

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (s266B)
Draft Conservation Advice (including listing advice) for the
Poplar Box Grassy Woodland on Alluvial Plains

1. The Threatened Species Scientific Committee (the Committee) was established under the EPBC Act and has obligations to present advice to the Minister for the Environment (the Minister) in relation to the listing and conservation of threatened ecological communities, including under sections 189, 194N and 266B of the EPBC Act.
2. The Committee provided its advice on the Poplar Box Grassy Woodland on Alluvial Plains ecological community to the Minister as a draft of this <approved> conservation advice. In <year>, the Minister <accepted/rejected> the Committee's advice, <and adopted this document as the approved conservation advice>.
3. <If accepted> The Minister amended the list of threatened ecological communities under section 184 of the EPBC Act to include the Poplar Box Grassy Woodland on Alluvial Plains ecological community in the <Endangered> category. It is noted that components of this ecological community are listed as threatened in Queensland.
4. <A draft conservation advice for this ecological community was made available for expert and public comment for a minimum of 30 business days. The Committee and Minister had regard to all public and expert comment that was relevant to the consideration of the ecological community.>
5. This <approved> conservation advice has been developed based on the best available information <at the time it was approved>; this includes scientific literature, advice from consultations, and existing plans, records or management prescriptions for this ecological community.



Poplar Box Grassy Woodland on Alluvial Plains. (Photo credit: Rosemary Purdie)

1 CONSERVATION OBJECTIVE

To mitigate the risk of extinction of the Poplar Box Grassy Woodland on Alluvial Plains ecological community, and maintain its biodiversity and function, through the protections provided under the *Environment Protection and Biodiversity Conservation Act 1999* and through the implementation of priority conservation actions outlined in Section 5.

2 DRAFT DESCRIPTION OF THE NOMINATED ECOLOGICAL COMMUNITY

The Poplar Box Grassy Woodland on Alluvial Plains ecological community is typically a grassy woodland with a canopy dominated by *Eucalyptus populnea* and understorey mostly of grasses and other herbs. The ecological community mostly occurs in gently undulating to flat landscapes and occasionally in hilly terrain on a wide range of soil types of alluvial and depositional origin (Webb et al., 1980).

2.1 Name of the ecological community

This advice follows the assessment of a public nomination to list the ‘*Poplar/bimble box grassy woodland on alluvial plains*’ as a threatened ecological community under the EPBC Act.

It is recommended that the ecological community be named **Poplar Box Grassy Woodland on Alluvial Plains**. The name appropriately describes the dominant canopy species, vegetation structure and landscape position that characterises the ecological community. *Eucalyptus populnea* is commonly known as either poplar box or bimble box, depending on the region and subspecies that were formerly recognised. As poplar box is more widely used and applies to the range of infraspecific taxa, the name of the ecological community is Poplar Box Grassy Woodland on Alluvial Plains (hereafter referred to as Poplar Box Grassy Woodland or the ecological community).

2.2 Location and physical environment

The Poplar Box Grassy Woodland is located west of the Great Dividing Range, typically at less than 300m above sea level (ASL) and between latitudes 20°S to 34°S. The ecological community is scattered across a broad distribution within an area that is roughly:

- south of Charters Towers in Queensland
- north of Cowra in New South Wales
- west of Ipswich in Queensland and Armidale in New South Wales
- east of Longreach in Queensland and Hillston in New South Wales

The ecological community primarily occurs within the Brigalow Belt North, Brigalow Belt South, Cobar Peneplain, Darling Riverine Plains, NSW South Western Slopes and Riverina IBRA bioregions¹.

The ecological community occurs on palaeo and recent depositional soils in gently undulating to flat terrain and occasionally in more hilly country. The woodland is mainly associated with alluvial plains including back plains, higher terraces,² levees along rivers (particularly in Qld) and stagnant alluvial plain landscapes (particularly in NSW) (Beeston et al., 1980). The Poplar Box Grassy Woodland is often found in close proximity to ephemeral watercourses and depressions. The soils in these watercourses are also considered alluvial and the regularity of flow after heavy rain, curtails shrub growth. These areas may contain part of the ecological

¹ Interim Biogeographic Regionalisation for Australia – IBRA Version 7

² River terraces are the remnants of earlier floodplains that existed at a time when a river was flowing at a higher elevation, before its channel down-cut to create a new floodplain at a lower elevation. Terraces can also be left behind when the volume of the river flow declines due to changes in climate, typical of areas which were covered by ice during periods of glaciation, and their adjacent drainage basins.

community where the native vegetation canopy is dominated by poplar box and the understorey is not shrubby (see section 2.6). The ecological community typically occurs on clay, clay-loam, loam and sandy-loam soils. However, it is generally absent from sandy soils and siliceous substrates (John Benson pers. comm., 2015) (Table 1).

With decreasing soil fertility and increasing topographic relief the Poplar Box Grassy Woodland is replaced by more shrubby types of *Eucalyptus* woodland and ironbark/cypress pine communities (NSW National Parks and Wildlife Service, 2003b).

Table 1. Landscape position of vegetation units that fully or partly correspond with the Poplar Box Grassy Woodland.

| Vegetation unit ³ | Soil | Landscape position |
|--|---|--|
| New South Wales | | |
| Poplar Box - Belah woodland on clay-loam soils of the alluvial plains of north-central NSW (PCT56) | Generally occurring on red or red-brown loams or light clay. | In the transition zone between the floodplain and the peneplain in the central and northern plains of the NSW wheatbelt. |
| Poplar Box - Coolabah floodplain woodland on light clay soil mainly in the Darling Riverine Plains Bioregion (PCT87) | Occurs on alluvial yellow earth and grey clay soils, sometimes gilgaied. | On elevated floodplains mainly of the Darling Riverine Plains bioregion. Ecotonal zone between lower floodplains and higher parts of the alluvial plain. |
| Poplar Box grassy woodland on alluvial heavy clay soils in the Brigalow Belt South Bioregion (PCT101) | Occurs on heavy alluvial clay soils derived from volcanic or sedimentary substrates. | On alluvial plains or gently undulating slopes in the Brigalow Belt South Bioregion including in the Liverpool Plains sub-region. |
| Poplar Box grassy/shrubby woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt) (PCT244) | Occurs on clay-loam soils. | On flats on alluvial plain and stagnant alluvial plain landscapes. |
| Queensland | | |
| <i>Eucalyptus populnea</i> woodland on alluvial plains (RE11.3.2) | Variable soil types including texture contrast, deep uniform clays, massive earths and sometimes cracking clays. | Occurs on Cainozoic alluvial plains. |
| <i>Eucalyptus populnea</i> woodland with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> on alluvial plains (RE11.3.17) | Soils are generally deep texture contrast with thin sandy surfaces. | Occurs on back plains, levees and terraces formed on Quaternary alluvial deposits. |
| <i>Eucalyptus populnea</i> with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on Cainozoic clay plains (RE11.4.7) | Soils are usually texture contrast, but gilgai microrelief with cracking clays and earths may also be present (ancient alluvium). | Usually associated with flat or lower, middle and upper slopes of gently undulating Cainozoic clay plains. |
| <i>Eucalyptus populnea</i> woodland on Cainozoic clay plains (RE11.4.12) | Ancient alluvium. | Occurs on eroding edge of Tertiary clay plains. |
| <i>Eucalyptus populnea</i> +/- <i>E. tereticornis</i> grassy woodland/tall woodland +/- patches of <i>Acacia</i> | Cracking clay soils. | Occurs on Quaternary alluvial plains. |

³ Vegetation units are explained in more detail in section 2.7, where Plant Community Types (PCT), Vegetation Classification and Assessment (VCA) and Regional Ecosystems (RE) are described.

| Vegetation unit ³ | Soil | Landscape position |
|---|------|--------------------|
| <i>harpophylla</i> and <i>Melaleuca bracteata</i> (RE12.3.10) | | |

Source: Benson et al. (2006; 2010); Accad and Neldner (2015).

Distribution maps of the ecological community are at Appendix D.

2.3 Climate

The Poplar Box Grassy Woodland is distributed over a large geographic area with various environmental conditions. It typically occurs in the D5, E3 and E4 agro-climate classes (Table 2). The margins of the ecological community's extent is delineated by the E6 boundary in the west and E7 boundary in the south-east (Hutchinson et al., 2005).

As Poplar Box Grassy Woodland has a wide distribution, the mean annual rainfall can range up to 800mm. The mean minimum daily temperature range in winter is 3.5 to 6.3°C and the mean maximum daily temperature range in summer is 26.6 to 34.8°C across the extent of the ecological community.

Table 2. Agro-climate classes associated with the Poplar Box Grassy Woodland.

| Agro-climate class | Agro-climate | Location and main land uses |
|--------------------|---|---|
| D5 | Moisture availability high in winter-spring, moderate in summer, most plant growth in spring. | South-east extent of the ecological community in NSW. Southern and central Tablelands of NSW. Forestry, cropping, horticulture, improved and native pastures |
| E3 | Most plant growth in summer, although summers are moisture limiting. Temperature limits growth in winter. | Main extent of the ecological community in NSW. Western slopes of NSW and part of the North Western Plains. Winter cereals and summer crops, grazing. |
| E4 | Growth is limited by moisture rather than temperature and the winters are mild. Growth is relatively even through the year. | Main extent of the ecological community. Unique low moisture area for sub-tropical continental eastern Australia and associated with the Brigalow belt of Queensland and NSW. Winter cereals (after summer fallowing), summer crops (including cotton) and sown pastures. |
| E6 | Semi-arid climate. Soil moisture tends to be greatest in winter. | Western edge of the ecological community in NSW and southern Queensland. Southern edge of the arid interior in NSW and Queensland. Primarily grazing. |
| E7 | Moisture is the main limit on growth. Growth index lowest in spring. | Eastern margin of the ecological community in Queensland. Inland and west of the Great Dividing Range where appropriate alluvial flats occur. |

| Agro-climate class | Agro-climate | Location and main land uses |
|--------------------|--------------|--|
| | | Land zone is mostly associated with the coastal areas of south-east Queensland. Sugar, crops and cattle grazing. |

Source: Hutchinson et al. (2005).

2.4 Vegetation

The Poplar Box Grassy Woodland occurs in eastern Australia, intergrading with and ranging further west and north than other grassy woodlands that extend through NSW and southern Queensland. The vegetation of the ecological community varies from a grassy woodland to grassy open woodland structure but may occasionally exhibit an open forest structure with an overstorey dominated by *Eucalyptus populnea* (poplar box) and an understorey predominantly composed of perennial forbs and C₄⁴ grasses (Specht, 1970; Beeston et al., 1980; Sivertson and Clarke, 2000; Metcalfe et al., 2003; Benson et al., 2010). The Poplar Box Grassy Woodland may include a low density of shrubs, however patches of the ecological community generally lack a substantial mid (tall shrub) layer. Shrubby forms of poplar box woodland typically occur on lower nutrient sandier soils and are not part of the ecological community. Although the canopy is predominantly composed of *Eucalyptus populnea*, a wide-ranging species, the ecological community is more restricted in extent than its dominant canopy tree species.

The structure and composition of vegetation are primarily determined by topography, hydrology, fire regimes, soil fertility, disturbance and management history. The Poplar Box Grassy Woodland is a continuum, comprising different understorey herb and low shrub assemblages at the extremities of the distribution in both an east-west and north-south direction, due to variations in climate and substrate (Metcalfe et al., 2003).

Because the woodlands are located on floodplains the ecological community experience occasional inundation and cyclic changes in the density of the understorey (Tierney and Watson, 2009). Vegetative ground cover can be very sparse during dry periods but become mid-dense after rain particularly if fire has been absent for a long time. Where the Poplar Box Grassy Woodland occurs near creek lines and low-lying areas, species adapted to occasional inundation, such as sedges and rushes, may dominate during these wetter periods. The cover of understorey shrubs may increase with distance from watercourses, in lower fire frequencies and lower soil fertility (Clarke and Knox, 2002; Graham et al., 2014; Darren Shelly pers comm., 2014). A list of plant species typical of the ecological community is given at Table E1 in Appendix E.

2.4.1 Upper layer (canopy) – trees capable of exceeding 10m

The canopy of the Poplar Box Grassy Woodland is dominated by *Eucalyptus populnea*. The canopy height of the Poplar Box Grassy Woodland typically ranges up to 20 metres. Poplar box tends to have a monopodial⁵ form in the north to hemi-sympodial in the south (Groves., 1981; Anderson, 2003; Boland et al., 1984). Other tree species of a similar height may occasionally occur in the tree canopy, but do not dominate a patch, depending on the characteristics of the site, including *Callitris glaucophylla* (white cypress pine), *Casuarina cristata* (belah), *Eucalyptus coolabah* (coolibah), *E. largiflorens* (black box) and *E. melanophloia* (silver-leaved ironbark). Emergent taller trees may occasionally include *E. microcarpa* (inland grey box) and *E. woollsiana* (narrow-leaved grey box).

⁴ C₄ plants are better adapted to hotter, drier conditions as they can balance photosynthesis and water loss processes more efficiently. In contrast C₃ plants are less efficient at conserving water loss during photosynthesis, so are better adapted to cooler, moister climates.

⁵ Monopodial growth forms have a single main trunk, sometimes with secondary lower branches. This is different to hemi-sympodial tree forms that have a branching lower trunk.

An upper layer crown cover of up to 50% is possible during regrowth of *E. populnea* but the species will thin out to 10–30% over 100 years (Rod Fensham pers comm., 2015). Beeston et al. (1980) noted that canopy density can average about 100 trees/ha in the north (Qld) and 50 trees/ha in the south (NSW). In the western distribution of the Poplar Box Grassy Woodland, *Eucalyptus populnea* may also occur as dense copses in moist depressions. Hybrids of *E. populnea* with other eucalypt species may also be present in the canopy layer and are considered to be part of the ecological community where present (or where they contribute to the dominant presence of *E. populnea*).

Poplar box goes through regular cycles of senescence (aging and death) and regeneration. Poplar box trees are also susceptible to defoliation by insects, such as psyllids (lerp), and are often lopped for domestic stock fodder. Therefore, the ecological community can include poplar box trees that are in a regrowth or defoliated state.

2.4.2 Understorey - Mid layer (small trees and medium shrubs) 1–10m

Tall shrubs and small trees may occur in the mid layer although they are mostly absent. They include *Acacia aneura* (mulga), *Alectryon oleifolius* subsp. *canescens* (western rosewood), *Apophyllum anomalum* (warrior bush), *Atalaya hemiglauca* (whitewood), *Capparis mitchellii* (wild orange), *Eremophila mitchellii* (budda) and *Geijera parviflora* (wilga) (Beeston et al., 1980). These are typically scattered or patchy and variable in composition although dense copses of one or more tall shrubs may occur as localised variation within a patch of Poplar Box Grassy Woodland. The mid layer may also include juvenile canopy trees. The density of the mid layer can influence the ground layer (for example, an absent to open mid layer leads to a more developed ground layer).

2.4.3 Understorey - Ground layer (low shrubs, groundcover, graminoids) < 1m

The ground layer of the Poplar Box Grassy Woodland can vary in composition depending on local hydrological conditions, rainfall, landscape position, soil type and season. It will also vary depending on fire, grazing and other regimes. However, many species are common to both northern and southern woodlands. The occurrence of grasses varies considerably with the tree and shrub density (Beeston et al., 1980). The ground layer is typically open, low and dominated by a variety of summer-growing or C₄ grasses such as *Aristida* spp. (wiregrass), *Bothriochloa* spp. (red grass), *Dichanthium* spp. (bluegrass), *Heteropogon* spp. and *Themeda* spp. (kangaroo grass).

The lighter-textured gradational soils in the western part of the ecological community are dominated by the C₄ grasses *Aristida* spp., *Eragrostis* spp. (lovegrass), *Thyridolepis mitchellianna* (mulga Mitchell grass) and *Monachather paradoxus* (bandicoot grass). To the north-east, heavier-textured soils (duplex or uniform clays) are more common and support the C₄ grasses *Bothriochloa* spp., *Dichanthium* spp. and *Heteropogon* spp.. The C₄ grasses *Enteropogon acicularis* (curly Mitchell grass), *Paspalidium* spp. (box grass) and *Sporobolus* spp. occur in both northern and southern locations.

In southern winter rainfall areas with heavy-texture soils the cooler season or C₃ grass species *Austrostipa* spp. (speargrasses) and *Rytidosperma* (formerly *Austrodanthonia*) spp. (wallaby grasses) may enter the ecological community. For example, *Austrostipa aristiglumis* (plains grass) occurs on the richer soils of the southern extent of the ecological community, such as the Liverpool Plains. However, these C₃ species are absent in northern summer rainfall areas.

Where the ecological community is occasionally prone to inundation in low lying areas, several species characteristic of moist sites, such as the sedges *Carex inversa* (knob grass) and *Eleocharis plana* (flat spike-sedge), rushes such as *Juncus* spp. and ferns, such as *Marsilea drummondii* (nardoo) may occur. Seasonal herbs are diverse and include *Bulbine alata* (bulbine lily), *Brachyscome dentata* (lobed-seed daisy), *Einadia nutans* (climbing saltbush), *Erodium crinitum* (blue crowfoot), *Oxalis chnoodes* (wood-sorrell) and *Wahlenbergia* spp. (bluebells).

