ecological, heritage, visual, social, surface water and ground water, geology, soils and topography, so as to guide the final location of the Project to avoid impacting on these features;
- where ever possible, the Project has been located in cleared areas to avoid native vegetation and habitat, specifically to avoid threatened species, populations and ecological communities;
- where possible, at spans where topography allows (i.e. gullies and escarpments) vegetation would be retained where conductor height is sufficient to make clearing unnecessary;
- access track locations have been selected with consideration of minimising disturbance to vegetation and protected ecological features;
- where possible the alignment has been selected to cross drainage lines at right angles to minimise the need for riparian vegetation removal; and
- use of the existing easement within Study Area East reduces the clearing requirement for the Project by avoiding potential clearing requirements by seventy-five percent.

The alignment and associated easement was developed based on the constraints identified and the recommendations contained within the URS (2009) *Constraints Identification and Preferred Corridor Report* as well as ongoing discussions with property owners, community and stakeholders.

7.2 Impact Mitigation

A full description of the measures proposed to mitigate adverse effects of the Project on threatened species, populations and ecological communities is provided below. Most of these measures form part of threat abatement plans, recovery plans and priority actions recommended by DECCW and SEWPAC for threatened species, populations and ecological communities.

Table 7-1 outlines the commitments that would form part of the conditions of approval for the Project. **Section 7.2.2** includes more detailed measures to help guide the future production of the Flora and Fauna Management Plans within the CEMP.

7 Biodiversity Maintenance and Improvement

Table 7-1 TransGrid Statement of Commitments

Mitigation Measures and Commitment	Implementation			Location for Pre-Clearance Assessment
	Design	Construction	Operation	
Biodiversity - General				
An Environmental Management Representative would be appointed by TransGrid to oversee the implementation of mitigation measures and commitments.	✓			N/A
Biodiversity – Vegetation Clearing				
A suitably qualified ecologist/botanist will undertake targeted pre-clearance assessments for all structure locations and access tracks that are proposed to pass through areas of intact native vegetation, to identify site specific mitigation measures to be included in the CEMP. Wherever possible, access tracks would avoid TECs, EPBC listed communities, identified breeding habitat and populations of threatened flora.	✓	✓		Entire project area
A Flora Management Plan would be developed and included in the CEMP. The Flora Management Plan would identify measures and management protocols designed to assist in the avoidance and mitigation of impacts on flora as a result of vegetation clearing associated with the Project. Mitigation measures would be implemented to maximise the avoidance of threatened plants during clearing, to ensure the protection of local populations, to promote long-term connectivity of populations within the landscape and to control weed invasion where necessary.	✓	✓		N/A
In vegetated areas the extent of clearing required would be clearly demarcated. Flagging tape would be used during construction to identify the edge of the area to be cleared. The Flora Management Plan and the pre-clearance assessments would identify those areas to be demarcated and avoided.	✓	✓		Entire project area
Where practical, hollow bearing trees would be selectively retained. This would be assessed on a case by case basis as part of the pre-clearance assessments.	✓			Entire project area
With TECs listed under the TSC and EPBC Act, the construction footprint associated with access tracks and transmission line structures would be minimised as far as possible. Access tracks would occur at restricted points and would be located in areas with minimal canopy cover where practical. If ground cover removal is required, all top soils from the area would be stockpiled separately and re-established following completion of construction activities.	✓	✓	✓	N/A

7 Biodiversity Maintenance and Improvement

Mitigation Measures and Commitment	Implementation			Location for Pre-Clearance Assessment
	Design	Construction	Operation	
With TECs listed under the TSC and EPBC Act, and important threatened species habitat constrained clearing and maintenance practices (**Appendix C, TransGrid Policies, Volume 2, EA**) would be implemented wherever possible, taking into consideration TransGrid's clearance requirements (GD AS G3 015 'Principles for the Clearing of Transmission Line Easements'). Wherever possible, bands of understorey vegetation would be retained. Intact habitat features such as hollow logs would be placed in these bands of vegetation.	✓	✓	✓	N/A
Biodiversity - Weed Management				
Weed surveys, focusing on noxious weeds, listed by local control authorities (Noxious Weeds Act 1993 (NW Act)), in areas representing high risk in terms of weed management as assessed by a qualified ecologist/botanist, will be undertaken immediately prior to construction. These would identify and record the noxious weeds occurring along the alignment and associated access tracks, and in surrounding areas. (This information would then be utilised to prepare the Weed Management Plan that is part of the CEMP).	✓	✓		Entire project area
A Weed Management Plan would be developed as part of the CEMP and would include specific measures for the minimisation, management, mitigation and monitoring of noxious/ environmental weeds within all work areas, including the easement.		✓		N/A
Once construction is complete, noxious weeds listed by local control authorities (NW Act) within the alignment and associated work areas would be controlled as per TransGrid Standard GM EN G2 010 Noxious Weed Control, and as per the most recent information available from the I&I NSW (formerly called DPI, NSW Department of Primary Industries).			✓	N/A
Biodiversity - Fauna Management				
Clearing of vegetation would follow best practice methods for fauna rescue (as per NSW National Parks and Wildlife Service (2001) Policy for the Translocation of Threatened Fauna in NSW).		✓		N/A
A Fauna Management Plan would be developed as a part of the CEMP to minimise impacts to resident native and threatened species. This would include the following procedures: • targeted pre-clearance surveys for breeding / nesting / primary habitat for threatened species; • two stage clearing process for hollow bearing trees; • management of fauna for translocation and rescue; • coarse woody debris relocation plan; • rehabilitation and revegetation plan to re-establish fauna passageways; and	✓	✓		See **Figure 9** and **Table 7.2**, **Section 7.2.1** for species and site specific information for pre-clearance surveys for breeding/nesting habitat for threatened