Low shrubs (<1m) may also occur in the understorey and can be locally patchy. During drought grass species may decline leaving low shrubs as the most conspicuous groundlayer plants. They mostly comprise chenopods such as *Enchylaena tomentosa* (ruby saltbush), *Maireana* spp., *Rhagodia spinescens* (thorny saltbush), *Sclerolaena birchii* (galvanized burr) and *Sclerolaena muricata* (black roly poly).

Plants with a climbing habit may occasionally be present, for example: *Capparis lasiantha* (bush caper), *Glycine canescens* (silky glycine), *Glycine tabacina* (glycine pea) and *Pandorea pandorana* (inland wonga vine).

For further information on plants likely to occur in the ecological community see Appendix E.

2.4.4 Derived Native Grasslands

Poplar Box Grassy Woodland does not often occur as a derived grassland as *Eucalyptus populnea* regrows readily after disturbance and will often be present in the landscape unless the landscape has been highly modified. Patches lacking the canopy cover and tree regrowth are not considered part of this ecological community, except where these represent a gap in, or the edge of a larger patch, or where the tree layer is sparse between two patches across a short distance⁶.

Derived grasslands from intergrading woodlands (e.g. White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland ecological community) are an important part of the broader ecosystem and may have potential for future restoration. They contain much of the native plant biodiversity present in the understorey of grassy woodlands and act as a seed bank and source of genetic material. Derived grasslands also act as buffer zones which protect woodland remnants from adjacent activities, and support the movement of some fauna between remnant woodlands. For this reason they should also be considered as part of the surrounding environment and landscape context for patches of Poplar Box Grassy Woodland (see section 2.6.3 *Further information to assist in determining the presence of the ecological community and significant impacts*).

2.5 Faunal components

The Poplar Box Grassy Woodland exists largely as scattered remnants in a mosaic of various dry and temperate woodlands and modified agricultural landscape in many parts of its range. Therefore many fauna species are not restricted to the ecological community. Fauna likely to be present in the ecological community include larger mammalian herbivores (e.g. kangaroos), smaller ground-dwelling mammals (e.g. short-beaked echidna, bandicoots), arboreal mammals (e.g. possums, koalas), bats, woodland birds, as well as many invertebrates. Given the intensive clearing and fragmentation of grassy woodland remnants across the intensive land use zone of south-eastern Australia, mainly the more common and resilient of vertebrate species remain.

Poplar box trees are a significant hollow forming tree, and provide important habitat for a diverse range of native fauna. The Poplar Box Grassy Woodland therefore provides essential resources such as nesting/breeding sites, protection from predators (for example logs and old growth tree hollows) and sources of food (nuts, seeds, nectar from flowers and invertebrate prey). Many animals are only likely to be part of the Poplar Box Grassy Woodland at certain times. For example, seasonal transients through the community, such as honeyeaters, are most likely to visit during the local flowering season. Some bird species, such as *Accipiter fasciatus* (brown goshawk) and the nationally vulnerable *Grantiella picta* (painted honeyeater) travel

⁶ Where native grassland connects discrete patches of the ecological community in close proximity (up to 50 m apart) then it should be treated as part of a single patch. Also where native grassland is within a gap in, or at the edge of a patch, (up to 50 m from the edge of the tree canopy/saplings) it should be considered to be part of the patch of the ecological community. See also Section 2.6.3.1 (Defining a patch). Native means vegetation 'dominated by native species'; i.e. that 50% or more of the perennial vegetation cover is native.

widely so use remnants of the ecological community as stepping stones to other woodland patches in an otherwise modified agricultural landscape. The association of the woodland ecological community with floodplains indicates its particular importance for birds both as woodland habitat and as nesting sites for colonial breeding waterbirds that rely on occasional wetlands in addition to woodland habitats.

The grassy layers and occasional cracking clays of the Poplar Box Grassy Woodland provide protection for fauna such as *Planigale tenuirostris* (narrow-nosed planigale) and *Sminthopsis crassicaudata* (fat-tailed dunnart). It was also likely to have been home to the extinct *Notomys mordax* (Darling Downs hopping mouse). Other terrestrial species within the ecological community include the soil engineers *Vombatus ursinus* (bare-nosed wombat) and the monotreme *Tachyglossus aculeatus* (short-beaked echidna).

Many bat species (insectivores, frugivores and nectivores) commonly use grassy woodlands such as the Poplar Box Grassy Woodland, for example, *Chalinolobus gouldii* (Gould's wattled bat), *Mormopterus planiceps* (inland freetail bat), *Nyctophilus geoffroyi* (lesser long-eared bat), *Pteropus poliocephalus* (grey-headed flying-fox) and *Vespadelus baverstocki* (inland forest bat). The microchiroptera bat *Chalinolobus picatus* (little pied bat) has been observed to roost in tree hollows of dead and living poplar box trees (Pennay and Freeman, 2005).

The open structure and grassy understorey of the Poplar Box Grassy Woodland provide various habitats for several functional guilds of bird species notably:

- ground-dwelling species that forage and/or nest on the ground and rely on native grasses, herbs and woody debris;
- species dependent on tree-hollows for shelter or breeding;
- insectivores that forage in the canopy layer; and
- mobile and migratory species that track and follow available resources, such as flowers fruits and seeds, across different landscapes and seasons.

Canopy foraging species are typically small arboreal insectivores such as *Pardalotus striatus* (striated pardalote), *Smicrornis brevirostris* (weebill) and *Gavicalis virescens* (singing honeyeater) (Hannah et al., 2007). Bark foraging species include *Daphoenositta chrysoptera* (varied sittella), *Cormobates leucophaea* (white-throated treecreeper) and *Climacteris picumnus* (brown tree-creeper).

The ecological community is essential habitat for several fauna species listed as threatened at national and/or state level, including *Lophoictinia isura* (square-tailed kite) (NSW TSC Act⁷), *Nyctophilus geoffroyi* (lesser long-eared bat), *Onychogalea fraenata* (bridled nailtail wallaby) (EPBC Act; Qld NC Act⁸) and *Phascolarctos cinereus* (koala) (EPBC Act). The Poplar Box Grassy Woodland also provides habitat for several fauna species which are declining or locally extinct in the region. For instance, bird species such as *Anthochaera phrygia* (regent honeyeater) (EPBC Act), *Geophaps scripta* (squatter pigeon) (EPBC Act), *Polytelis swainsonii* (superb parrot) (EPBC Act), *Pomatostomus temporalis temporalis* (grey-crowned babbler (eastern subspecies) (NSW TSC act) and *Stagonopleura guttata* (diamond firetail) (NSW TSC Act) (Reid JRW., 2000). Other locally rare species include *Ardeotis australis* (Australian bustard) (NSW TSC Act) and *Dromaius novaehollandiae* (emu).

Reptiles from a range of groups that are likely to be present in the Poplar Box Grassy Woodland include: *Ctenotus ingrami* (unspotted yellow-sided ctenotus), *Pogona barbata* (eastern bearded dragon), *Pseudonaja textilis* (eastern brown snake), *Tiliqua rugosa* (shingleback lizard) and *Varanus varius* (lace monitor).

⁷ NSW Threatened Species Conservation Act 1995

⁸ Queensland Nature Conservation Act 1992

The ecological community also provides habitat for a range of amphibian species. These include appropriate substrates and microclimates for burrowing species such as *Cyclorana novaehollandiae* (New Holland frog), *Cyclorana verrucosa* (rough frog) and *Neobatrachus sudellae* (Sudells burrowing frog), above ground sites in standing vegetation, e.g. tree hollows, for arboreal species such as *Litoria peronii* (Peron's tree frog) and *Litoria rubella* (desert tree frog) and seasonally damp sites for breeding, such as for *Limnodynastes tasmaniensis* (spotted grass frog) and *Crinia sloanei* (Sloane's froglet).

Appendix E, Table E3 lists the various fauna species known to be associated with the Poplar Box Grassy Woodland and that use it as habitat, including threatened species.

DRAFT

2.6 Key diagnostic characteristics and condition thresholds

In order to be considered a Matter of National Environmental Significance under the EPBC Act, areas of the ecological community must meet:

- the Key diagnostic characteristics (in Section 2.6.1); AND
- at least the minimum Condition thresholds for Moderate quality (i.e. for class B, in Section 2.6.2).

National listing focuses legal protection on patches of the ecological community that are the most functional, relatively natural (as outlined in the '*Description*') and in comparatively good condition.

The Poplar Box Grassy Woodland is generally found on moderate to high fertile soils. Owing to the productive nature of the soils they grow on, most of the grassy box woodlands have been historically cleared for agriculture. Remnants of the Poplar Box Grassy Woodland often exhibit various degrees of disturbance and degradation. This degree of degradation has been taken into account in developing the condition thresholds (Section 2.6.2 *Condition thresholds*).

Key diagnostic characteristics and condition thresholds assist in; identifying a patch of native vegetation as being the threatened ecological community; determining whether the referral, environment assessment and compliance provisions of the EPBC Act are likely to apply to a patch; and distinguishing between patches of different quality.

Because the ecological community exhibits various degrees of disturbance and degradation, condition categories and thresholds have been developed. These provide guidance on whether a patch of a threatened ecological community retains enough conservation values to be considered as a Matter of National Environmental Significance (MNES), as protected under the EPBC Act. This enables the referral, assessment and compliance provisions of the EPBC Act to be focussed on the most valuable elements of the ecological community. Very degraded patches, which do not meet the minimum condition thresholds, will be largely excluded from national protection.

In some cases, the loss and degradation is irreversible; or rehabilitation is impractical because many natural characteristics have been removed. For instance, most areas permanently converted to improved pastures are unlikely to be effectively restored.

Further information to assist in determining the presence of the ecological community and significant impacts (in Section 2.6.3) *should also help with identifying the ecological community.*

For EPBC Act referral, assessment and compliance purposes, the nominated ecological community is limited to patches that meet the following diagnostic characteristics and condition thresholds.

2.6.1 Step 1 Key diagnostic characteristics

The key diagnostic characteristics summarise the main features of the Poplar Box Grassy Woodland and are intended to aid the identification of the national ecological community, noting that a broader description is given in previous sections.

The key diagnostic characteristics of the ecological community are:

Location and physical environment:

- Occurs in the Brigalow Belt North, Brigalow Belt South, Cobar Peneplains, Darling Riverine Plains, NSW South Western Slopes, Riverina and Murray Darling Depression IBRA bioregions.
- Associated with ancient and recent depositional alluvial plains with clay, clay-loam, loam and sandy loam, non-sodic soils.

Structure:

- A grassy woodland to grassy open woodland with a tree crown cover⁹ of 10% or more at patch scale.
- A canopy (tree) layer, capable of reaching 10 m or more in height and dominated¹⁰ by *Eucalyptus populnea* (poplar box) or co-dominated with *E. populnea* hybrids.
- Mid layer (1-10 m) crown cover of shrubs to small trees¹¹ of 20% or less.
- A ground layer (<1 m) mostly dominated across a patch by native grasses, other herbs and occasionally chenopods, ranging from sparse to thick (in response to canopy development, soil moisture, disturbance and/or management history). Characteristic ground layer species are at Table E1 in Appendix E (not all species are present within each patch).

Contra-indicators:

The dominance of the following species in the canopy layer indicates that a patch is not the Poplar Box Grassy Woodland and that a different ecological community is present. Dominance refers to the single and/or combined contribution of any of the following species as being more than 50% of the total tree crown cover:

- *Acacia aneura* (mulga)
- *Acacia harpophylla* (brigalow)
- *Allocasuarina luehmannii* (buloke)
- *Callitris glaucophylla* (white cypress pine)
- *Casuarina cristata* (belah)
- Other species of eucalypts, but notably *Eucalyptus moluccana* (grey box), *E. microcarpa* (grey box, western grey box), *E. woollsiana* (grey box, narrow leaved grey box)
- *E. albens* (white box), *E. coolabah* (coolibah), *E. largiflorens* (black box) and *E. melliodora* (yellow box) that are known to co-occur with poplar box

⁹ Crown cover is the percentage of the sample site within the vertical projection of the periphery of the tree crowns with the crowns considered to be opaque.

¹⁰ Dominant, in this document means accounting for more than 50% of the crown cover. Crown cover is the preferred benchmark for dominance; except in regenerating areas with few mature canopy trees. Where this is the case, tree basal area is the next best measure of dominance, since it measures biomass to some degree.

Tree basal area: the cross-sectional area of a tree trunk measured at breast height (1.3 m) over bark.

¹¹ Small trees are those typically less than 10m in height at maturity. This is not including seedlings and non-native trees of canopy layer species.

2.6.2 Step 2 Condition thresholds

If the patch fits the key diagnostics characteristics, then the following condition thresholds need to be considered. Information in Section 2.6.3 should also be taken into account when assessing a patch of remnant vegetation.

The condition thresholds for this ecological community are designed to identify the best patches for national protection (**Table 3**). As the ecological community has been heavily cleared and degraded, many of the remnants are fragmented, isolated and modified. Any remnants that remain largely intact, include mature trees, or are connected to other native vegetation and form a large patch are a high priority for protection and management. Small, isolated patches subject to high disturbance, for example, narrow stands of trees without native understorey, either on farms or roadsides do not contribute so greatly to the conservation of the ecological community so may not meet the condition thresholds for national protection.

Although very degraded/modified patches are not considered part of the ecological community, it is recognised that some patches that do not meet the minimum condition thresholds may still contain important natural values and may be critical to protecting those patches that meet the minimum thresholds. They may also be protected through state and local laws or covenants. Therefore, these patches should not be excluded from recovery and other management actions. Suitable recovery and management actions may improve these patches to the point that they may be regarded as part of the ecological community fully protected under the EPBC Act. Management actions should, where feasible, also aim to restore patches to meet the highest quality condition thresholds outlined below.

Note:

- Consideration must be given to the timing of surveys and recent disturbance (see 2.6.3.4, Timing of Surveys for more detail).
- The surrounding context of a patch must also be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds (see 2.6.3.6, Surrounding environment and landscape context for more detail).
- A relevant expert (e.g. ecological consultant, local NRM or environment agency) may be useful to help identify the ecological community and its condition.

In Table 3 shows Class B is the minimum threshold for remnant native patches to be considered moderate quality and part of the ecological community subject to the referral assessment and compliance provisions of the EPBC Act. Classes A1, A2 and A3 are the thresholds for a patch to be regarded as highest quality and provide guidance for restoration of lower condition patches.

Table 3. Draft condition categories and thresholds for the Poplar Box Grassy Woodland on Alluvial Plains ecological community

| Category and rationale | Native cover and diversity thresholds | Minimum patch size thresholds |
|---|---|-------------------------------|
| CLASS A HIGHEST QUALITY | | |
| Class A1 category. Little to no perennial weeds and diverse native understorey | ≥ 90% of perennial vegetation cover in ground layer* is native And ≥ 30 native plant species per ha in ground layer | ≥ 1 ha |
| Class A2 category. A large patch with low perennial weeds and diverse native understorey | ≥ 70% of perennial vegetation cover in ground layer* is native And ≥ 30 native plant spp. per ha in ground layer | ≥ 5 ha |
| Class A3 category. A large patch with high quality habitat features | ≥ 10 trees per ha with ≥ 30cm dbh** (and/or with hollows) And smaller trees, saplings or seedlings suggestive of periodic recruitment And ≥ 20 native plant spp. per ha in ground layer | ≥ 5 ha |
| CLASS B MODERATE QUALITY | | |
| A large patch with moderate quality native understorey | ≥ 50% of perennial vegetation cover in ground layer* is native And ≥ 20 perennial native plant species per ha in ground layer Or ≥ 10 trees per ha with ≥ 30cm dbh** (or hollows) | ≥ 5 ha |

* **Perennial vegetation cover in the ground layer** (i.e. below the tree canopy) includes vascular plant species of the ground layer with a life-cycle of more than two growing seasons. The ground layer includes herbs (i.e. grasses and forbs) and some low shrubs (woody plants ≤ 1 m high). Measurement of perennial ground layer vegetation cover excludes annuals, cryptogams (i.e. mosses, lichens and related flora), leaf litter or exposed soil.

** **Dbh** (diameter at breast height) refers to the tree diameter measured at 1.4 m above the ground.

2.6.3 Further information to assist in determining the presence of the ecological community and significant impacts on the ecological community

Landuse history influences the current state of a patch of the Poplar Box Grassy Woodland. The structural form of the ecological community will also influence its species richness and diversity. The position of a patch relative to surrounding vegetation also influences how important a patch of the ecological community is in the broader landscape. For example, if it enables movement of native fauna or plant material or supports other ecological processes.

2.6.3.1 Defining a patch

A patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks (including exposed soil, leaf litter, cryptogams and watercourses/drainage lines), or localised variations in vegetation that do not significantly alter the overall functionality¹² of the ecological community. Such breaks are generally included in patch size calculations. Where there is a break in native vegetation cover, from the edge of the tree canopy of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies typically more than 30 m wide) then the gap typically shows that separate patches are present (see Appendix F for interpreting patches in a roadside verge context).

Variation in canopy cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition. Average canopy cover and quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall canopy cover and vegetation condition. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition categories that would apply across different parts of the site respectively. Where the average canopy cover or quality falls below the minimum thresholds, the next largest area or areas that meet key diagnostics (including minimum canopy cover requirements) and minimum condition thresholds should be specified and protected. This may result in multiple patches of the ecological community being identified within the overall area first considered.

2.6.3.2 Buffer zone

A buffer zone is a contiguous area immediately adjacent to a patch of the Poplar Box Grassy Woodland that is important for protecting its integrity. As the risk of damage to an ecological community is usually greater for actions close to a patch, the purpose of the buffer zone is to minimise this risk by guiding land managers to be aware when the ecological community is nearby and take extra care around the edge of patches. The buffer zone will help protect the root zone of trees and other components at the edge of the ecological community from spray drift (fertiliser, pesticide or herbicide sprayed in adjacent land) and other threats, such as weed invasion.

The buffer zone is not part of the ecological community; so whilst having a buffer zone is strongly recommended, it is not formally protected as a matter of national environmental significance. For EPBC Act approval, changes in use of the land that falls within the buffer zone must not have a significant impact on the ecological community, but there are exemptions for continuing use (e.g. cropping, grazing or maintaining existing fire breaks). If the use of an area that directly adjoins a patch of the ecological community will be intensified, approval under the

¹² Functionality refers to processes such as the movement of wildlife and pollinators, the dispersal of plant propagules, activities of seed and plant predators and many others.

EPBC Act may also be needed to avoid adverse impacts. The buffer zone may also be a suitable focus for revegetation or other restoration initiatives.

The recommended minimum buffer zone is 30 m from the outer edge of the patch (as defined by the edge of the tree canopy) as this distance accounts for likely influences upon the root zone. A larger buffer zone should be applied, where practical, to protect patches that are of particularly high conservation value, or if patches are down slope of drainage lines, a source of nutrient enrichment or groundwater drawdown.

2.6.3.3 Revegetated areas and areas of regrowth

Revegetated or replanted sites and areas of regrowth are included in the Poplar Box Grassy Woodland, provided that the patch meets the *Key diagnostic characteristics* and *Condition thresholds* above. It is recognised that revegetation often needs longer-term effort and commitment and it may take some time for a degraded patch to reach minimum condition. It is recognised that reconstruction/revegetation often requires long term effort and commitment and results are uncertain. Reconstructing a woodland or forest ecological community to a state that resembles appropriate reference sites can, at best, be extremely slow and ultimately prove unsuccessful (Wilkins et al., 2003).

2.6.3.4 Sampling protocols

Thorough and representative on-ground surveys are essential to accurately assess the extent and condition of the ecological community. Patches can vary markedly in their shape, size, condition and features that appear within a given patch. As a general principle, sampling protocols and the number of sample plots/transects should address the following:

- sampling in area(s) with the highest apparent number of different native plant species to determine estimates of native species richness in each patch;
- significant variation in the vegetation, landscape qualities and management history (where known) across the patch; for instance localised weed cover, drainage lines, grazed areas, saline zones; and
- an appropriate size and number of plots or transects to provide a representative sample across the full extent of the patch (taking into consideration the shape and condition across the site, as well as providing a good representation of the species present).

The application of plots/transects per patch must take into consideration the size, shape and condition across the site. Recording the search effort (identifying the number of person hours spent per plot/transect and across the entire patch; along with the surveyor's level of expertise and limitations at the time of survey) is useful for future reference.

2.6.3.5 Timing of surveys and seasonal variation

The timing of surveys is an important consideration because the Poplar Box Grassy Woodland can be variable in its appearance throughout the year and between years depending on drought-rain cycles. Seasonal factors also determine the visual dominance of taxa. For example, native grasses such as *Bothriochloa* spp. are easily recognised when flowering in summer and early autumn; however, the same sites when surveyed in June or July may be dominated by exotic annuals. There may also be a flush of non-native species in early spring.

On balance an assessment should occur in spring to early summer, when the greatest number of species is likely to be detectable and identifiable. Ideally, surveys should be held in more than one season to maximise the chance of detecting all species present. In years of low rainfall, assessment should recognise that many species may not be detectable. In these situations it is preferable that surveys are carried out over more than one year. For example, during prolonged dry periods, many grass species may not be apparent with drought tolerant forbs and low species e.g. chenopods, dominating the understorey for a time. Where possible, pool results of all surveys across years.

As well as considering the detectability of flora species in the ground layer at different times of their life cycle, timing of surveys should also allow for recovery after recent disturbances to the ecological community (whether natural, or human-induced). For example, after a severe fire or flood one or more vegetation layers may be absent for a time. Ideally, to maximise the assessment of understory condition, sites should be assessed during a good season, six months after cessation of disturbance (fire/grazing/mowing/slashing) and within two months of effective rain. At a minimum, it is important to note climate conditions and what kind of disturbance may have happened within a patch and when that disturbance occurred.

2.6.3.6 Surrounding environment and landscape context and other considerations

Actions that may have 'significant impacts'¹³ on any patches of the Poplar Box Grassy Woodland, that meet the minimum *Condition thresholds* (in Section 2.6.2) need referral under the EPBC Act.

The ecological importance of a patch is influenced by its surrounding landscape; for example, if it is connected to, or near, other areas of native vegetation the patch may contribute substantially to landscape connectivity and function. Similarly, actions beyond the boundary of a patch may have a significant impact on the patch (for example, through changes in hydrology). For this reason, when considering actions likely to have impacts on this ecological community, it is important to also consider the environment surrounding any patches of the ecological community. Other patches may occur in isolation and in addition to requiring protection may also need management of the surrounding area and/or linking them with other native vegetation.

In some cases patches do not currently meet *Condition thresholds*, and so are not recognised as part of the nationally protected ecological community (i.e. they are not a Matter of National Environmental Significance). However, in the context of their surroundings, recovery to a higher condition may be possible, so these areas should be considered as a priority for management and funding and for inclusion in buffer zones.

The following indicators of the ecological context provided by the areas surrounding patches of the ecological community should be considered both when assessing the impacts of actions or proposed actions under the EPBC Act, or when considering priorities for recovery, management and funding:

- Large size and/or a large area to boundary ratio – patches with larger area to boundary ratios are less exposed and more resilient to edge effects (from disturbances such as weed invasion and other anthropogenic impacts). However, patches that occur in areas where the ecological community has been most heavily cleared and degraded, or that are at the natural edge of its range, may also have importance due to their rarity, genetic significance, or because of the absence of some threats;
- Evidence of recruitment of key native plant species or the presence of a range of age cohorts (including through successful revegetation). For example, tree canopy species are present as saplings through to larger hollow-bearing trees;
- Good faunal habitat as shown by: diversity of landscape, the diversity of plant species, patches containing mature trees (particularly those with hollows), logs, or large rocks, and that contribute to movement corridors;
- High species richness, as shown by the variety of native plant species or high number of native fauna species;
- Patches that contain a unique combination of species and/or rare or important species in the context of the particular ecological community or local region (for example, a patch with

¹³ A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Further information regarding 'significant impact' and the EPBC Act is available at DOTE (2015).

unique fauna and/or understorey flora composition; or a patch that contains flora or fauna that has largely declined in the broader ecological community or region);

- Presence of EPBC and state listed threatened species or key functional species such as key pollinator and dispersal animals;
- Areas of minimal weeds and feral animals or where these can be efficiently managed;
- Presence of cryptogams, soil crust and leaf litter on the soil surface, which may indicate low recent disturbance to natural soil structure and potential for good functional attributes such as nutrient cycling;
- Connections to other native vegetation remnants or restoration works (e.g. native plantings) in particular, a patch in an important position between (or linking) other patches in the landscape (taking into account that connectivity should not exacerbate the incidence or spread of threats e.g. weeds). This can contribute to movement of fauna and transfer of pollen and seeds; and
- Linear road reserves or stock routes often contain remnant native vegetation in good to moderate condition, representing a diverse range of upper storey, mid-storey and ground layer species. These areas also act as important corridor links to larger patches of nearby vegetation. In many instances linear reserves can represent the only remnant native vegetation occurring in an area where adjacent land has largely been cleared.

2.6.3.7 Area critical to the survival of the ecological community

Areas that meet the minimum condition thresholds (i.e. moderate condition class in Table 3), or are within the buffer zone, are considered critical to the survival of the Poplar Box Grassy Woodland. Additional areas such as adjoining native vegetation and areas that meet the description of the ecological community but not the condition thresholds are also important to the survival of the ecological community and should be taken into consideration as part of the surrounding environment and landscape context, as outlined in the previous section (Section 2.6.3.6).

2.7. Relationships to other vegetation classification systems

2.7.1. Caveat

In each State and Territory, different systems are used to classify ecological communities and vegetation types. This can create challenges of comparison. The various methods of classifying and mapping ecological communities may also vary in accuracy, particularly if distributions are modelled. Any reference to vegetation and mapping units as equivalent to a national ecological community, at the time of listing, should be taken as indicative rather than definitive. Consideration of whether a nationally protected ecological community is present at any site should focus on how the patch meets the description, particularly the key diagnostic characteristics and condition thresholds for the ecological community.

2.7.2. Relationships to national and state vegetation systems

2.7.2.1. National Vegetation Information System (NVIS)

Under the National Vegetation Information System (NVIS), the Poplar Box Grassy Woodland can be classified as follows:

Major Vegetation Group (MVG)

- 5 - Eucalypt woodlands; and
- 11 - Eucalypt Open Woodlands

Major Vegetation Subgroup (MVS)

- 9 - *Eucalyptus* woodlands with a tussock grass understorey; and
- 48 - *Eucalyptus* open woodlands with a grassy understorey.

2.7.2.2. *New South Wales*

NSW has classified its vegetation under various schemes. Under the broad-scale classification by Keith (2004), the Poplar Box Grassy Woodlands align with the following formations and classes:

- Grassy woodlands - Floodplain transition woodlands
- Semi-arid Woodlands (Grassy sub-formation) - North-west floodplain woodlands

Finer-scale vegetation units were determined for the NSW Plant Community Type (PCT) (formerly known as Vegetation Classification and Assessment units - VCA) by Benson et al. (2006; 2010). These provide a descriptive basis for identifying vegetation communities in NSW and have since been subsumed into the NSW Vegetation Information System (VIS) database. The following Plant Community Type (PCT) identification units best correspond to the Poplar Box Grassy Woodland:

- PCT56 - Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW
- PCT87¹⁴ - Poplar Box - Coolabah floodplain woodland on light clay soil mainly in the Darling Riverine Plains Bioregion
- PCT101 - Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion
- PCT244 - Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)

The ecological community may also occur as minor components of PCT88 - Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

The reports for the NSW PCT provide a detailed summary of information about the ecological community, including a summary of previous vegetation mapping and classifications (Benson et al., 2006; Benson et al., 2010).

Vegetation community descriptions also were developed for the NSW biometric system that is linked to the NRM regionally-based vegetation management system. The following Biometric vegetation types correspond to the Poplar Box Grassy Woodlands:

- Border Rivers/Gwydir region: BR186, BR187, BR189, BR190
- Central West region: CW167, CW168, CW172
- Namoi region: NA182, NA183, NA185, NA186
- Lachlan region: LA175, LA178
- Western region: WE78, WE136, WE138

2.7.2.3. *Queensland*

Queensland classifies its vegetation using a system of Regional Ecosystems (RE). In the Regional Ecosystem designations (e.g. 11.3.2) the first number denotes the bioregion, the second number the Land Zone and the third number the vegetation type. The Poplar Box Grassy Woodland mostly occurs in the Brigalow Belt bioregion extending into the South Eastern Queensland bioregion. It is associated with Land Zones 3 (Recent Quaternary Alluvial Systems, derived from sediments that are mass deposited from channelled stream flow or over-bank stream flow) and Land Zone 4 [Paleogene-early Quaternary Clay Plains that originate from ancient alluvial deposits and aeolian clays (parna)] and are elevated above Land Zone 3. The following REs best correspond with the Poplar Box Grassy Woodland:

¹⁴ PCT87 is ecotonal between EPBC Act and NSW TSC Act listed Coolabah Woodlands and Poplar Box woodland but would qualify for this ecological community when dominated by poplar box and the other key diagnostics are met.

- RE11.3.2 *Eucalyptus populnea* woodland on alluvial plains
- RE11.3.17 *Eucalyptus populnea* woodland with *Acacia harpophylla* and/ or *Casuarina cristata* on alluvial plains
- RE11.4.7 *Eucalyptus populnea* with *Acacia harpophylla* and/or *Casuarina cristata* open forest to woodland on Cainozoic clay plains
- RE11.4.12 *Eucalyptus populnea* woodland on Cainozoic clay plains
- RE12.3.10 *Eucalyptus populnea* woodland on alluvial plains

There may be some variants recognised within these Regional Ecosystems that are not part of the national ecological community. For instance, areas mapped as RE 11.3.2a *Eucalyptus conica* woodland are unlikely to be the national ecological community because *Eucalyptus conica* dominates the canopy.

Queensland also has a higher level vegetation classification, the Broad Vegetation Group (BVG), of which the ecological community generally corresponds to one type:

- 17a - Woodlands dominated by *Eucalyptus populnea* (poplar box) or *E. brownii* (red river box) on alluvium, sand plains and footslopes of hills and ranges.

2.7.3. Relationships to State-listed ecological communities

All five Queensland Regional Ecosystems that correspond to the national ecological community, are listed as threatened under the *Queensland Vegetation Management Act 1999* and *Environmental Protection Act 1994* (Table 4a).

Table 4a. Legislative status of Queensland Regional Ecosystems that correspond to the Poplar Box Grassy Woodland ecological community.

| Regional ecosystem | Vegetation Management Act class | Biodiversity status |
|--------------------|---------------------------------|---------------------|
| RE11.3.2 | of concern | of concern |
| RE11.3.17 | of concern | endangered |
| RE11.4.7 | endangered | endangered |
| RE11.4.12 | endangered | endangered |
| RE12.3.10 | endangered | endangered |

Source: Accad and Neldner (2015)

There are no vegetation types which correspond with the national ecological community that are formally recognised as threatened in NSW, as at January 2017. However, the following NSW *Threatened Species Conservation Act 1995* (TSC) listed ecological communities may contain minor components of, intergrade with, or occur adjacent to, the national Poplar Box Grassy Woodland:

- Artesian Springs Ecological Community (TSC: Endangered).
- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (TSC: Endangered).
- Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions (TSC: Endangered).
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (TSC: Endangered).
- Native Vegetation on Cracking Clay Soils of the Liverpool Plains (TSC: Endangered).
- White Box Yellow Box Blakely's Red Gum Woodland (TSC: Critically Endangered).

2.7.4 Similar and intergrading ecological communities

The Poplar Box Grassy Woodland is a relatively distinctive woodland that co-occurs with other woodland to open forest vegetation associations within a matrix of remnant native vegetation in the temperate and semi-arid zones of NSW and Queensland. The Poplar Box Grassy Woodland is mainly distinguished from similar threatened woodland types by the dominant presence of *Eucalyptus populnea* in the tree canopy and from native grasslands by the presence of a tree canopy. Other poplar box woodlands may overlap with the national ecological community; for example, PCT105 (Poplar Box grassy woodland on flats mainly in the Cobar Peneplain Bioregion and Murray Darling Depression Bioregion) and PCT207 (Poplar Box grassy low woodland of drainage lines and depressions of the semi-arid (hot) and arid zone climate zones). However, these are considered to be distinct from the national ecological community as they have few understorey species in common.

Woodlands dominated by poplar box also occur in bioregions to the west of the Darling Riverine Plains and Brigalow Belt South bioregions. These are excluded from the national ecological community on the basis that they are associated with different soils, landscape or climate. Further inland, towards the Mulga lands, in Queensland for example, the landscape becomes progressively arid and the diversity of woodland ground layer plant species becomes increasingly depauperate.

Throughout the range the ecological community grades into various floodplain woodlands dominated by other tree canopy species. Differences in the tree canopy species are determined by flood levels and landscape position. For instance, woodlands dominated by *Eucalyptus camaldulensis* (river red gum) are closely associated with the banks of channels, streams, drainage lines and associated floodplains and are inundated more often than Poplar Box Grassy Woodland. Woodlands dominated by *Callitris glaucophylla* (white cypress pine) occupy sites on higher ground with loamy or sandy soils. The national ecological community may also grade into native grasslands, for example, in the Liverpool Plains where there are heavier, cracking clay soils.