7 Biodiversity Maintenance and Improvement

Mitigation Measures and Commitment	Implementation			Location for Pre-Clearance Assessment
	Design	Construction	Operation	
• habitat replacement plan, including nest box, bat roosts and glider pole allocation and placement.				species.
Vegetation would be cleared using the two-stage approach in areas identified as containing habitat trees (trees with hollows and other habitat features such as nests, dreys etc). Areas containing habitat trees would be identified during targeted pre-clearance assessments of structure locations and access tracks proposed for construction in areas of intact native vegetation. This approach involves the following process: • Initially all non-habitat trees would be removed, leaving 2-3m wide connections between stands of habitat trees. • All habitat trees would be knocked (gently tapped with plant equipment) once all non-habitat trees have been removed at the end of each day. • At least 48 hours after partial clearing, habitat trees would be removed and checked for fauna in the presence of a suitably qualified ecologist, fauna rescue personnel or certified wildlife handler. • Suitably qualified personnel would guide the plant equipment operators on 'how' and to what side to fell habitat trees to facilitate fauna observation and rescue.	✓	✓		N/A
Where needed all fauna habitat features such as logs and tree hollows, known as coarse woody debris (CWD), would be relocated to the edge of the easement subject to safety and fire risk considerations.		✓		N/A
Any rescued fauna would be transferred to appropriate areas within adjacent habitat or placed in the care of WIRES or other certified wildlife rescue organisations within the local area, if injured.		✓		N/A
If injured microbats are found during vegetation clearing procedures, only a vaccinated ecologist with the lyssavirus innocculation would handle these species.		✓		
During targeted pre-clearance assessments, ecologists would undertake targeted searches for the presence of gliders as well as the habitat suitability along the transmission to determine whether there is a requirement for installation of glider poles.	✓	✓		See **Figure 11** and **Section 7.2.1** for species and site specific information for pre-clearance assessments for gliders.

7 Biodiversity Maintenance and Improvement

Mitigation Measures and Commitment	Implementation			Location for Pre-Clearance Assessment
	Design	Construction	Operation	
Biodiversity – Connectivity, Fragmentation and Edge Effects				
A Flora Management Plan will be developed as part of the CEMP and will include revegetation protocols which will be established following construction to re-connect potential wildlife corridors where possible. Provision will be made to reconnect remnant patches of vegetation along creek lines and floodplains. In all areas locally occurring species will be used to replace habitat.		✓	✓	N/A
Stockpiling of material would avoid TECs		✓		N/A
Soil erosion and sedimentation controls in accordance with the Soil and Water Management Plan and the Erosion and Sediment Control Management Plan would be implemented prior to vegetation clearing work commencing in an area.		✓		N/A
Biodiversity - Offset Strategy				
A Biodiversity Offset Strategy will be developed in consultation with DECCW and DEWHA to compensate for clearing associated with the proposal.	✓	✓		N/A

7 Biodiversity Maintenance and Improvement

Table 7-2 Targeted Pre-clearance Assessment Mitigation Measures

Angle Position (AP)*	Assessment Location/Detail	Potential Threatened Biodiversity Habitat
11-14	Along the alignment between AP 11 and 14 and along all category 2 and 3 access tracks (**Figure 7**).	**Flora**: *Dichanthium setosum* and *Eucalyptus caleyi* subsp. *ovendenii.*
14-16	Along the alignment between AP 14 and 16 and along all category 2 access tracks (**Figure 7**) towards Reedy Creek road. All rocky crevices, potential caves, mines and/or abandon infrastructure would be investigated for maternal roosts.	**Fauna:** Eastern Cave Bats
15-16	500m either side of Mole River between AP15 -16	**TEC**: Natural Grasslands on Basalt and Alluvial Plains
17-20	Along the alignment, all rocky crevices, potential caves, mines and/or abandon infrastructure within the area of impact would be investigated for maternal roosts for Eastern Cave Bats. All hollow trees would be surveyed for Eastern False Pipistrelles.	**Fauna:** Eastern Cave Bats, Eastern False Pipistrelles.
24-25	Along the alignment and category 2 and 3 access tracks.	Unknown valley area, potential for Box Gum Woodland TEC and associated fauna.
33-34	Along the alignment and category 2 and 3 access tracks.	Unknown valley area, potential for Box Gum Woodland TEC and associated fauna.
41-45	Along the alignment within Girard State Forest. All tree hollows and abandoned buildings (if any) within the areas of impact would be investigated for the roosting/nesting parrots and bats. Flying fox camps would be surveyed for as well.	**Fauna:** Golden Tip Bat, Glossy Black Cockatoo, Grey-headed Flying-fox (camp)
62-63	Along the alignment between AP62-63. All tree hollows stormwater drains, culverts, bridges and abandon buildings (if any) within the areas of impact would be investigated.	**Fauna:** Little Bentwing-bats