Other intergrading nationally listed woodland and grassland ecological communities include:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) is associated with a wide range of landscapes including river and creek flats, but mainly on old loamy and sandy plains, basalt plains and hills, or hills and lowlands on metamorphic or granitic rocks. Brigalow is usually either dominant in the canopy or co-dominant with other species such as *Casuarina cristata* (belah), other species of *Acacia*, and occasionally with species of *Eucalyptus*. The structure of the vegetation ranges from open forest to open woodland but unlike the Poplar Box Grassy Woodland, a prominent shrub layer is usually present.
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions is associated with the floodplains and drainage areas. It is found on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands, stream levees, drainage depressions and areas of lower floodplain that remain inundated for longer periods in addition to higher floodplain areas. Although this ecological community has a very similar structure to Poplar Box Grassy woodland, its canopy is dominated by *Eucalyptus coolabah* (coolibah) or with *E. largiflorens* (black box). Coolibah is known to hybridise with a range of other eucalypt species, including black box and poplar/bimble box.
- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia can occur in NSW on low relief landscapes such as undulating plains, drainage depressions and flats with alluvial and colluvial soils but is not generally associated with floodplains. Grey Box Grassy Woodlands are distinguished by the dominant presence of grey box in the canopy and an understorey with a moderately dense (up to 30%) to shrub layer.

- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin and the Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland. Both of these are natural grasslands where a tree layer is sparse or absent.
- Weeping Myall Woodlands occur on flat areas, shallow depressions or gilgais on raised (relictual) alluvial plains. These areas are not associated with active drainage channels and are rarely flooded. This ecological community can exist naturally either as a shrubby or a grassy woodland but is distinguished by the dominance of *Acacia pendula* (weeping myall) in the canopy.
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland are characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of *Eucalyptus albens* (white box), *Eucalyptus melliodora* (yellow box) or *Eucalyptus blakelyi* (Blakely's red gum) trees. The main distribution of this woodland generally occurs further east of the Poplar Box Grassy Woodland, but there are some areas where the two ecological communities occur nearby.

2.8 Existing protection

The majority of the remaining area of the ecological community occurs on private or leasehold land. Of the remaining area of the ecological community, approximately 16 750 ha (1.5%) occurs in conservation reserves (Table 4b).

Table 4b. Conservation reserves containing the Poplar Box Grassy Woodland ecological community

| Vegetation unit | Conservation Reserve |
|------------------------|---|
| Queensland | |
| RE11.3.2 | Carnarvon NP, Taunton NP, Expedition (Limited Depth) NP, Dipperu NP, Homevale RP 2, Chesterton Range NP, Homevale NP, Expedition RP, Tregole NP, Nuga Nuga NP, Isla Gorge NP, Blackdown Tableland NP, Narrien Range NP, Bouldercombe Gorge RP 2, Epping Forest NP, Lake Broadwater RP |
| RE11.3.17 | Carnarvon NP, Culgoa Floodplain NP |
| RE11.4.7 | Humboldt NP |
| RE11.4.12 | Nil |
| RE12.3.10 | Nil |
| New South Wales | |
| PCT56 | Bobbiwaa SCA, Boomi and Boomi West NR, Boronga NR, Gamilaroi NR, Killarney SCA, Macquarie Marshes NR |
| PCT87 | Boomi West NR, Budelah NR, Culgoa NP, Narran Lake NR |
| PCT88 | Bobbiwaa SCA, Brigalow SCA, Bullawa NP, Coolbaggie NR, Gamilaroi NR, Timallallie NP, Trinkey SCA |
| PCT101 | Gunyerwarildi NP |
| PCT244 | Boomi NR, Boomi West NR, Boronga NR, Budelah NR, Midkin NR |

NP - National Park; NR - Nature Reserve; RP - Regional Park; SCA - State Conservation Area

3 SUMMARY OF THREATS

The key threats to the ecological community are:

- **Clearance and fragmentation.** Agricultural development and now mining and gas development are the main drivers of clearing; remaining areas of the community are more fragmented (isolated) and much less resilient to on-going impacts from a range of threats.
- **Weed invasion.** Weeds compete with locally indigenous flora species for available resources (water, light, nutrients) and lead to a decline in the diversity and regenerative capacity of a native ecosystem. For example, weed species impacting diversity in the ground layer of the ecological community include: buffel grass (*Cenchrus ciliaris*) in Qld, Coolatai grass (*Hyparrhenia hirta*) in southern Qld and northern NSW, African lovegrass (*Eragrostis curvula*) in NSW and lippia (*Phyla canescens*) at sites subject to occasional inundation.
- **Inappropriate fire and grazing regimes.** Fire intensity, frequency, seasonality and patchiness in addition to grazing regimes by domestic stock and grazing of regrowth by native fauna, influence vegetation composition and structure as well as the success of plant invasions and the subsequent impacts on native biota. Native perennial grasses within good quality patches of the ecological community can produce appropriate fire loads that generally benefit native groundcover species. Changes to less frequent and lower intensity fires can alter understorey structure. More intense and frequent fires, as a result of introduced grasses, can substantially reduce the understorey diversity within the Poplar Box Grassy Woodlands and further their spread into the ecological community.
- **Dieback** within the Poplar Box Grassy Woodland occurs via a range of causes, such as insect and vertebrate herbivory, water stress and pathogens, can lead to widespread long-term decline in tree health. Ongoing defoliation can exhaust tree energy reserves, particularly when combined with other environmental stresses, such as unfavourable weather conditions, leading to death and medium to long term loss of canopy species.
- **Chemical impact and spraydrift** from agricultural chemicals. As the canopy trees and grassy/herbaceous understorey of the Poplar Box Grassy Woodland are dependent on surface and groundwater, and given the ecological community mainly occurs on alluvial soils in agricultural areas, the inappropriate application of chemicals, inorganic fertilisers or pesticide/herbicide e.g. spray drift of chemicals via various pathways can adversely impact on the integrity of the ecological community.
- **Salinity.** Largely due to modification of the landscape and hydrology through overclearing. Poplar box Grassy Woodlands generally occur in low to non-sodic soils. Salinity affects both the understorey and overstorey species in remnant native woodlands particularly the growth and health of poplar box trees during drought.
- **Nutrient enrichment.** Nutrient enrichment of native grassy woodland such as the ecological community remnants is highly detrimental to the many native plant species that have adapted to the lower nutrient status of most Australian soils. This can occur through the spread of inorganic fertilisers, incidental drift from adjacent farmland or accumulation of manure from livestock. Increased availability of soil nutrients following soil disturbance also contributes to the establishment of weeds into grassy systems such as the Poplar Box Grassy Woodland.
- **Hydrological changes** (including altered groundwater levels). Largely due to modification of the landscape through overclearing, changed aquifer and river levels. Changes in ground water levels can increase soil salinity
- **Invasive fauna.** The Poplar Box Grassy Woodland provides habitat for many ground dwelling birds and animals. Pest species such as foxes and cats impact these small to medium native animal species through predation and also compete for resources. Rabbits can selectively remove the most palatable herbs and grasses and suppress regeneration. Goats damage trees and can cause erosion, while pigs damage groundlayer vegetation by

digging and turning over soil impacting on the structure and integrity of the ecological community.

- **Climate change** across the distribution of Poplar Box Grassy Woodland is likely to include increases in temperatures, seasonality and intensity of rainfall, with unknown compounding effects on other disturbances such as fire. In addition to threatening species that cannot adapt, by altering resource availability and the competitive relationships between species, climate change can exacerbate existing threats such as habitat loss.

3.1. Key threatening processes

Key threatening processes have been defined at the national level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and for NSW under the *NSW Threatened Species Conservation Act 1995* (TSC Act). Those most relevant to the Poplar Box Grassy Woodland are listed in Table 5a:

Table 5a. Potentially relevant key threatening processes identified in the Threatened Species and Communities Act (NSW) and the EPBC Act.

| NSW TSC Act | EPBC Act |
|--|--|
| | <ul style="list-style-type: none"> • Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (<i>Manorina melanocephala</i>) |
| <ul style="list-style-type: none"> • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands | |
| <ul style="list-style-type: none"> • Anthropogenic climate change | <ul style="list-style-type: none"> • Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases |
| <ul style="list-style-type: none"> • Clearing of native vegetation | <ul style="list-style-type: none"> • Land clearance |
| <ul style="list-style-type: none"> • Competition and grazing by the feral European rabbit (<i>Oryctolagus cuniculus</i>) | <ul style="list-style-type: none"> • Competition and land degradation by rabbits |
| <ul style="list-style-type: none"> • Competition and habitat degradation by feral goats (<i>Capra hircus</i>) | <ul style="list-style-type: none"> • Competition and land degradation by unmanaged goats |
| <ul style="list-style-type: none"> • Competition from feral honey bees (<i>Apis mellifera</i>) | <ul style="list-style-type: none"> • Novel biota and their impact on biodiversity |
| <ul style="list-style-type: none"> • Exotic vines and scramblers | <ul style="list-style-type: none"> • Novel biota and their impact on biodiversity |
| <ul style="list-style-type: none"> • Herbivory and environmental degradation caused by feral deer | <ul style="list-style-type: none"> • Novel biota and their impact on biodiversity |
| <ul style="list-style-type: none"> • High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition | |
| <ul style="list-style-type: none"> • Infection by <i>Psittacine circoviral</i> (beak and feather) disease affecting endangered psittacine species and populations | <ul style="list-style-type: none"> • <i>Psittacine circoviral</i> (beak and feather) Disease affecting endangered psittacine species |
| <ul style="list-style-type: none"> • Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae | <ul style="list-style-type: none"> • Novel biota and their impact on biodiversity |
| <ul style="list-style-type: none"> • Invasion and establishment of the cane toad (<i>Bufo marinus</i>) | <ul style="list-style-type: none"> • The biological effects, including lethal toxic ingestion, caused by Cane Toads (<i>Bufo marinus</i>) |
| <ul style="list-style-type: none"> • Invasion of native plant communities by exotic perennial grasses | <ul style="list-style-type: none"> • Novel biota and their impact on biodiversity |

| NSW TSC Act | EPBC Act |
|--|--|
| <ul style="list-style-type: none"> Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants | <ul style="list-style-type: none"> Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants |
| <ul style="list-style-type: none"> Loss of hollow-bearing trees | |
| <ul style="list-style-type: none"> Predation and hybridisation of feral dogs (<i>Canis lupus</i>) | <ul style="list-style-type: none"> Novel biota and their impact on biodiversity |
| <ul style="list-style-type: none"> Predation by the European red fox (<i>Vulpes vulpes</i>) | <ul style="list-style-type: none"> Predation by European red fox |
| <ul style="list-style-type: none"> Predation by the feral cat (<i>Felis catus</i>) | <ul style="list-style-type: none"> Predation by feral cats |
| <ul style="list-style-type: none"> Predation, habitat degradation, competition and disease transmission by feral pigs (<i>Sus scrofa</i>) | <ul style="list-style-type: none"> Predation, habitat degradation, competition and disease transmission by feral pigs |
| <ul style="list-style-type: none"> Removal of dead wood and dead trees | |
| <ul style="list-style-type: none"> More information on threats to the ecological community is provided in Appendix A - Description of threats. | |

Source: Office of Environment and Heritage (2016); DotE (2016).

The following approved EPBC threat abatement plans¹⁵ are considered relevant to the Poplar Box Grassy Woodland:

- Threat abatement plan for competition and land degradation by unmanaged goats;
- Threat abatement plan for competition and land degradation by rabbits;
- Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi*;
- Threat abatement plan for predation by European red fox;
- Threat abatement plan for predation by feral cats;
- Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads; and
- Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs.

¹⁵ The threat abatement plan for beak and feather disease affecting endangered psittacine species ceased on 1 October 2015. A non-statutory threat abatement advice is being developed.

4 SUMMARY OF ELIGIBILITY FOR LISTING AGAINST EPBC ACT CRITERIA

Further details about how the ecological community was judged against the EPBC Act listing criteria can be found at Appendix B.

Criterion 1 – Decline in geographic distribution

The pre-European extent of the ecological community across its entire range is estimated to be almost 5.6 million ha and the current extent is estimated to be almost 1.3 million ha. The ecological community has therefore undergone a decline in extent of at least 77%. These estimates account for most known patches of the ecological community and are considered indicative of total decline.

The Committee judges the ecological community has undergone a severe decline in its geographic extent and is therefore eligible to be listed as Endangered under this criterion.

Criterion 2 – Limited geographic distribution coupled with demonstrable threat

Neither the extent of occurrence or area of occupancy are limited for this ecological community. Patch size data available for Queensland indicates that 93% of remnants are less than 100 ha in size and the median patch size is less than 10 ha. This indicates the distribution of the ecological community in Queensland may be very restricted. However, there are no equivalent data for NSW and consequently there is insufficient information to determine the eligibility of the ecological community for listing against Criterion 2.

Criterion 3 – Loss or decline of functionally important species

Whilst threats are likely to have broadly impacted upon functionally important species such as small burrowing mammals and woodland bird species, particularly insectivores and terrestrial granivores, specific data related to the decline of such species in this ecological community are not available. As such there is insufficient information to determine the eligibility of the ecological community for listing under any category of Criterion 3.

Criterion 4 – Reduction in community integrity

Substantial clearing, severe fragmentation, weed invasion, inappropriate fire and grazing regimes, and associated changes to vegetation structure and loss of faunal components have substantially reduced the integrity of the ecological community. The very long lag time to recover vegetation structure, with adequate representation of large old trees, limits the likelihood of recovery in the near future. The intractability of other problems, such as the loss of fauna regionally, and the nature of existing land and water use in the ecological community's extent further reduces the potential for recovery.

The reduction in integrity experienced by the ecological community across most of its geographic distribution is severe, as indicated by severe degradation of the community and its habitat. Therefore, the ecological community is eligible for listing as endangered under this criterion.

Criterion 5 – Rate of continuing detrimental change

There is evidence of ongoing clearing of the Poplar Box Grassy Woodland over the previous two decades though the rate of clearing has been variable, at least for the Queensland occurrences, during that period. The nature of development, especially mining, pressures facing the region where the ecological community occurs indicates a likelihood in the immediate future, of landscape-level impacts to the ecological community or the surrounding region. The Committee recommends the ecological community meets this criterion as vulnerable for listing under Criterion 5.

Criterion 6 -- Quantitative analysis showing probability of extinction

There are no quantitative data available to assess this ecological community under this criterion. As such there is **insufficient information to determine the eligibility** of the ecological community for listing under any category of Criterion 6.

A detailed assessment of eligibility for listing against the EPBC Act criteria is at Appendix B.

DRAFT

5 PRIORITY RESEARCH AND CONSERVATION ACTIONS

5.1 Conservation Objective

The conservation objective provides the goal and rationale for the priority actions identified here.

The conservation objective is mitigate the risk of extinction of the Poplar Box Grassy Woodland on Alluvial Plains ecological community, and help recover its biodiversity and function, through:

- protecting it using the *Environment Protection and Biodiversity Conservation Act 1999*, particularly to avoid further vegetation clearance; and
- implementing priority conservation actions (as outlined in Sections 5.2 and 5.3 below).

5.2 Priority protection and restoration actions

It is more practical and cost-effective to maintain existing high quality remnants than to allow their degradation and then attempt rehabilitation of these or other areas. The more disturbed and modified a patch of the ecological community, the greater is the recovery effort needed. To gain the most cost-effective outcomes of investments in management it is important to consider the likely interaction of management actions at any one site, as these may be synergistic or antagonistic. There are also likely to be interactions between sites. Additionally, when allocating resources it is important to consider the minimum investment needed for success and the follow up required to secure long term recovery.

Priority actions are recommended for the abatement of threats and supporting recovery of the ecological community. Actions inconsistent with these recommendations that are likely to significantly affect the ecological community should not be undertaken.

In assessment of activities that may have a significant impact on the ecological community, incorporate relevant actions listed below when determining recommendations including conditions of approval. Applications to Australian Government funding programs should also consider prioritising these restoration activities. Also take into consideration the information outlined in Section 2.6 'Further information to assist in determining the presence of the ecological community and significant impacts'.

The three key approaches to achieve the conservation objective are:

PROTECT the ecological community to prevent further loss of extent and condition;

RESTORE the ecological community within its original range by active abatement of threats, re-vegetation and other conservation initiatives;

COMMUNICATE WITH AND SUPPORT researchers, land use planners, landholders, land managers, community members, including the Indigenous community, and others to increase understanding of the value and function of the ecological community and encourage their efforts in its protection and recovery.

These approaches are overlapping in practice and form part of an iterative approach to management that should include research, planning, management, monitoring and review.

PROTECT

Preventing vegetation clearance and direct habitat degradation

Highest priorities

- Prevent further clearance, fragmentation or detrimental modification of remnants of the ecological community and of surrounding native vegetation. High conservation value, unmodified and older growth areas are particularly important for retention and

management. Do not allow such patches to be further reduced and not at all below the size and quality thresholds (refer to condition thresholds in section 2.6 for guidance).

- Minimise further conversion of the ecological community to cropping and improved pasture.
- Ensure that any further mineral and energy extraction and exploration activities minimises direct impacts to the ecological community or indirect effects on its ecological functionality.
- Ensure that any further development of river and ground water infrastructure and water storage minimises impacts on the ecological function of the ecological community. Avoid significant changes to water table levels and /or run-off, salinity, pollution and water flow patterns arising from developments, such as mineral and gas extraction on the Liverpool Plains and Darling Downs.
- Protect mature trees, particularly with hollows, even if they are dead. Large and old trees may have many fissures that provide shelter; support diverse insects and their predators; and act as ‘stepping stones’ for fauna moving between remnants in an otherwise cleared landscape. Ensure juvenile poplar box trees are left to grow to maturity and if necessary supplement retention of habitat trees by placing artificial hollows (e.g. various sized nest boxes) in, or near to, the ecological community and monitor outcomes.
- Identify and protect high quality remnants in advance of zoning and development planning decisions and avoid clearing or damaging them. High quality patches should not be reduced.
- Prevent impacts from any developments and activities adjacent to or near patches that might result in further degradation, by planning for and appropriately mitigating off-site effects (for example, by avoiding disturbances to native vegetation and soil, applying recommended buffer zones around the ecological community).
- Apply recommended buffer zones of at least 30 m around patches of the ecological community using appropriate local native species, although wider buffers may be needed where there is larger scale landscape change, for example hydrological modifications.
- Recognise the landscape position of remnants of the ecological community and ensure that planning supports increased resilience within the landscape (for example, by retaining appropriate connectivity between remnants of all naturally occurring ecological communities).
- Retain other native vegetation remnants, derived native grasslands or shrublands and mature paddock trees near patches of the ecological community where they are important for connectivity.
- Manage access to remnants to prevent, for example, disturbance and spread of plant pathogens and weeds.
- Ensure that areas that form important landscape connections, such as wildlife corridors or other patches of particularly high quality or regional importance are considered for inclusion in formal reserve tenure or other conservation related tenure for protection and management in perpetuity.
- Avoid the requirement for offsetting, by avoiding and mitigating impacts to the ecological community first. Further, to meet “like-for-like” principles, match offsets to the same sub-community (e.g. Qld Regional Ecosystems or NSW Vegetation Classification and Assessment units), as it is not appropriate to offset losses of one component with other

components of the ecological community, given the high local endemism and β -diversity. Further information is in Section 5.4 'Offsets'.

Other priorities

- Protect the native soil seed bank by minimising soil disturbance and removal.
- Prevent impacts to native vegetation, native fauna, hydrology or soil structure from any developments and activities adjacent to or near patches of the ecological community by planning for and appropriately mitigating off-site effects. For instance, apply buffer zones and avoid activities that could cause significant hydrological change or eutrophication.
- Retain habitat features for fauna, noting species requirements (for example, large rocks, logs embedded in the soil or hollow logs), or particular vegetation structure (for example, shrubs may be important at some sites). If necessary, supplement, (but do not replace) habitat by placing artificial hollows (e.g. various sized nest boxes) in, or near to, the ecological community. Maintain the boxes, including controlling invasive species such as bees and monitor outcomes.
- Prior to removal of any trees, or use of heavy machinery that may also damage the understorey, ensure comprehensive flora and fauna surveys have identified threatened species on site and their potential shelter and nesting sites, for example hollows, burrows, rocks and tree crevices, as well as visible nests. Damage to these should be avoided altogether, but if approved for removal, care should be taken to appropriately relocate fauna.
- Retain paddock trees or small degraded stands that were formerly part of the ecological community where they are important for connectivity.
- Retain other native vegetation remnants, derived native grasslands or shrublands and paddock trees near patches of the ecological community, particularly patches of the community less than 5 ha. Increase the size and condition of patches by promoting regeneration of and replanting canopy trees and a diversity of understorey species. As part of this create or restore appropriate wildlife corridors and linkages, including stepping stones.
- Where appropriate, fence significant remnants in or adjacent to agricultural and development areas and limit access for vehicles, in consultation with local and state authorities.

Preventing weeds, feral animals, tree dieback and other diseases

Highest priorities

- Prevent weed invasion by minimising soil disturbance.
- Implement effective control and management techniques for invasive grasses, such as *Cenchrus ciliaris* (buffel grass).
- Do not plant (or spread) known, or potential, environmental weeds within or near the ecological community:
 - prevent activities such as planting potentially invasive species near the ecological community; or dumping garden waste in or near patches of the ecological community.
 - control runoff to prevent movement of weed material into natural areas.

- review the planting schedule for new developments to ensure that potential weeds or other inappropriate plants (e.g. likely to contaminate the local gene pool) are not included.
- Target management of existing weed problems to sites if high diversity or where threatened or regionally significant species are known to occur.
- Detect and control weeds early to prevent major infestations. Small infestations should be a priority for removal.
- Monitor for signs of new disease such as myrtle rust or incursions by new weeds for example, African boxthorn or blackberry or pest animals, for example goats, rabbits and deer and manage early for local eradication.

Other priorities

- Ensure stock do not carry weeds into patches of the ecological community (for example, hold stock in other weed-free paddocks for an appropriate time prior to introduction).
- Use appropriate hygiene to minimise the introduction or spread of weeds and diseases at susceptible sites. For example, keep vehicles and machinery to dedicated roads and out of remnants wherever possible. If vehicles must be taken into remnants ensure vehicles are washed first to remove soil, potential fungal pathogens and weed seeds. Use plants from accredited nurseries (e.g. see the Nursery Industry Accreditation Scheme: Nursery and Garden Industry Australia, undated).
- Implement strategic responses to rural tree dieback, in particular, implement preventative measures.

Fire and grazing

- Use a landscape-scale approach and available knowledge on fire histories and age of stands, to identify priority conservation sites that need fire for biodiversity conservation. Ensure a representative spread of age classes and post-fire stages of the ecological community are maintained in the landscape.
- Fires must be managed to ensure that where possible, prevailing fire regimes do not disrupt the life cycles of the component species of the ecological community, that they support rather than degrade the habitat necessary to the ecological community, that they don't promote invasion of exotic species, and that they do not increase impacts of other disturbances such as grazing or predation by feral predators. Faunal populations in isolated patches may be vulnerable to permanent extinction following intense fires.
- Implement appropriate fire management regimes for the ecological community that take into account results from research. Appropriate actions relating to burning may include:
 - clearing fuel away from the base of old trees prior to burning; minimising high intensity fires and extinguishing tree bases after the fire front has passed to retain old and /or hollow trees and roost sites;
 - burning to control annual weeds, where they dominate, taking into consideration the requirements of any threatened species;
 - not burning during peak reproductive seasons, e.g. flowering and fruiting seasons, for threatened, functionally important or characteristic native flora and fauna species within the ecological community;
 - not burning if soil moisture is very low, or dry conditions are predicted for the coming season, because native grass recovery will be slow and erosion may occur,

or weeds may become established or recover quicker than native species while the groundcover is reduced;

- for large patches mosaic burning different parts of a remnant in rotation, rather than the whole area in any one season; and
- monitor outcomes of fire and manage consequences at the appropriate time e.g. monitoring and management of feral predators must take place immediately and be followed up; weed management must also be ongoing; take monitoring results into account when managing future fire regimes.
- monitoring the results to determine changes in native understorey and weed cover.
- Consider fire regimes appropriate for nearby ecological communities when planning burning e.g. where wetlands are adjacent.
- Integrate appropriate grazing management regimes with fire management requirements.
- Persistent grazing can negatively affect understorey species composition and impact diversity (Dorrough et al., 2006). Provide alternative shelter and watering areas for stock, for example, by planting shade trees in nearby cleared or non-native areas.
- Strategically manage total herbivore grazing (by native, and domestic animals), for instance by:
 - temporary or permanent fencing of regrowth, revegetation areas, or sites with threatened, regionally important or diverse understorey species to restrict grazers; and
 - managing populations of feral grazing animals that damage native vegetation, including rabbits, deer and goats.
- Ensure that livestock grazing, if it occurs in the area, uses an appropriate management regime and stocking rate that does not detrimentally affect the ecological community:
 - occasional grazing may be beneficial for reducing grass cover, encouraging herb growth and minimising shrub regeneration; however, if stock could carry noxious weeds into the remnant, then it would be preferable to exclude stock altogether or admit them only at times when weeds are not producing seed;
 - wherever possible avoid grazing during peak native plant flowering and seeding times (spring and summer); and
 - avoid long term grazing at high stocking densities.

RESTORE

Priority recovery and threat abatement actions

It is more practical and cost-effective to maintain existing high quality remnants than it is to disturb then rehabilitate or offset. The more disturbed and modified, the greater recovery effort needed.

The following priority recovery and threat abatement actions should be implemented to support the recovery of the ecological community. Assessments of activities that involve likely significant impacts to the ecological community should incorporate the relevant actions below when determining any approval conditions or other recommendations.

Highest priorities

- Avoid or restrict further clearance, fragmentation or detrimental modification of remnants of the ecological community and of surrounding native vegetation. High conservation value, unmodified and older regrowth areas are particularly important. Do not allow such patches to be further reduced and not at all below the size and quality thresholds (refer to condition thresholds in section 2.6 for guidance).
 - Minimise further conversion of the ecological community to cropping and improved pasture.
 - Protect mature trees with hollows. Ensure juvenile poplar box trees are left to grow to maturity and if necessary supplement retention of habitat trees by placing artificial hollows (e.g. various sized nest boxes) in, or near to, the ecological community and monitor outcomes.
 - High quality patches should not be reduced further in size or integrity.
 - Apply recommended buffer zones (see section 2.6) between the ecological community and agricultural and development zones.
- Prevent impacts from any developments and activities adjacent to or near patches that might result in further degradation, by planning for and appropriately mitigating off-site effects (for example, by avoiding disturbances to native vegetation and soil, applying recommended buffer zones around the ecological community).
 - Protect and establish vegetated buffer zones around remnants, preferably of a minimum width of 30 m from the remnant's boundaries, using appropriate native species.
- Implement effective control and management techniques for invasive grasses, such as *Cenchrus ciliaris* (buffel grass).
- Do not plant (or spread) known, or potential, environmental weeds within or near the ecological community.
 - Promote knowledge about local weeds and keep non-indigenous invasive plant species controlled at all times.
 - Encourage appropriate use of local native species, including *Eucalyptus populnea*, in developments and revegetation projects through local government and industry initiatives and best practice strategies.
- Target management of existing weed problems to sites of high diversity or where threatened or regionally significant species are known to occur.
- Implement strategic responses to rural tree dieback.

- Monitor for signs of new disease or new weed incursions early and manage for local eradication.

Other priorities

Prevent habitat loss, disturbance and modification

- Retain fallen log, rocks and habitat for fauna, noting different requirements for different species (e.g. logs embedded in the soil are necessary for some species and hollow logs are needed by other species). Supplement with re-introducing logs to degraded patches.
- Implement optimal revegetation and restoration strategies for the ecological community, across the landscape, using information from research projects.
- Implement effective adaptive management regimes and best practice standards to maintain the biodiversity (including listed threatened and regionally important species) of patches of the ecological community on private and public lands.
- Survey and monitor recovery, through estimates of extent and condition assessments for the ecological community.
- Restore wildlife corridors and linkages (e.g. travelling stock routes/reserves) and ensure that these areas or other patches of particularly high quality or regional importance are considered for inclusion in formal reserve tenure or other conservation related tenure in perpetuity.
- Create habitat linkages (where appropriate) between remnants for the ecological community and other areas of native vegetation (e.g. other listed threatened ecological communities such as Brigalow (*Acacia harpophylla* dominant and co-dominant), or reconstructed habitat to reduce fragmentation and isolation.
- Retain paddock trees or small degraded stands that were formerly part of the ecological community where they are important for connectivity.
- Retain other native vegetation remnants, derived native grasslands or shrublands and paddock trees near patches of the ecological community, particularly patches of the community less than 5 ha. Increase the size and condition of patches by promoting regeneration of and replanting canopy trees and a diversity of understorey species. As part of this create or restore appropriate wildlife corridors and linkages, including stepping stones.
- Where appropriate, fence significant remnants in or adjacent to agricultural and development areas and limit access for vehicles, in consultation with local and state authorities.
- See also Offsets – Section 5.4

Prevent, control and eradicate invasive species and diseases

- Manage weeds before and after ecological burns, and during revegetation works to maximise success of restoration.
- Ensure chemicals or other mechanisms used to eradicate or control invasive or other pest species avoid impacts on non-target species and do not have any long-term adverse impacts upon the ecological community.
 - Ensure workers are appropriately trained in the use of herbicides (and fertilisers) and what to target.
 - Avoid chemical spray drift and off-target damage within or near to the ecological community, having regard to minimum buffer zones.

- Control run-off to prevent dispersal of weeds and plant diseases.
- Use appropriate hygiene to minimise the introduction of spread of weeds at susceptible sites (For example: keep vehicles and machinery to dedicated roads and out of remnants wherever possible. If vehicles must be taken into remnants ensure vehicles are washed first to remove soil and weed seeds).
- Control introduced pest animals through consolidated landscape-scale control programs.

Prevent trampling, browsing or grazing damage

COMMUNICATION AND SUPPORT

Education, information and local regulation

- Develop a communication strategy, education programs, information products and signage to help local communities and managers recognise:
 - the presence and importance of the ecological community;
 - the appropriate management of patches of the ecological community; and
 - responsibilities under state and local regulations and the EPBC Act.
- Develop coordinated and strategic education and incentive programs to encourage landholders to undertake weed control activities, conservation and rehabilitation activities on private land.
- Develop education programs to discourage the removal of dead timber, the dumping of rubbish, and the use of off-road vehicles in environmentally sensitive areas (e.g. high quality condition patches).
- Encourage local participation in recovery efforts, for example, through local conservation groups, field days and planting projects. Ensure revegetation workers are aware of appropriate native species to plant and which species to avoid in woodland revegetation projects. Restoration activities should consider and implement improved restoration techniques and new knowledge about species' requirements.
- Promote awareness and protection of the ecological community by relevant agencies and industries. For example with:
 - state and local government planning authorities, to ensure that planning around towns takes the protection of remnants into account, with due regard to principles for long-term conservation;
 - state and local government planning and construction industries, to minimise threats associated with land development;
 - local councils and state authorities, to ensure road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance do not adversely impact the ecological community. This includes avoiding the introduction or spread of weeds;
 - the use of signage to identify key sites of the ecological community that occur along road verges and other public lands such as travelling stock reserves; and
 - natural resource management groups, consultant agronomists and livestock industry.
- Liaise with local fire management authorities and agencies and engage their support in fire usage to manage the ecological community.

Incentives and support

- Support opportunities for traditional owners or other members of the Indigenous community to manage the ecological community
- Continue to seek and implement formal conservation agreements (for example, covenants) for sites containing the ecological community.
- Develop coordinated incentive projects to encourage conservation and stewardship on private land, and link with other programmes and activities, especially those managed by regional catchment groups, local natural resource management authorities or Local Land Services.

5.3 Research and monitoring priorities

Relevant and well-targeted research and other information gathering activities are important in informing the protection and management of the ecological community. Coordination with individuals and groups with responsibilities for planning and on ground management is important to ensure that research questions and methods are well chosen, and that the information gathered can be applied to the benefit of the ecological community. Research and ongoing management activities can often be integrated to achieve the best results in the face of ongoing change. It is important that any monitoring is planned before management commences, considering data requirements to address research questions. Monitoring must also be resourced for the duration of the management activities, especially for those using a novel approach.

High priority research and monitoring activities that would inform future regional and local actions in relation to the Poplar Box Grassy woodland on Alluvial Plains ecological community include:

- Improve and update the mapping of the ecological community across its range:
 - Support field survey and interpretation of other data such as aerial photographs and satellite images to more accurately document current extent, condition, threats, function, presence and use by regionally significant or threatened species.
 - Support and enhance existing programs to: model the pre-1750 extent across the entire range of the ecological community to inform restoration; identify the most intact, high conservation value remnants and to gain a better understanding of variation across the ecological community.
 - Monitor changes in the extent of the ecological community.
- Determine priority areas for restoration to enhance connectivity and landscape resilience.
- Conduct research leading to the development of effective landscape scale restoration techniques for the ecological community, particularly after clearance (e.g. mineral and unconventional gas¹⁶ extraction).
- Investigate the interaction between disturbance types such as fire, grazing and invasion by weeds and feral animals to determine how an integrated approach to threat management can be implemented.
- Monitor changes in condition, including response to all management actions at key sites and use this information to increase understanding of the ecological community and inform recommendations for future management.

¹⁶ Unconventional gas: natural gas (methane and other hydrocarbon gases) extracted from non-porous rock layers such as coal seams (300–1000m below ground level) or shale formations (>1500m below ground level). Gas is generally extracted either by removing groundwater within the coal seam formation or hydraulically fracturing (fracking) the shale formation.