* Angle positions refer to position shown on **Figures 7a-m**.

7.2.1 Management Strategies

A Construction Environmental Management Plan (CEMP) as well as operational mitigation measures would be prepared for the construction and operational phases of the Project and would include measures for the minimisation or avoidance of the impacts on native flora and fauna as well as aquatic ecology. The management plans would include subplans for flora and fauna management of which the components are outlined below. The CEMP and operational mitigation measures would also include ongoing monitoring requirements, performance indicators, timing and responsibilities.

7 Biodiversity Maintenance and Improvement

Flora Management Plan

A flora management plan would be developed and included in the CEMP and operational mitigation measures would be developed and implemented to mitigate impacts on flora as a result of habitat clearing associated with the Project. Mitigation measures would be implemented to avoid removal of threatened plants during clearing, to ensure the protection of local populations, to promote long-term connectivity of populations within the landscape and to control weed invasion where necessary. The following strategies and mitigation measures would be incorporated as part of the Flora Management Plan:

- management of clearing impacts on native vegetation;
- management of edge effects and connectivity;
- management of exotic flora; and
- sediment and erosion control.

Management of Clearing Impacts on Native Vegetation

A number of mitigation measures have been proposed to minimise the impacts of clearing on native vegetation within and adjacent to the alignment and along access tracks. Measures have focused on minimising the impacts on existing vegetation communities, TECs and habitat for threatened flora, and are listed below:

- a suitably qualified ecologist/botanist would undertake targeted pre-clearance assessments for all structure locations and access tracks proposed for construction within areas of intact native vegetation and for all areas listed in **Table 7.1**. The location of these targeted pre-clearance assessments would need to be determined once intermediate structure locations and all access track locations are confirmed. Where practical, areas comprising TECs, suitable habitat for identified threatened species would be avoided for the placement of structures and access tracks (**Table 6-2**),
- where possible, targeted pre-clearance assessments would be conducted to maximise the chance of detecting cryptic species given the seasonal occurrence of some species. **Table 7.2** provides targeted locations where pre-clearance assessments would be required for important threatened species, populations and TEC habitat.
- Commonwealth threatened flora species predicted with having potential to occur in the project area that have also been assessed as being significantly impacted (**Table 6-1**) would be surveyed for during pre-clearance assessments by a suitably qualified botanist and if identified, clearly marked for protection wherever possible.
- NSW threatened flora species previously recorded in the project area (**Figure 4a** and **b**) as well as impacted species (**Table 6-1**) would be surveyed for by a suitably qualified botanist during pre-clearance assessments and if identified, clearly marked for protection wherever possible.
- where practical, hollow bearing trees would be selectively retained. This would be assessed on a case by case basis.
- clearing boundaries would be clearly marked prior to construction using highly visible flagging tape or equivalent to prevent accidental clearing.
- where practical, areas comprising threatened flora species and TECs would be avoided for the placement of structures and access tracks. If this is unachievable in relation to the threatened grass *Dichanthium setosum* around Reedy Creek (**Figure 9a**), then it is highly recommended that the top soil in this area is removed and stockpiled separately. Post construction this top soil would be re-established in the general area to allow the species to regenerate. The full extent of this grass within the alignment and along access tracks is unknown and needs to be identified during pre-clearance assessments (**Table 7.2**).

- if unrecorded threatened flora species are identified during pre-clearance asssessments, these areas would be recorded, clearly marked and avoided wherever possible (**Table 7.2**).
- areas mapped as the critically endangered TEC Natural Grasslands on Basalt and Alluvial Plains and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (**Figure 8**), listed under EPBC Act would be avoided are far as possible during construction activities, with access tracks being restricted to specific points, and structure placement to proceed across areas with minimal canopy cover. If ground cover removal is required, all top soils from the area would be stockpiled separately and re-established post construction.
- any maintenance of the easement in areas mapped as the critically endangered TEC Natural Grasslands on Basalt and Alluvial Plains and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (Box Gum Woodland) (**Figure 8**) using slashing or burning techniques would avoid doing so during peak flowering season from spring to summer. Disruptions to water flow in this community would be managed to prevent changes to hydrology.
- targeted pre-clearance assessments to identify other locations of the TEC Natural Grasslands on Basalt and Alluvial Plains and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (Box Gum Woodland) listed under EPBC would be undertaken along Mole River for approximately 1km south-east from the proposed crossing point of the Alignment along the river edges (**Figure 7d** and **Table 7.2**).
- where practical, any clearing in TECs (including the clearing on the banks of the waterways comprising the AECDR) or significant threatened species habitat, would apply constrained clearing and maintenance practices (**Appendix C, TransGrid Policies, Volume 2** of this **EA**). Constrained clearing and maintenance within transmission lines has the potential to enhance biodiversity benefits (Clarke *et al,* 2006).