- Research the effects of fire on floristics and structure of vegetation, native fauna and invasive species in patches and across the broader landscape:
 - Keep precise records of fire history;
 - Monitor the response of the ecological community to fire, using an appropriate measure (species composition, population of key species, etc) with a monitoring design that aims to improve understanding of the species response to fire; and
 - Identify and publish appropriate fire management regimes to conserve key species and the broader ecological community and to maintain or recover an open grassy structure.
- Undertake or support analysis of the hydrological needs of the ecological community including groundwater, surface water flow and impacts from dryland salinity.
- Undertake or support ongoing research aimed at managing feral animals and major weeds, such as African boxthorn (*Lycium ferocissimum*), African lovegrass (*Eragrostis curvula*), buffel grass (*Cenchrus ciliaris*), Coolatai grass (*Hyparrhenia hirta*), lippia (*Phyla canescens*), mother of millions (*Bryophyllum delagoense*), parthenium weed (*Parthenium hysterophorus*), perennial veldt grass (*Ehrharta calycina*) and prickly pear (*Opuntia* spp. and related genera).
 - Determine how an integrated invasive species management approach can be developed with regard to any threat abatement plans.
 - Identify optimal and sustainable grazing regimes, and determine appropriate management prescriptions to maintain plant diversity and/or faunal habitat quality.
- Assess the vulnerability of the ecological community to climate change and how to improve resilience through other threat abatement and management actions.
- Investigate key ecological interactions, such as the role of fauna in pollination, seed dispersal and nutrient cycling.
- Investigate the most cost-effective options for restoring landscape function, including:
 - re-vegetation or assisted regeneration of priority areas, potentially buffering, connecting and protecting existing remnants;
 - predator control options such as trapping and baiting, exclusion fencing;
 - re-introduction of key fauna.
- Determine optimal management regimes and best practice management standards including for integrated fire, grazing and invasive species best practice for each region within its broad range (e.g. Brigalow Belt North and NSW South Western Slopes IBRA Bioregions, Central West Local Land Services, Condamine Alliance Natural Resource Management organisation).

5.4 Offsets

Further clearance and damage to this ecological community should be avoided. Offsetting is a last resort, which may be proposed as an attempt to compensate for damage to the ecological community that is deemed unavoidable. The ecological outcomes of offsetting activities are generally uncertain: for instance, when replanting areas there is no guarantee that reconstruction of all layers of a woodland will be successful and that diversity (of flora and fauna) and adequate ecological function can be restored. Areas that already meet the condition thresholds are protected by this listing so should not be used as an offset unless there is a substantial net conservation benefit such as a perpetual change in land tenure for conservation purposes and ongoing threat abatement measures and monitoring put in place. With regard to

any proposals involving offsets for this ecological community, which has been greatly reduced in spatial extent and condition, the aims should be to:

- minimise the need to offset;
- retain remaining areas with mature trees and other high quality patches rather than offset;
- ensure that offsets conform to the EPBC Act Environmental Offsets Policy (Commonwealth of Australia, 2012), including 'like-for-like' principles based on meeting the overall definition of the ecological community and considering the particular species composition, maturity of trees, vegetation structure and other habitat and landscape features at a particular site (e.g. avoid the location of offsets distant from the site of impact, as there is local variation of the ecological community);
- either maintain (or increase) the overall area and/or quality and ecological function of the remaining extent of the ecological community and/or improve the formal protection of high quality areas through a combination of the following measures:
 - managing and protecting offset areas in perpetuity in areas dedicated under legislation for conservation purposes; that is, avoid reducing their size, condition and ecological function in the future through ongoing threat abatement measures and adaptive management based on monitoring; and/or
 - increasing the area and improving ecological function of the woodlands, for example by enhancing landscape connectivity, habitat diversity and condition; and/or
 - restoring moderate condition patches to achieve high condition (see the high condition classes in the condition thresholds in Table 2), particularly to ensure that any offset sites add additional value to the remaining extent; and/or
 - extending protection to sites otherwise unprotected. This may include patches that do not meet the condition thresholds for national protection in Table 2 but can reasonably be restored to a better, more intact condition that achieves EPBC Act protection (and hence adds area to the remaining extent). This particular measure should not be undertaken unless in combination with one or more of the other measures above.

5.5 Existing plans/management prescriptions

There are no approved state recovery plans for the ecological community, as defined in this listing. However, relevant management prescriptions exist in various forms, including threat abatement plans and recovery plans for some species occurring in the ecological community. These include:

Crawford P (2008). Challenges, opportunities and strategies. Lippia (*Phyla canescens*) management. The National Lippia Working Group.

Department of the Environment (2015). Threat abatement plan for predation by feral cats, Commonwealth of Australia.

Available on the internet at:

<http://www.environment.gov.au/system/files/resources/78f3dea5-c278-4273-8923-fa0de27aacfb/files/tap-predation-feral-cats-2015.pdf>

Department of the Environment (2015). Draft Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*). Commonwealth of Australia.

Available on the internet at:

<http://www.environment.gov.au/system/files/resources/e8344ac9-5527-4402-aca9-cc0c4b533b3a/files/draft-tap-feral-pigs-2015.pdf>

- Department of Environment and Climate Change (NSW) (2008). Recovery plan for the koala (*Phascolarctos cinereus*).
Available on the internet at:
<http://www.environment.nsw.gov.au/resources/threatenedspecies/08450krp.pdf>
- Department of Environment and Conservation (NSW) (2006). Southern Brown Bandicoot (*Isoodon obesulus*) Recovery Plan. NSW DEC, Hurstville NSW.
Available on the internet at:
<http://www.environment.nsw.gov.au/resources/nature/SouthernBrownBandicootFinalRecoveryPlan.pdf>
- Department of the Environment and Heritage (2006). Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis.
Available on the internet at:
www.environment.gov.au/biodiversity/threatened/publications/tap/infection-amphibians-chytrid-fungus-resulting-chytridiomycosis
- Department of Environment and Heritage Protection (2012). Koala-sensitive design guideline. A guide to koala-sensitive design measures for planning and development activities.
Available on the internet at:
<http://www.ehp.qld.gov.au/wildlife/koalas/legislation/pdf/koala-sensitive-design-guideline.pdf>
- Department of Sustainability, Environment, Water, Population and Communities (2011). Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads.
Available on the internet at:
<http://www.environment.gov.au/system/files/resources/2dab3eb9-8b44-45e5-b249-651096ce31f4/files/tap-cane-toads.pdf>
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). Threat abatement plan for competition and land degradation by rabbits, DEWHA, Canberra.
Available on the internet at:
<http://www.environment.gov.au/system/files/resources/7097f100-4a22-4651-b0e1-df26e17c622c/files/tap-rabbit-report.pdf>
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). Threat abatement plan for competition and land degradation by unmanaged goats, DEWHA, Canberra.
Available on the internet at:
<http://www.environment.gov.au/system/files/resources/2109c235-4e01-49f6-90d0-26e6cb58ff0b/files/tap-goat-report.pdf>
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). Background document for the threat abatement plan for predation by the European red fox, DEWHA, Canberra.
Available on the internet at:
<http://www.environment.gov.au/system/files/resources/1846b741-4f68-4bda-a663-94418438d4e6/files/tap-fox-background.pdf>
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). Threat abatement plan for predation by the European red fox, DEWHA, Canberra.
Available on the internet at:
<http://www.environment.gov.au/system/files/resources/1846b741-4f68-4bda-a663-94418438d4e6/files/tap-fox-report.pdf>
- National Lippia Working Group (2008). Lippia (*Phyla canescens*) Management: Challenges, opportunities and strategies.

Ross C (2013). Fact sheet: Dieback in south-east Australia. Greening Australia.

Available on the internet at:

<http://murrumbidgeelandcare.asn.au/files/Dieback%20fact%20sheet.pdf>

Sinclair Knight Merz (2008). Central West Catchment Environmental Weeds Strategy. Sinclair Knight Merz, Newcastle, NSW.

Threatened Species Scientific Committee (2008). Commonwealth Conservation Advice on *Acacia lauta*. Department of the Environment and Heritage, Canberra.

Available on the internet at:

<http://www.environment.gov.au/biodiversity/threatened/species/pubs/4165-conservation-advice.pdf>

Threatened Species Scientific Committee (2008). Commonwealth Conservation Advice on *Homopholis belsonii*. Department of the Environment, Water, Heritage and the Arts, Canberra.

Available on the internet at:

<http://www.environment.gov.au/biodiversity/threatened/species/pubs/2406-conservation-advice.pdf>

APPENDIX A – DESCRIPTION OF THREATS

Clearance and fragmentation

In eastern Australia areas containing poplar box (*Eucalyptus populnea*) were predominantly the first lands settled west of the Great Dividing Range. Settlement in these regions commenced in the 1820s in New South Wales and about 1840 in Queensland. The first domestic livestock introduced were cattle, horses and later sheep. With the development of railways some land was used for growing cereal crops and for dairying. In this period of European expansion most areas of woodland were selectively cleared or were modified by grazing and burning (Weston et al., 1980). Since the early 1890s, the killing of trees on grazing lands to increase grass growth in the ground layer for livestock has been common practice, although some trees were kept for stock shelter and for timber harvesting (Back et al., 2009a).

Of the 1.2 million ha of woody vegetation cleared in Australia for agricultural, pastoral and other non-forestry related land uses between the years 1991 - 1995, 81% occurred in Queensland (Barson et al., 2000; Wilson et al., 2002). Between 1997 and 1999, the annual rate of remnant vegetation clearing in Queensland was 446 000 ha of which over 60% occurred in the Brigalow Belt bioregion (Wilson et al., 2002).

Clearing has therefore substantially decreased the extent of and fragmented, Poplar Box Grassy Woodland and the landscape in which it occurs. Impacts from historical clearance for agricultural and pastoral activities have been compounded by rural-residential development and construction of mines and other infrastructure, including roads and railways.

The Poplar Box Grassy Woodland has been heavily cleared over much of its former range, or the native understorey has declined or been replaced by exotic plants. Some patches may retain some native trees; however, destruction of the ground layer effectively represents a loss of the largest component of vegetative biodiversity in the ecological community. In many cases, the loss of the understorey is effectively irreversible if remnants are converted to permanent croplands, improved pastures, mining voids and other permanently developed sites.

Grazing

Impacts are exacerbated where ploughing or other measures remove the soil-stored seed bank or disrupt their germination potential, thus preventing the natural, unassisted regeneration of the vegetation (Lunt, 2005). Many native grass and forb species do not form persistent longer-term soil seed banks, so that once plants have been eliminated from a patch of vegetation, they are unable to re-establish naturally (Cole et al., 2004).

Extensive clearing and conversion to cropping, such as in the NSW Liverpool Plains and Queensland Darling Downs has resulted in smaller, fragmented stands with a moderate edge to area ratio (Benson et al., 2006; Benson, 2008; Queensland Herbarium, 2015). Smaller, isolated fragments are less buffered against disturbances and edge effects, such as invasion by weeds that encroach from their margins, or impacts from surrounding landscape and development activities such as spray drift and hydrological changes. As the condition of many remnants continues to decline through additional clearance of the canopy and understorey modification, the degree of fragmentation are expected to increase.

Mining

Significant high-quality bituminous coal (black coal) deposits, and substrates containing unconventional gas (including shale and coal seam gas) underlay the Poplar Box Grassy Woodland in both NSW and Queensland. Direct removal of coal from open-cut and subterranean mining involves land clearing. Exploration for and extraction of unconventional gas also often impacts remnant vegetation. Once vegetation is cleared and topsoil stripped these areas cannot easily be recovered to a pre-mining state. In addition to the mine site, further clearing and modification occurs in order to provide service infrastructure for mining activities. Draft conservation advice for Poplar Box Grassy Woodlands on Alluvial Plains

(associated buildings, roads and pipelines) and the requirement of additional areas for deposition of overburden and spoil (Butt et al., 2013).

Clearing and vegetation disturbance associated with access tracks and gas pipelines provide an opportunity for fast growing, colonising species, such as acacias and weed species, to establish which can lead to changes in the floristic structure and composition of vegetation communities. Colonisation by these species can lead to an increase in competition for resources such as light, nutrients and space and changes to the micro-climate through shading. In the long-term, the impact is a loss of native biodiversity and an increase in weed infestations, loss of fauna habitat value, increase in fire fuel loads and changes in the subsequent conservation management requirements of remnant vegetation (Australia Pacific LNG, 2010b).

Mining can also lead to the disruption of hydrological processes, erosion and changes to soil structure and chemistry. Underground mining and unconventional gas extraction can result in subsidence or fractures in the subsurface rocks which can be associated with cracking of valley floors, creek lines and aquifers, subsequently affecting surface and groundwater hydrology (ACARP, 2001, 2002, 2003; Australia Pacific LNG, 2010a, 2010b)

Likely fauna impacts from mining activities include (Australia Pacific LNG, 2010a, 2010b; Cumberland Ecology, 2013):

- Removal of habitat such as mature vegetation, hollow-bearing trees and fallen logs and therefore loss of breeding, nesting, perching and foraging resources
- Disturbance to shelter including ground cover such as leaf litter for reptiles, small mammals and terrestrial dependant birds
- Disturbance to fauna movement corridors and dry season fauna refuges (e.g. riparian vegetation)
- Unearthing burrowing fauna species during construction
- Trenchfall – Ground-dwelling fauna may fall into open trenches and become trapped and exposed to overheating, dehydration, predation and/or drowning. Fauna entrapment particularly within pipeline trenches has been recognised as a key environmental issue by the Australian Pipeline Industry Association (APIA) Code of Environmental Practice (2009).

Invasive weeds and pest animals

Grassy woodlands such as the Poplar Box Grassy Woodland are distinguished from shrubby woodlands by the presence of a well-developed grass and forb layer and the lack of a dense shrub layer, although scattered or patchy shrubs may be present. Given the ecological community's open grassy structure and association with more fertile alluvial soils, understorey species in the Poplar Box Grassy Woodland can be readily impacted by a range of environmental and agricultural threats including introduced pasture species that spread from surrounding agricultural lands or disturbed sites. These weeds can disperse into the ecological community via water, wind, livestock, machinery or other disturbance.

The Poplar Box Grassy Woodland has an extensive geographic range but remnants throughout this range are in close proximity to heavily disturbed and modified land. As a result, many invasive species which threaten the ecological community include perennial species often associated with agricultural and pastoral lands. These include: African lovegrass (*Eragrostis curvula*), buffel grass (*Cenchrus ciliaris*), Coolatai grass (*Hyparrhenia hirta*) and lippia (*Phyla canescens*), which may also be present at some sites subject to occasional inundation. Annual and seasonal weeds, such as burr medic (*Medicago polymorpha*), Cretan weed (*Leontodon rhagadioloides*), flat weed (*Hypochaeris radicata*), parthenium weed (*Parthenium hysterophorus*), paspalum (*Paspalum dilatatum*) and small-flowered mallow (*Malva parviflora*) have also become established in the ecological community (Cox et al., 2001; Wang et al., 2008; Benson et al., 2010; Welsh et al., 2014).

Several exotic animal species have been recorded throughout the ecological community, for example rabbits, foxes, pigs, rats, goats, deer, mice and feral cats. Rabbits may selectively remove the most palatable herbs and grasses and suppress regeneration. Goats damage trees and can cause erosion. Pigs do considerable damage to vegetation by digging and turning over the sod. They may also selectively target native lilies and orchids which have palatable tubers. They may also consume eggs and young of ground-nesting birds. Introduced carnivores such as foxes, cats and feral dogs are a threat to a wide range of native fauna species that are part of the ecological community (DEWHA, 2008a, b).

Inappropriate fire regimes

Prior to European settlement Indigenous use of fire is likely to have managed parts of the vegetation in the range of the Poplar Box Grassy Woodland. Fire was used in grassy woodlands for purposes such as flushing out of possums and kangaroos, to encourage new growth and to limit tree and shrub densities (McIntyre, 2011; Graham et al., 2014). Fire frequency is considered to have been a factor in maintaining an open grassy structure prior to European settlement. However, drought coupled with overgrazing dramatically altered fuel loads and fire regimes.

Graham et al., 2015 notes that fire frequency varies greatly across the full extent of poplar box woodlands. Estimates of fire frequency range from almost annually in the higher rainfall areas of northern Queensland, down to 1:10, 1:25 and 1:50 years in the southern NSW extent of the woodlands particularly in semi-arid regions. Fuel loads have been attributed to high rainfall and fire frequency with native perennial grass species producing higher fuel loads than annual species, but with invasive species such as buffel grass producing very high fuel loads.

Fire frequency, seasonality, height and intensity of fires therefore can affect species dominance in the ecological community. Disruption or changes to one or more of these processes can alter the prevalence and density of flora components. For example, the grass species *Heteropogon* and *Themeda* exhibit differing protective and germination strategies. *Heteropogon's* deep seed burial mechanism can protect the species more effectively from hot fires than associated shallow seeding native species, such as *Bothriochloa* and *Dichanthium*. In addition, the germination of buried *Heteropogon* seeds can be enhanced by burnt, blackened soils absorbing greater amounts of solar radiation at a time when ambient temperatures are too low for this to occur in unburnt situations. *Themeda's* dense internally damp tussocks can more effectively insulate the species from radiant heat damage of fire than the loose tussock formation of *Heteropogon* such as in regularly burned and lightly grazed areas (Shaw, 1957; Walker et al., 1981; Graham et al., 2015).

The spread of shrub species in recent decades is reported to have changed the structure of some grassy woodlands (Cunningham et al., 1992; Yates and Hobbs, 1997; Graham et al., 2014). Fire frequency is considered to have been a factor in maintaining an open grassy structure before European settlement (Hodgkinson and Harrington, 1985). In the absence of fire, woody cover can increase, particularly in semi-arid areas (Hodgkinson, 1998, Hodgkinson and Harrington, 1985; Yates and Hobbs, 1997). In addition, impacts from drought and preferential grazing may impact on the understorey structure of grassy woodlands (Harrington, 1991). The net effect is that woody cover has increased and areas of grassy woodland have been lost since European settlement.

Grazing

Moderate to heavy, or frequent, grazing by domestic stock along with the activities of feral pests and native herbivores can change the structure, composition and ecological function of the ecological community (Lunt, 2005). Grazing impacts such as browsing, compaction of topsoil, which often prevents seeds from germinating (Cole et al., 2004), and erosion, result in the decline and disappearance of palatable plant species and make restoration of diverse native understorey species problematic (Prober et al., 2002; Prober and Thiele, 2005; Martin and McIntyre, 2009). Many native grass and forb species do not appear to form persistent longer-term soil seed banks, so that once plants have been eliminated from a patch of vegetation, they are unable to re-establish naturally, even if grazing pressure is removed (Cole et al., 2004). Impacts on the soil seed bank are exacerbated where ploughing or other measures remove the soil-stored seed bank or disrupt their germination potential, thus preventing the natural, unassisted regeneration of the vegetation (Lunt, 2005).

The extent to which native plant species are affected by grazing depends on their palatability, growth form and regeneration capacity. For example, kangaroo grass (although not wide spread but occurs in parts of the ecological community, for example, PCT101) is highly palatable and proliferates when grazing is excluded, particularly in response to summer rain, but may be eliminated under continued heavy grazing regimes. Forbs with erect growth forms are also more prone to decline under grazing than those with rosette or prostrate growth forms. Bare areas or 'scalds' created by heavy grazing also provide opportunities for the establishment of exotic plant species.

Livestock tend to concentrate around points of water availability or shelter from heat, cold and wind. For example, in the most westerly extent of the ecological community in the wheat sheep zone of south eastern Australia, watering points are often located within or adjacent to remnant vegetation, therefore concentrating nutrient deposition and stock activity in these sensitive areas. Native flora species adapted to low nitrogen and phosphorous soils can decline due to nutrient enrichment from animals or direct pasture improvement which can also further advantage exotic plant species (Lunt, 2005; Duncan et al., 2008).

Clearance of hollow bearing canopy tree species such as poplar box, and/or grass and forb species in the understorey have direct impacts on fauna species through loss of habitat for foraging, breeding, roosting and shelter and leading to the decline of microbats and arboreal mammals and birds. The removal of standing and fallen hollow-bearing trees for timber, altered fire regimes, and grazing of domestic livestock are likely to have long-term effects on remaining tree health.

Dieback

Dieback is the premature, relatively rapid decline of canopy crown health of native tree species often leading to their death. Dieback affects eucalypts in ecological communities that range from forests, woodlands to scattered trees in open woodland and farmland. Eucalypts such as *Eucalyptus populnea*, affected by dieback typically have sparse foliage, often with chlorosis (yellowing), and a large proportion of dead or dying branches. It can be caused by a variety of biotic or abiotic factors, that can interact synergistically to cause decline in tree health, and that appear to be linked with land use practices (Reid and Landsberg, 1999; Jurskis, 2005; Reid et al., 2007).

Factors implicated in the dieback of *Eucalyptus populnea* include:

- Water stress, notably from drought and falling water tables, which can increase foliar nitrogen levels.
- Insect herbivory, notably outbreaks of insect pests in response to increased nutrient levels in the foliage and roots of food plants. Insect pests involved include lerps (Hemiptera:

Psyllidae), sawfly larvae (Hymenoptera: *Perga* spp.), and Christmas and leaf beetles (Coleoptera: Scarabaeidae and Chrysomelidae).

- Vertebrate herbivores, such as *Phascolarctos cinereus* (koala), *Trichosurus vulpecula* (brush-tailed possum), *Cacatua galerita* (sulphur-crested cockatoo) and *Eolophus roseicapillus* (galah)
- Pathogens and parasites, including heavy infestations of mistletoes (e.g. *Amyema miquelii* and *A. pendula*); and fungal diseases of trees, cankers, foliage diseases and diseases of seedlings.
- Woodland fragmentation disrupting community function, for instance through a decline in parasitoids and predator insects and birds that keep pest populations in check. Bird insectivores may be displaced by *Manorina melanocephala* (noisy miners). Agricultural chemicals may contribute to a decline in arthropod predators.
- Tree populations with little age structure variation or degree of regrowth levels that are more attractive to herbivores.

Chemical impacts and spraydrift

The crops and pastures that surround or occur adjacent to remnant patches of the Poplar Box Grassy Woodland are also prone to significant weed invasion problems. Broad-scale application of herbicides and pesticides is often used to control undesirable weeds on these agricultural lands.

Non-selective chemicals in the form of defoliant, herbicides and insecticides can be spread to remnant vegetation via various pathways including spray drift, vapour and dust transport, leaching and runoff. These pathways can transport agricultural chemicals many kilometres given specific conditions. The movement of chemicals through spray drift is dependent on several factors including droplet size and prevailing winds, while runoff can be either in the form of soil to which the chemical is bound, or in aqueous solution. The movement of agricultural chemicals through runoff and leaching can lead to contamination of surface and groundwater.

Reid et al. (2007) noted that since the 1970s herbicide use has increased on the Liverpool Plains with the shift from grazing to cropping land use. The change to minimum tillage for soil conservation purposes has also contributed to the trend towards increased herbicide reliance in cropping systems. The defoliant glyphosate is widely used in all cropping systems in the region.

Groundwater recharge on the Liverpool Plains consists of localized runoff flowing onto the colluvial and alluvial fans on the mid and lower slopes surrounding the Plains, with recharge also occurring across the broad alluvial plains (Dawes et al., 2000). As the canopy trees of the Poplar Box Grassy Woodland are dependent on surface and shallow groundwater, and given the ecological community mainly occurs on alluvial soils in agricultural areas, the spread of chemicals via these various pathways can adversely impact on the integrity of the ecological community.

The scale and duration of chemical impacts from mining activities, such as coal seam gas (CSG) extraction can also be significant. The associated water produced during CSG extraction typically contains concentrations of salts, boron, fluoride and sodium and elevated pH compared with potable water" (Australia Pacific., 2010a). These chemicals can also leach into surface and groundwater impacting on remnant vegetation.

Nutrient enrichment

Nutrient enrichment of native grassy woodland remnants is highly detrimental to the many native plant species that have adapted to the poor nutrient status of most Australian soils. This can occur through intentional application of inorganic fertilisers to promote non-native pastures, incidental drift from adjacent farmland or accumulation of manure from livestock.

Although eucalypts are likely to adapt to increasing nutrient loads, understorey species such as native perennial geophytes, decline with an increase in soil nutrient phosphorus content (Prober and Thiele, 2005; Reid et al., 2007; Duncan et al., 2008). Increased availability of soil nutrients following soil disturbance also contributes to the establishment of weeds into grassy systems.

As a result of these agricultural practices, good quality patches of grassy vegetation have become increasingly restricted to small remnants in areas marginal for agriculture. Smaller woodlands are further prone to increased soil nutrient load as a consequence of livestock sheltering as well as drift from surrounding agricultural land. In a study by Duncan et al. (2008), it was noted that small remnants patches (<3ha) were accumulation zones for nutrients, with levels comparable or higher than adjacent crop lands. In the semi-arid crop lands, current trends in intensification of cropping are also likely to increase the nutrient threat to larger remnants. Re-establishing natural soil nutrient status is identified as a major inhibitor to restoring grassy ecosystems (Prober et al., 2005) and areas where exotic pasture species have been sown are difficult to restore.

Salinity

Salinisation or dry land salinity can be dependent on the specific geomorphology and topography of a site (House of Representatives, 2004). As a consequence of the lateral flow of subsurface seepage, dissolved salts move from hill-slopes to valley floors. As the Poplar Box Grassy Woodland is often located in low lying sites such as alluvial plains and terraces adjacent to watercourses, salinisation can be a problem. Salinity affects both the understorey and overstorey species in remnant native woodlands. Causes include the prevalence of naturally saline soils, historic land use practices, and the destruction of perennial vegetation through clearance resulting in increased recharge and/or a rise in groundwater. Dry land salinity occurs most significantly in components of the ecological community that corresponds within NSW mapping unit Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion (PCT101).

Climate change

Climate change poses a serious long-term threat to terrestrial and aquatic ecosystems with the potential to change ecology of these environments through changes to species composition and function (Dunlop et al., 2012). The increasingly fragmented nature of the Poplar Box Grassy Woodland greatly increases its vulnerability to the effects of a changing climate (for example, movement of native species is limited). Climate change could also exacerbate existing threats such as habitat loss, altered fire regimes, altered hydrological regimes and the spread of invasive species (Table A1).

Table A1. Projected climate change effects in NSW regions that correspond with the Poplar Box Grassy Woodland extent.

| | New England/North West region | Western region |
|-------------|---|--|
| Temperature | <ul style="list-style-type: none"> Daily maximum temperatures to increase over all seasons by 1–3°C, with the greatest increase during winter and spring (2–3°C). Nights are also projected to be warmer, with mean minimum temperatures likely to increase by 2–3°C in the east of the region, and by 1–2°C in the west. | <ul style="list-style-type: none"> Daily maximum temperatures are projected to increase by an average of 1–3°C, with the greatest increases during autumn, winter and spring (2–3°C). Maximum temperatures in summer are projected to increase by 2–3°C in the west, and by 1.5–2°C in the east. |

| | New England/North West region | Western region |
|-------------|---|---|
| | | <ul style="list-style-type: none"> Minimum temperatures are projected to increase by 0.5–2°C across the region. |
| Rainfall | <ul style="list-style-type: none"> Increase in all seasons except winter, when it is expected to decrease by 10–20%. Increase 5–20% in summer and autumn but higher evaporation is projected to create drier conditions. Winter and spring projected to be the driest. | <ul style="list-style-type: none"> Increase by 20–50% in the tablelands and central west, and to increase moderately by 10–20% in the rest of the region. Winter rainfall to decrease by 10–20% across most of the region, while some areas in the south are projected to decrease by 20–50%. |
| Evaporation | <ul style="list-style-type: none"> Evaporation to increase throughout the year, especially in spring when a 10–20% increase is likely in the east, grading to a 20–50% increase in the west. Moderate increases are likely in summer and autumn, and in winter increases of 5–10% are projected for the east and 10–20% for the west. Overall water balance is likely to remain similar, but with some redistribution of runoff likely to produce substantial increases in summer and a substantial decrease during spring and winter. Despite the potential for drier conditions due to increased evaporation, flood-producing rainfall events are likely to increase both in frequency and intensity. | <ul style="list-style-type: none"> Evaporation to increase by more than 50% during spring in the far north-west of the region, and substantial increases are likely for the rest of the region during spring, and throughout the region in summer. In autumn, evaporation is likely to increase most in the west (20–50%) with smaller increases in the east (10–20%). In winter, a slight increase is likely in the north-east of the region. An increase in evaporation across most of this region is projected overall to create drier conditions throughout the year. |
| Fire | <ul style="list-style-type: none"> The frequency of very high or extreme fire-risk days is projected to increase. Increases in temperature, evaporation and high fire-risk days are likely to influence fire frequency and intensity across the region, and the fire season is likely to be extended. Peak fire dangers are currently reached during summer in the west of the region, and spring–summer in the east. Changes out to 2050 project possible extensions both forward into spring in the west, and back into late summer in the east. Historically, the New England/North West region experiences more than 10 very high to extreme fire danger days per year on the tablelands and more | <ul style="list-style-type: none"> The frequency of very high or extreme fire-risk days is projected to increase in the Western region. Increases in temperature, evaporation and high fire-risk days are likely to increase further, but more research is needed to assess the impact on fire frequency and intensity across the region. The fire season is likely to be extended as a result of higher temperatures. Peak fire dangers in the Western region are currently reached in summer. Projections out to 2050 include a tendency for the season to commence earlier (spring) and for the fire danger to be more intense during the season as the incidence of prolonged wet periods through winter–spring declines. |

| | New England/North West region | Western region |
|--|--|---|
| | than 30 further inland. These are projected to increase by 10–50% out to 2050. | <ul style="list-style-type: none"> Historically, the Western region experiences more than 30 very high to extreme fire danger days per year, and more again in the far west. These will possibly increase by 10–50%. |

Source: (DECCWA, 2010a; DECCWA, 2010b).

By 2050, the ecological community is predicted to experience a general warming in all seasons, reduced winter and spring rainfall, and increased summer rainfall (DECCW, 2010a; Dunlop et al., 2012; Hueston et al., 2012). These changes are likely to result in issues such as:

- loss of resilience to degradation and fragmentation;
- structural and compositional changes of the herbaceous ground layer:
 - changed C₃/C₄ ratios e.g. summer-growing or C₄ grasses, such as kangaroo grass, redgrass or the weed African lovegrass (*Eragrostis curvula*), are likely to replace the winter-growing or year-long green or C₃ grasses, such as speargrasses and wallaby grasses in the ecological community's southern extent.
 - replacement of perennial grasses with annual species.
 - reduced pasture production and increasing grazing pressure from livestock, eastern grey kangaroos and other macropods and exotic herbivores.
- predominance of exotic plant species and reduced native forb diversity;
- altered fire frequency, increased intensity and spread;
- high rainfall areas under increased pressure for cropping; and,
- cascading changes in ecological interactions.

It is predicted that climate change will exacerbate existing threats and put increasing pressure on the ecological community as a whole and by altering the survival rates of constituent species. It is also likely to interact with other threats, such as changed fire regimes and weed invasion. The long generation time and limited dispersal ability of some key species, such as poplar box is likely to limit adaptation through range shift. While cool seasonal species such as C₃ grass species, are likely to contract further south than their current range.

Appendix B - Eligibility for listing against the EPBC Act criteria

Criterion 1 – Decline in geographic distribution

Prior to European settlement the Poplar Box Grassy Woodland was part of an extensive range of intergrading grassy woodland and grassland ecosystems that extended throughout eastern Australia inland from the Great Dividing Range. Many of these areas and ecosystems have been heavily modified for agricultural, pastoral, urban and mining activities. Changes in structure, composition and function have occurred to the ecological community through clearance of overstorey and understorey species and from intensive long-term grazing, pasture development and cropping (see also Criterion 4 below).

Published estimates of the pre-European extent, current distribution and decline are incomplete for some areas of Poplar Box Grassy Woodland. However, available data document substantial declines of the Poplar Box Grassy Woodland's range. The pre-European extent of the ecological community in Queensland has been estimated to have been 2 486 312 ha but has declined to 577 510 ha (a decline of about 77%) (Table B1). In Queensland, it is also apparent that clearing of native remnant vegetation, including the ecological community is continuing for certain activities, including: high-value agriculture, extractive industries and grazing (DNRM, 2013; DNRM, 2014).

Table B1. Estimates of extent and decline for NSW (PCT) and Queensland (RE) mapping units that primarily correspond to the Poplar Box Grassy Woodland.

| Map Unit | Pre-European extent (ha) | Current extent (ha) | Decline (%) |
|------------------------------|--------------------------|---------------------|-------------|
| Queensland | | | |
| RE 11.3.2 ¹⁷ | 1 924 549 | 514 706 | 73 |
| RE 11.3.17 | 258 835 | 34 848 | 87 |
| RE 11.4.7 ¹⁸ | 208 455 | 20 052 | 90 |
| RE 11.4.12 | 69 923 | 7 451 | 89 |
| RE 12.3.10 | 24 550 | 453 | 98 |
| Sub total in Qld | 2 486 312 | 577 510 | 77 |
| NSW | | | |
| PCT56 (RVC 22) ¹⁹ | 450 000 | 100 000 | 78 |
| PCT87 (RVC 76) | 600 000 | 200 000 | 67 |
| PCT101 (RVC 80) | 20 000 | 5 000 | 75 |
| PCT244 (RVC 22) | 1 500 000 | 400 000 | 73 |
| Sub total in NSW | 2 570 000 | 705 000 | 73 |
| Total | 5 563 312 | 1 282 510 | 77 |

Source: Benson, 2006; Benson et al., 2010; Accad and Neldner, 2015.

The pre-European extent of the Poplar Box Grassy Woodland in NSW has been estimated to total 2 570 000 ha by Benson et al. (2006, 2010). Estimates indicate that the ecological community has declined in NSW to the present extent of approximately 705 000 ha.

¹⁷ In the Queensland Regional Ecosystem description (e.g. RE11.3.2) the first number denotes the bioregion, the second number the Land Zone and the third number the vegetation type. Land Zone 3 - Recent Quaternary alluvial systems. Alluvium is sediment mass deposited from channelled stream flow or over-bank stream flow.