Management of Edge Effects and Connectivity

Mitigation measures to minimise edge effects are typically associated with reducing impacts outside the construction zone, reducing the contrast of the edge and controlling impacts at their source within the alignment. To reduce the impacts associated with increased edge effects and fragmentation the following mitigation measures have been recommended:

- in densely vegetated areas, temporary fences would be used during construction to minimise disturbance to adjacent vegetation.
- wherever possible, structures and access tracks would be located such that disturbance to water bodies would be minimised.
- where possible construction machinery would be parked in cleared or disturbed areas away from waterways, tree drip lines and other sensitive areas.
- stockpiling of material would avoid areas of native vegetation and be restricted to cleared or disturbed areas.
- construction activities would be managed to ensure waste material is disposed off site as it is generated, and in a manner compliant with environmental legislation.
- soil erosion and sedimentation controls would be implemented prior to vegetation clearing work commencing, particularly in sections of the alignment around waterways and the community AECDR.

Management of Exotic Flora

Fourteen noxious weeds were recorded within the alignment. In addition, 110 total species of noxious weeds are known to occur within the Lismore, Richmond Valley, Inverell, Kyogle and Tenterfield LGA areas (DPI 2009).. A full list of noxious weeds per LGA area is provided in **Appendix L.**

A Weed Management Plan would be implemented within the alignment and along access tracks. The Weed Management Plan would include:

- measures to reduce the spread of weeds via vehicles and machinery where risk identified;
- targeting areas of potential new weed outbreaks including soil stockpiles, roadsides and any other disturbed areas;
- targeted weed control programs in the areas surrounding the AECDR waterways requiring the upgrade and installation of water crossings;
- measures to mitigate noxious weeds should they be found.
- monitoring and control programs for weeds, including noxious listed weeds on sites and in the surrounding areas, during construction and operation of the line; and
- where weed management is undertaken in the areas mapped as the critically endangered TEC Natural Grasslands on Basalt and Alluvial Plains and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (**Figure 8**), this would avoid using chemicals that kill grasses that form a key part of this TEC.
- construction areas and access tracks to be managed to minimise the invasion of noxious weeds through to, and during the operational phase of the Project.

Management of Sediment and Erosion Control

Sedimentation and erosion created from construction activities has the potential to influence water quality and vegetation condition. Mitigation measures to minimise sedimentation and erosion within the construction zone have been recommended in order to reduce these impacts:

- stockpiling of material would avoid areas of native vegetation and be restricted to cleared or disturbed areas.
- stockpiling to be appropriately sediment fenced to avoid scouring and runoff into adjoining creeklines and vegetated areas.
- all access track works associated with the currently proposed 28 waterway crossing upgrades and 15 new waterway installations (**Table 7-4**) to be designed and constructed in accordance with the NSW DPI *Policy and Guidelines for Fish Friendly Waterway Crossings* and *Why Do Fish Need to Cross the Road? (2003)* and relevant TransGrid specifications.
- sediment and erosion control measures would be implemented prior to vegetation and soil disturbance to manage impacts to sites during construction and operation of the transmission line. All works would be carried out in accordance with industry guidelines developed by Landcom (2008) *Managing Urban Stormwater: Soils and Construction Volume 1,* and (DECC, 2008) Volume 2, *The blue book Volumes 1 and 2*. Where necessary practices would include:
  - access would be restricted in sensitive areas of the alignment (e.g. TECs and threatened species habitat) during the construction phase through the installation of fencing and signage surrounding such areas.
  - endemic seeds and plants to be used for all revegetation and erosion control works.
  - mulching or revegetation of cleared areas to be undertaken as soon as possible to permanently stabilise the soil and reduce erosion and run-off.
  - construction of diversion banks and channels to intercept and divert water away from disturbed ground.
  - appropriate physical stabilisation techniques to be employed, including terracing and the use of geotextiles.
  - limiting the removal of ground covering vegetation for construction of the line.

7 Biodiversity Maintenance and Improvement

Fauna Management Plan

A fauna management plan would be developed and included in the CEMP and operational mitigation measures in order to mitigate impacts on fauna as a result of habitat clearing associated with the Project. The following strategies and mitigation measures listed below would be incorporated as part of the Fauna Management Plan to be implemented to reduce the impact on flora:

- management of threatened species and fauna habitat;
- management of nesting resources;
- management of connectivity; and
- management of invasive species.

Management of Threatened Fauna and Fauna habitat

To enable the effective management of threatened fauna and fauna habitat, a range of mitigation measures that need to be addressed are listed below:

- targeted pre-clearing assessments at spans shown in **Table 7-1** and **7.2** would be conducted to identify any nesting and breeding habitat for fauna within the alignment. This would include targeted searches of breeding habitat (dreys, hollow bearing trees, rocky crevices, caves, coarse woody debris) for threatened species recorded by URS (**Figure 9**) and any species with the potential to be impacted by the project (**Table 6-4**).
- NSW threatened fauna species previously recorded in the project area (**Figure 4a** and **b**) as well as impacted species (**Table 6-4**) would be identified during targeted pre-clearance assessment and their habitat identified and clearly marked for protection.
- species that are likely to be adversely affected by the Project would have focused management controls developed with the fauna management plan to further ameliorate any Project impacts (**Section 6.1.1**). These species are listed below:
  - Black-chinned Honeyeater;
  - Brown Tree-creeper;
  - Diamond Firetail;
  - Grey-crowned Babbler;
  - Hooded Robin;
  - Speckled Warbler;
  - Painted Honeyeater;
  - Squirrel Glider; and
  - Turquoise Parrot.
- detailed Koala habitat searches as outlined in the Recovery plan for the Koala (DECC 2008a) would be conducted in all primary and secondary habitat mapped in **Figure 10** prior to construction. If Koalas are found to be using any areas within the alignment then a detailed Koala Management Plan would be prepared in accordance with the recovery plan (DECC 2008a).
- detailed Yellow-bellied Glider habitat searches would be conducted in areas with known feed trees (**Appendices I** and **J**), in accordance with the Recovery Plan. If a high level of Yellow-bellied Glider activity is found in any areas within the alignment then detailed management controls and procedures for the species would be developed for inclusion in the fauna management plan. These procedures would be prepared in accordance with the recovery plan (NSW National Parks and Wildlife Service, 2003).

- targeted pre-clearing assessments for roost sites for micro-bats would be undertaken for Eastern Cave Bats, Golden Tip Bats, Eastern False Pipistrelles and Little Bentwing-bats (**Table 7.2**). Roosting habitat for microbats is provided in **Appendices I** and **J** for each relevant species. If roosting habitat is identified for these species focused management controls and procedures for these species would be developed for inclusion in the fauna management plan.
- targeted re-clearance assessments for Grey-headed Flying-fox camps would be undertaken in Girard State Forest (**Table 7.2**), given the number of records in the area. If camps occur in close proximity to the transmission line, then it is recommended that coloured PVC disks with wind strips attached would be attached to the over-head wires to discourage the flying foxes from landing on the lines.
- targeted pre-clearing assessments would be undertaken to identify nesting/breeding Turquoise Parrots and Glossy Black Cockatoo's habitat. Surveys for these species would be undertaken in the following locations: in areas of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (Box Gum Woodland) listed under the EPBC Act for Turquoise Parrots (**Figure 8**) and Girard State Forest for Glossy Black Cockatoos. Refer to **Table 7.2** for location of pre-clearance assessments for each species. If surveys demonstrate evidence of the species than focused management controls and procedures would need to be developed for inclusion in the Fauna Management Plan.
- targeted pre-clearance assessments to identify potential Red Goshawk, Square-tailed Kite and Little Eagle nests in woodland vegetation would be completed during the spring prior to clearing. If nests are found, appropriate management measures to avoid and/or minimise impacts would be undertaken. These would be included in the fauna management plan;.
- targeted pre-clearance assessments to be undertaken during optimal breeding season periods for Hesperiidae, Papilionidae and Lycaenidae butterflies known to occur in far north NSW, to identify potential hill-topping sites along hilltops and ridges designated for clearing. If sites are found, appropriate management measures to avoid and/or minimise impacts would be implemented. These masures would be included in the fauna management plan.
- clearing of vegetation would follow best practice methods for fauna rescue developed by DEC (2004), including relocation of rescued fauna and the involvement of wildlife specialists in the process.
- vegetation would be cleared using the two-stage approach in areas identified as containing hollow bearing and habitat trees (DBH>400mm). Areas containing habitat trees could be identified during pre-clearance assessments of pole locations and access tracks. Initially all non-habitat trees would be removed. All habitat trees then to be knocked (gently tapped with plant equipment). At least 48 hours after non habitat trees have been removed, habitat trees can be carefully removed in the presence of a suitably qualified ecologist, fauna rescue personnel or certified wildlife handler. It is also suggested that the suitably qualified individual guides the plant equipment operators on 'how' and to what side to fell habitat trees, so that habitat resources can be quickly and easily checked for fauna once the tree has been felled.
- habitat features such as felled hollow bearing trees and coarse woody debris can be placed in areas where vegetation is retained to provide fauna corridors. Density of coarse woody debris would be consistent with that found in surrounding vegetation communities. Specific guidelines would be developed for the Project to guide contractors and prevent heaping of debris in adjacent woodland.
- in areas where embedded or rock outcrops occur, care would be taken to avoid their removal. Where unavoidable, a suitably qualified ecologist or certified wildlife handler would be present for fauna rescue and translocation of reptiles and amphibians.

- it is recommended that coloured PVC spirals be placed along the ground wire of the transmission lines in areas where wetlands (**Figure 7l,** refer to vegetation community Coastal Floodplain Sedgelands Rushlands and Forblands) occur in close proximity to the line. This measure would assist in the prevention or minimisation of bird collision with the wire (Alonsoa J, Alonsob J. and Muñoz-Pulido R, 1993). This technique is of particular importance for Black-necked Storks given numerous records of this species occur around AP82 and the fact that powerline collisions are one of the most significant causes of mortality for this species (DEC, 2005).
- where unavoidable, clearing of hollow bearing trees would be done carefully to allow inspection of the hollow once felled and minimise impacts on any fauna using the hollow.
- clearing of habitat trees would be undertaken outside of the breeding/nesting months wherever possible (i.e. not during spring or early summer).
- all waterway and wetland crossings (refer to category 3 access tracks on **Figure 7**) would be constructed in accordance with TransGrid specifications which are strongly aligned with NSW Department of Primary Infrastructure & Industries Policy and Guidelines for *Fish Friendly Waterway Crossings* (2004) and *Why Do Fish Need to Cross the Road*?
- where ever possible structures would be preferentially located beyond waterway features to avoid polluting and altering local waterway systems (**Chapter 8** of the **EA, Surface Water and Hydrology).**
- it is recommended that wash down protocols be developed and applied to prevent the spread of amphibian chytrid disease *chytridiomycosis*. Protocols would be consistent with DECCW guidelines (DECC, 2008b). Wash down would occur whenever vehicles enter or leave a new drainage area. Wash down protocols would also stop further spread of the alien freshwater fish, Eastern Gambusia (*Gambusia holbrooki)* by removing any individuals or eggs that may be collected in the engines of construction or 4wd drive vehicles crossing waterways.
- it is recommended that regular checks be undertaken for cane toads on construction vehicles, machinery and stockpiled materials. Any individuals found would be humanely euthanized by a trained individual to avoid potential misidentification and euthanasing of native frogs.
- any rescued fauna would be transferred to appropriate areas within adjacent habitat or placed in the care of WIRES or other certified wildlife rescue organisations within the local area, if injured.
- wherever remnant vegetation patches become disconnected in the western study area, revegetation protocols would be established to re-connect, where possible, potential wildlife corridors.
- the rehabilitation plan developed as part of the Fauna Management Plan would include provisions to reconnect remnant patches of vegetation along creek lines and floodplains. In all areas, locally occurring species would be used.
- fire regime requirements of threatened fauna species would be considered should asset management burning be proposed.
- if injuried microbats are found during vegetation clearing procedures, only a vaccinated ecologist with the lyssavirus innocculation should handle these species.

Management of Nesting Resources

The study area contains nesting habitat for a number of threatened fauna species in the form of tree hollows, stags and hollow logs. Due to this, a number of mitigation measures would need to be addressed to manage nesting resources:

- where possible, nesting resources such as fallen timber would be placed intact in adjacent vegetation outside of the alignment, or within the alignment, prior to clearing.

- suitable nest boxes and/or artificial bat roosts would be installed using an appropriate ratio to replace removed hollows in consultation with DECCW. The appropriate ratio for this current Project would be decided after targeted pre-clearance assessments for hollow bearing trees are completed.
- different type, style and sized nest boxes would be required for different species (Franks & Franks, 2003). Further nest box specifications and guidance would be consulted from the following sources:
  - Franks A and S (2006), Nest-boxes for Wildlife: A Practical Guide, Bloomings Books, Melbourne;
  - Smith G C, Lees N, Ross Y (1998), Sustainable Forest Management Technical Report. Habitat Trees and Hollow-dependent Fauna, Department of Natural resources, Queensland;
  - Gibbons P and Lindenmayer D (2002), Tree Hollows and Nature Conservation in Australia, CSIRO, Australia;
  - Gibbons P and Lindenmayer D (1997), Conserving Hollow-dependent Fauna in Timber-production Forests, NSW National Parks and Widlife Service, Australia; and
  - Franks A and S (2008), Hollow Log Homes, http://www.hollowloghomes.com.au/nHome.htm

Management of Connectivity

Vegetation corridors facilitate the safe movement of fauna between patches of habitat and prevent local extinction of mobile populations (Bolger *et al,* 1997). Transmission line easements can represent a significant source of habitat fragmentation limiting the movement of fauna (Clarke *et al.,* 2006; Goosen & Marsh, 1997). Management measures to maintain or improve the connectivity of vegetation across the proposed alignment include:

- Where possible retain vegetated bands between continuous vegetation patches within the alignment. Habitat features such as hollow logs would be placed in these bands.
- Native understorey would be left intact where ever possible to allow connectivity and fauna passage.
- Where possible additional planting would be undertaken to promote understorey and mid storey growth in areas where the transmission line creates a sharp contrasting edge. These areas are likely to be where the transmission line clears forested vegetation with a dense mid-storey.
- Significant distances between trees can create barriers to the movement of Squirrel Gliders. The ability of this animal to freely move about the canopy is hindered by gaps in the vegetation greater than the average ‘glide distance’. It is considered that gaps greater than 75m can pose a significant barrier to the movement of Squirrel Gliders (Van der Ree *et al.* 2003). Mitigation measures would therefore apply in situations where vegetation clearance would create significant gaps. Pre-clearance assessments in squirrel habitat (mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range (DEC 2005)) would identify areas where significant treeless gaps would be created. Pre-clearance assessments would focus on areas mapped as White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (Box Gum Woodland) (refer to **Figure 8**), River Red Gum Riverine Woodland and Tumble Down Red Gum/ Blakely’s Red Gum/Pine Shrubby Open Forest (refer to **Figure 7**). A detailed glider pole placement plan would be prepared as part of the CEMP to identify suitable locations where poles would provide connectivity while also complying with adequate safety clearance requirements of the transmission line. **Table 7-3** gives an example of possible heights and distances for placing gliding poles, taking into account landing height.

Table 7-3 Glider Pole Heights and Average Glide Distance from Poles

Pole Height (m)	Average glide distance (m)
25	40
20	32
15	22
10	12

Management of Invasive Species

Fragmentation of native ecosystems can facilitate the spread of feral species such as foxes, cats, dogs, rabbits and pigs. Establishment of the Project and associated access tracks has the potential to increase the movement of feral species within the area. The associated impacts of feral animals on native flora and fauna could potentially include increased predation and grazing. Foxes, rabbits, cats and dogs are all known to use the alignment and study area.

Given the existing level of disturbance within the alignment and study area it is unlikely that the Project would significantly increase the impacts of feral species. No feral animal control is currently recommended. If there is evidence of increased predation or grazing within the alignment, TransGrid would implement an appropriate control program in consultation with relevant experts.

7.2.2 Monitoring Strategies

Ongoing monitoring as outlined in flora and fauna management plans, incorporated as apart of the broader CEMP would be undertaken post construction. Monitoring would assess the short and long term impacts of management strategies and feed directly back into the management of the proposed alignment and access tracks. An ongoing monitoring plan would be developed for the transmission line.

7.3 Biodiversity Offset

7.3.1 Overview

TransGrid recognises that the clearing of vegetation for the development of the Project represents long term removal of vegetation. In light of the DECC (2005) guidelines for Part 3A biodiversity assessments (i.e. to maintain and improve biodiversity values resulting in no net impact on threatened species or native vegetation), as well as the Commonwealth Draft Policy Statement: use of environmental offsets under the *Environment Protection and Biodiversity Conservation Act 1999* (DEWHA 2007) and the DoP and Supplementary DGR's, an offset strategy would be designed and developed that is appropriate for the proposed development.

The potential impacts of the Project in relation to vegetation clearance have been identified and are provided in **Table 6-7**. This table includes data on each type of community to be impacted, community condition, and the potential scale of impact, namely the amount of vegetation to be cleared, and any corresponding TECs that would be impacted. Based on this, any offset arrangement to be agreed with DECCW and SEWPAC would need to respond to the following potential Project impacts:

- Vegetation losses of between 312 ha and 434 ha of native vegetation
- TEC losses of up to 91 ha, (or a maximum total of 143 ha including the unsurveyed wooded vegetation) including principal TEC losses in the following communities:
  - Natural Grasslands on Basalt and Alluvial Plains in Northern NSW and Southern Queensland (EPBC Act);
  - White Box, Yellow Box, Blakely's Red Gum Grassy Woodland (EPBC and TSC Act);
  - Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (TSC Act); and
  - Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast; Sydney Basin and South East Corner Bioregions (TSC Act).
- Other potential impacts on biodiversity values such as threatened flora, fauna and populations as discussed in **Section 6**.

While this biodiversity assessment report has quantified potential impacts to a large degree, it has also identified that constraints to impact assessment, including access restrictions to some areas, have limited the degree to which all potential impacts could be quantified. Consequently, there is an area of between 9 and 52 ha of wooded vegetation that remains unmapped, but that would potentially be impacted by the Project.

TransGrid is committed to reaching an agreement with both DECCW and SEWPAC on an initiative that would meet the requirements, principles and guidelines for offsetting established by those bodies. To this end, detailed discussions have commenced with DECCW in relation to confirming the scale, geographic location, and biodiversity assets that would need to be reflected in an agreed offset outcome.

NSW State Requirements for Offsetting

DECC (2005) and DECCW (2010) guidelines and principles clearly state that where measures to avoid and mitigate impacts on threatened species are not possible, then an offset strategy needs to be considered. The principals according to the DECCW *Principles for the use of biodiversity offsets in NSW* (DECCW 2010) for the use of biodiversity offsets in NSW include:

1) Impacts must be avoided first by using prevention and mitigation measures.
2) All regulatory requirements must be met.
3) Offsets must never reward ongoing poor performance.
4) Offsets would complement other government programs.
5) Offsets must be underpinned by sound ecological principals.
6) Offsets would aim to result in a net improvement in biodiversity over time.
7) Offsets must be enduring 'they must offset the impact of the development for the period that the impact occurs'.
8) Offsets would be agreed prior to the impact occurring.
9) Offsets must be quantifiable 'the impact and benefits must be reliably estimated'.
10) Offsets must be targeted.
11) Offsets must be located appropriately.
12) Offsets must be supplementary.
13) Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.

7 Biodiversity Maintenance and Improvement

These offset requirements are used to describe the 'compensatory' offset type where a representative habitat offset is prescribed and maintained by land managers such as DECCW or Landcare etc.

Commonwealth Requirements for Offsetting

The Commonwealth has identified eight principals for the use in environmental offsets under the EPBC Act, these are:

1. Environmental offsets would be targeted to the matter protected by the EPBC Act that is being impacted.
2. A flexible approach would be taken to the design and use of environmental offsets to achieve long-term and certain conservation outcomes which are cost effective for proponents.
3. Environmental offsets would deliver a real conservation outcome.
4. Environmental offsets would be developed as a package of actions – which may include both direct and indirect offsets.
5. Environmental offsets would, as a minimum, be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are 'like for like'.
6. Environmental offsets would be located within the same general area as the development activity.
7. Environmental offsets would be delivered in a timely manner and be long lasting.
8. Environmental offsets would be enforceable, monitored and audited.

Proposed Biodiversity Offset

The offset package would be developed in accordance with the principals contained in the DECC guidelines (2005) and DECCW guidelines (2010). The offset package would be developed in consultation with the DECCW and SEWPAC and preliminary consultations have commenced.

The offset package would need to compensate for the likely vegetation and habitat losses described in **Table 6-7** in terms of the diversity of communities potentially impacted, the scale of that impact, and the condition of the impacted communities. **Section 6** provides detail in relation to the potential impacts of the Project with respect to each of these parameters.

Further consultation would occur with DECCW and SEWPAC in regards to the offset strategy.

The Maintain or Improve Test

The DECC (2005) guidelines identify matters that are relevant to the assessment of impacts to threatened species, populations or ecological communities or their habitats, arising from a Project assessed under Part 3A. A key principle in the DECC guidelines state that Projects maintain or improve biodiversity values (i.e. there would be no net impact on threatened species, populations, ecological communities or native vegetation). Where impacts cannot be avoided or mitigated then it is necessary to identify a suitable offset in order to maintain or improve biodiversity values.

The Project's response in relation to avoidance and mitigation of potential impacts has been detailed in **Section 7.1** and **7.2**.

Any agreed biodiversity offset package would be used as a means of ensuring that the Project maintains and improves biodiversity in the locality. The offset would protect and conserve, in perpetuity, threatened species habitats, vegetation types including TECs and landscape features similar or equivalent to those found within the Project.

The offset would be:

- strategic in nature, adding value to DECCW and SEWPAC conservation priorities for the region;
- focused at a landscape level, to provide valuable outcomes to regional biodiversity connectivity;
- representative of the range of vegetation communities impacted, and the scale of those potential impacts;
- of a scale and configuration, that would
  - be sustainable in terms of the maintenance of flora and fauna populations;
  - minimise edge effects; and
  - adequately offset the area of native vegetation that would potentially be impacted by the Project; and
- managed by DECCW, under the umbrella of the NSW NPWS, so as to improve its condition and biodiversity values, where this is possible.

On the basis of the above assessment, the proposed offset package is consistent with the DECCW and SEWPAC guidelines for offsets and would meet the key criterion for like-for-like trade-offs of biodiversity values. Agreement to an offset of the above type would compensate for the loss of native vegetation and threatened species habitats associated with the Project and maintain biodiversity values in the study area.

7.4 Key Thresholds

As required by the *Draft Guidelines for Threatened Species Assessment for Part 3A applications* (DEC 2005), the following assessment of key thresholds must be addressed by this biodiversity assessment. Each key threshold and the location in the report in which each one is addressed is provided in **Table 7-4** below.

Table 7-4 Key Thresholds Assessments

Key Thresholds	Location
1. Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts would maintain or improve biodiversity values.	**Section 7**
2. Whether or not, the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.	**Section 6, Appendix I** and **J**
3. Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.	**Section 6, Appendix I** and **J**
4. Whether or not the proposal would adversely affect critical habitat.	**Section 5.2.11** and **Appendix I**

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9

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of TransGrid and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between March 2009 and February 2010 and is based on the conditions encountered and the information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report would be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Figures

These figures are provided at A3 scale within Volume 3, Section 3 of the EA