¹⁸ Land Zone 4 - Paleogene-early Quaternary clay plains. Originates from ancient alluvial deposits and aeolian clays (parna). Elevated above Land Zone 3.

¹⁹ RVC - Regional Vegetation Community

The estimates for decline in Tables B1 do not take into consideration the condition of remnants. Although the majority of decline in extent has mainly occurred due to historical clearance and weed invasion, expanding agricultural, pastoral and mining activities are continuing to reduce the extent in both NSW and Queensland (Benson, 2006; Australia Pacific., 2010b; Benson et al., 2010; Cumberland Ecology, 2013).

The pre-European extent of the ecological community across its entire range is estimated to be 5 563 312 ha and the current extent is estimated to be 1 282 510 ha. These estimates account for most known patches of the ecological community and are considered indicative of total decline. It is likely that the extent of the Poplar Box Grassy Woodland that remain in good condition and which meet the condition thresholds (1.6.2) is lower than indicated in the above Table B1. The Committee judges that it is likely that the ecological community has undergone a decline in extent of at least 77%.

The ecological community has undergone a **severe decline** in its geographic extent and is therefore eligible to be listed as **Endangered** under this criterion.

Criterion 2 – Limited geographic distribution coupled with demonstrable threat

This criterion aims to identify ecological communities that are geographically restricted to some extent. Three indicative measures apply:

- extent of occurrence (i.e. the total geographic range of the ecological community);
- area of occupancy (i.e. the area actually occupied by the ecological community within its natural range); and
- patch size distribution, which is indicative of the degree of fragmentation.

The highest category met (i.e. indicating the most restricted distribution), against any one of these measures, is applied in the assessment of the criteria to determine the conservation status of the ecological community.

It is recognised that an ecological community with a distribution that is limited, either naturally or that has become so through landscape modification, has an inherently higher risk of extinction if it continues to be subject to ongoing threats that may cause it to be lost in the future. As discussed in the threats section, the ecological community is affected by a range of demonstrable threats. Clearing of Poplar Box Grassy Woodland has resulted in patches of the ecological community becoming more isolated from each other and from surrounding vegetation communities, including remnants of related woodlands. These fragmented patches are more susceptible to threats, and experience ongoing impacts from grazing, weed invasion, and further clearing (see Criterion 4). Isolated stands of Poplar Box Grassy Woodland and the species populations they contain are at risk from loss of genetic diversity and other deleterious genetic effects (see Criterion 3).

Extent of occurrence

The Poplar Box Grassy Woodland occurs widely from central Queensland to southern NSW. The extent of occurrence of the ecological community is approximately 5.5 million ha (Table C1) which exceeds the threshold for being considered limited.

Area of occupancy

The Poplar Box Grassy Woodland is estimated to occupy a total area of approximately 1.3 million ha (Table B1). The estimated area of occupancy of the ecological community therefore greatly exceeds the 100 000 ha threshold for being considered limited.

Patch size distribution

Accurate patch size data for the ecological community are available only for Queensland (Accad and Neldner, 2015). These data cover much of the northern half of the Poplar Box Grassy Woodland and are likely to be indicative of the patch size distribution for the ecological community as a whole. Data collated for five regional ecosystems across Queensland showed that 57% of patches were less than 10 ha in size and 93% were under 100 ha. The median patch size in Queensland was 7.5 ha (Table B2).

Available data on patch size (for three NSW units) is limited. The available data for three indicates a similar pattern of fragmentation to that which occurs in Queensland.

Table B2. Patch size distribution for Queensland Regional Ecosystems that correspond to the Poplar Box Grassy Woodland.

| Regional Ecosystem | Patch no. ≤ 10 ha | Patch no. >10 - ≤100ha | Patch no. >100ha - <1000ha | Patch no. ≥1000ha | Total no. of patches | Median patch (ha) |
|--------------------|-------------------|------------------------|----------------------------|-------------------|----------------------|-------------------|
| RE 11.3.2 | 1 429 | 931 | 222 | 11 | 2 582 | 7.9 |
| RE 11.3.17 | 263 | 171 | 19 | 0 | 453 | 7.5 |
| RE 11.4.7 | 415 | 213 | 35 | 0 | 663 | 6.3 |
| RE 11.4.12 | 144 | 91 | 12 | 0 | 247 | 8.1 |
| RE 12.3.10 | 27 | 9 | 1 | 0 | 37 | 2.6 |
| Total | 2 278 | 1 415 | 289 | 11 | 3 982 | 7.5 |

Source: Accad and Neldner (2015).

Table B3. Indicative patch size distribution for the Poplar Box Grassy Woodland ecological community in Queensland.

| Thresholds | | Size range (ha) | No. patches | % patches | Cumulative % |
|------------|-----------------|-----------------|-------------|------------|--------------|
| Restricted | Very Restricted | ≤ 10 | 2278 | 57 | 93 |
| | | > 10 - ≤100 | 1415 | 36 | |
| | | > 100 - <1000 | 289 | 7 | |
| | | ≥ 1000 | 11 | 0.3 | |
| | | Total | 3982 | 100 | |

Source: Accad and Neldner (2015).

Conclusion

The extent of occurrence and area of occupancy are both not limited. The patch size data indicates that the ecological community has become more fragmented with the majority of patches under 100 ha in size (Table B3). This suggests a restricted geographic distribution. However, median patch size for the ecological community across Queensland is 7.53 ha which is indicative of a very restricted geographic distribution. However, the lack of equivalent comprehensive data from NSW means that there is insufficient information to determine eligibility of the ecological community for listing under any category of criterion 2.

Criterion 3 – Loss or decline of functionally important species

There are few detailed studies on functional species in the Poplar Box Grassy Woodland. However, *Eucalyptus populnea* being the dominant species of the canopy cover of the ecological community has a key functional role in determining vegetation structure and influencing hydrological inputs for groundwater, surface water flow and salinity. The canopy further alters microclimate, affecting light transmission, temperature and humidity, as well as mitigating the erosional effects of wind and rainfall.

Poplar box trees are also important as they provide food and habitat for fauna in the ecological community, for example, for nectarivores when the trees flower during summer. However, the ability of the trees to provide resources and habitat is diminished if they are in poor condition, or in a state of young regrowth. A large variety of native fauna species are dependent on tree hollows for shelter and nesting, including parrots, owls, possums, gliders and bats. The proportion of trees with hollows increases with tree diameter (Gibbons and Lindenmayer, 2002; Manning et al., 2004). The formation of large hollows in the trunk can take many decades. Gibbons and Lindenmayer (2002) noted that hollows suitable for fauna species do not generally form in eucalypts until at least 120 years, with larger hollows taking up to in excess of 200 years. Therefore, lost large hollows may not be replaced for very long periods. Mature trees with hollows are limited in many of the rural lands of Queensland, where widespread clearing has removed much of the mature vegetation and habitat features. Despite the alteration in the age cohorts and impaired recruitment, poplar box is still present in all remnants.

The Poplar Box Grassy Woodland is characterised by subtle variations in understorey species composition across its full extent due to the wide-ranging climate, soil types and landscape positions. A consequence of the variable nature of the ecological community is that no individual understorey species has an apparent functional importance across the entire range of the Poplar Box Grassy Woodland.

Fragmentation of the ecological community has reduced its ability to support a natural and complete assemblage of birds, particularly those with small home ranges. The loss of woodland birds is a major cause of eucalypt dieback in eastern Australia by insect attack. In some locations a healthy bird community has been observed to remove 50–70% of foliage feeding insects, thus playing an important role in maintaining the health of the tree layer (Ford, 1989; Barrett, 2000). However, there are no specific data on impacts from loss of fauna for Poplar Box Grassy Woodland.

The loss of bird and mammal species from the ecological community is likely to have a negative effect on ecological function, through the reduction of pollination, seed dispersal and soil engineering (Fleming et al., 2013). Additionally fundamental changes in nutrient inputs and hydrology associated with land clearing for agriculture and pastoral activities cause physical, chemical and biological changes to woodland soils, driving reductions in the abundance of soil, groundcover density and type, and litter dwelling invertebrates, which are a major food source for many woodland birds (Hannah et al., 2007; Ford, 2011; Maron et al., 2011; Watson, 2011; Ingwersen and Tsaros, 2015).

Whilst threats are likely to have broadly impacted upon functionally important species such as poplar box trees and woodland bird species, particularly insectivores and terrestrial granivores, specific data related to the decline of such species in this ecological community are not available. As such there is **insufficient information to determine the eligibility** of the ecological community for listing under any category of Criterion 3.

Criterion 4 – Reduction in community integrity

As noted under criterion 1, the Poplar Box Grassy Woodland is estimated to have declined in extent by at least 76% due to clearance. This is mainly in the past for agricultural and pastoral activities and in recent times mostly due to rural-residential and infrastructure developments and mining. Criterion 1 considers when the ecological community has been lost outright. Criterion 4

considers that areas of the ecological community that remain are subject to progressive degradation and loss of flora and fauna diversity and ecological integrity, notably a consequence of the increased fragmentation and isolation of remnants, weed invasion and inappropriate land management (e.g. grazing and fire) regimes. Other threats, such as rural tree dieback and the potential impacts from climate change may also contribute to loss of integrity over time.

The Poplar Box Grassy Woodland has not been the subject of extensive studies, as has been the case for some other woodland types in the intensive land use zone of eastern Australia. Many of the threats and disturbances acting on the Poplar Box Grassy Woodland are common to these other grassy woodland systems and it is assumed the nature of their impacts are similar across woodland types.

Reduction in integrity through fragmentation

Reliable data on patch size distribution of the Poplar Box Grassy Woodland in Queensland shows that the ecological community was naturally fragmented, in line with the alluvial landscape associated with the ecological community (Table B4). However, clearance has decreased the number and size of patches in addition, patches originally would have been contiguous with other woodland and grasslands that also were present across alluvial plains and lowlands but are now also heavily cleared in the areas where the ecological community occurs.

Table B4. Patch size distribution of the Poplar Box Grassy Woodland ecological community in Queensland for the modelled pre-European extent and remnant vegetation in 2013.

| | ≤ 10 ha | >10 - 100 ha | >100 - 1000 ha | >1000 ha | Total | Median |
|--------------------------|---------|--------------|----------------|----------|-------|--------|
| <i>Number of patches</i> | | | | | | |
| Pre-European | 5312 | 3472 | 953 | 84 | 9821 | 8.38 |
| 2013 | 2278 | 1415 | 289 | 11 | 3982 | 7.53 |

Source: Accad and Neldner (2015). Data collated for five Regional Ecosystems in Queensland that correspond to the Poplar Box Grassy Woodland ecological community: 11.3.2, 11.3.17, 11.4.7, 11.4.12 and 12.3.10.

The main difference between the pre-European distribution and the 2013 extent is that there are fewer patches overall in 2013, particularly of very large sites over 1000 hectares in area (these very large patches have declined by 87% overall). There were 2.5 times as many more patches pre-European than exist at 2013. It is presumed that the fewer patches in 2013 are more isolated, being spaced further apart. This is in line with the study of eucalypt woodlands as bird habitat in central Queensland by Hannah et al., (2007), who noted that:

"analysis of Landsat imagery taken in 1984 and 1999 [showed that] the amount of woodland within 10 km of each woodland fragment site had fallen from 68% in 1984 to 34% in 1999 (and that within 1 km of these sites had fallen from 67% to 31%)."

The pattern of decline in Poplar Box Grassy Woodlands is not distributed evenly across the landscape, as shown by decline within each local government area in Queensland (Table B5). Local government areas in the northern and western edge of the ecological community's northern range had relatively lower levels of decline. High levels of decline (70% or more) were evident in the central and southern LGAs, that often coincide with prime, very productive agricultural lands (e.g. Darling Downs), hence the extensive nature of their clearing.

Table B5. Extent and decline of Poplar Box Grassy Woodlands within local government areas (LGAs) that occur in Queensland. LGAs are sorted in order of decline for poplar box.

| Local Government Area | Pre-European extent (ha) | 2013 extent (ha) | Decline (%) |
|----------------------------|--------------------------|------------------|-------------|
| Somerset Regional | 1 144 | 3 | 99.7 |
| Lockyer Valley Regional | 1 619 | 8 | 99.5 |
| Ipswich City | 945 | 21 | 97.8 |
| North Burnett Regional | 55 409 | 1 600 | 97.1 |
| Southern Downs Regional | 12 776 | 528 | 95.9 |
| Gympie Regional | 855 | 47 | 94.5 |
| Gladstone Regional | 6 755 | 398 | 94.1 |
| Rockhampton Regional | 38 446 | 2 416 | 93.7 |
| Scenic Rim Regional | 284 | 19 | 93.3 |
| Livingstone | 1 476 | 100 | 93.2 |
| Toowoomba Regional | 119 652 | 8 403 | 93.0 |
| Western Downs Regional | 381 437 | 41 556 | 89.1 |
| South Burnett Regional | 3 873 | 446 | 88.5 |
| Goondiwindi Regional | 175 178 | 20 376 | 88.4 |
| Balonne | 213 492 | 30 762 | 85.6 |
| Banana | 184 684 | 29 385 | 84.1 |
| Barcaldine Regional | 131 106 | 30 772 | 76.5 |
| Maranoa Regional | 434 574 | 107 592 | 75.2 |
| Central Highlands Regional | 343 508 | 100 828 | 70.7 |
| Isaac Regional | 189 197 | 81 899 | 56.7 |
| Murweh | 114 887 | 65 147 | 43.3 |
| Mackay Regional | 438 | 272 | 37.9 |
| Blackall Tambo Regional | 44 463 | 28 891 | 35.0 |
| Whitsunday Regional | 43 141 | 28 433 | 34.1 |
| Woorabinda Aboriginal | 2 208 | 1 496 | 32.3 |
| TOTAL | 2 501 547 | 581 398 | 76.8 |

Source: Accad and Neldner (2015). Data were collated for five Regional Ecosystems that have poplar box as a dominant component: RE11.3.2, 11.3.17, 11.4.7, 11.4.12 and 12.3.10.

Equivalent data are not available for occurrences in NSW. However, Reid et al., (2007) noted that woodland fragmentation is greatest in the most intensively developed agricultural areas, in line with the observations of [Table B5](#). An example is the highly fragmented nature of remnant vegetation on the NSW Liverpool Plains, a region of very fertile soil and highly productive agricultural activity.

As patches become more isolated and surrounded by a matrix of modified land uses, the remnants become more susceptible to disturbances, for instance weed invasion and spray drift. Their habitat value also declines if the remnants become too isolated to support a diversity of flora and fauna. Increased separation of patches is likely to limit regeneration and colonisation opportunities as some understorey plants have restricted seed dispersal or seed longevity, while some fauna (e.g. ground-dwelling reptiles) have limited ability to move among sites if they are too distant and separated by large expanses of unfavourable habitat.

Reduction in integrity through altered management regimes (grazing and fire)

Prior to European settlement, grazing of the Poplar Box Grassy Woodland would have naturally occurred by soft-footed native herbivores such as kangaroos and wallabies. These species browse in a different manner to domestic stock, so would not have had the same impact on the understorey of the ecological community.

Grazing by domestic stock (sheep and cattle) is most likely to occur in the more open woodland patches of the ecological community and near to watering points. Many patches of the ecological community occur on or adjacent to agricultural land where stock may seek shelter from adverse weather under the canopy trees. Their presence leads to trampling of vegetation, direct but selective removal of vegetation through browsing and soil compaction. Damage caused by grazing tends to increase with grazing intensity. Heavy, persistent grazing can suppress the growth of many native plants. Soil compaction is a common impact of stock grazing, and medium to fine-textured moist soils such as clays and loams (i.e. those that support the ecological community) are particularly susceptible to compaction by stock. Soil compaction can lead to reduced water infiltration which in turn can affect germination and growth of seedlings. Fauna that generally depend on understory vegetation for foraging and nesting are negatively affected by livestock grazing, whereas species that forage predominantly in the canopy are likely to be less affected by grazing (Martin and McIntyre, 2007).

A few studies have examined the impacts of grazing specific to Poplar Box Grassy Woodlands. Hinchcliffe (2004) noted that overgrazing impacted on ecosystem services by disrupting water and nutrient cycling in poplar box woodlands. Tunstall et al. (1981) noted that grazing in poplar box remnants reduced overall herbage biomass. Grazing can keep patches relatively shrub-free but under heavier regimes can also increase the amount of bare areas (scalds). However, Fritz (2012) observed that, while patch grazing affected some floristic components, it did not influence overall species richness or tree condition in the poplar box remnants she studied in southern Queensland. The main difference was a decline in the composition of lightly grazed relative to ungrazed sites, possibly due to loss of thick grass tussock species under low levels of grazing, which then promoted recruitment of inter-tussock species. However, Lunt (2005) has noted that heavy grazing of many perennial dominated systems, such as the ecological community, have the composition of their understorey replaced by exotic annuals.

Grass is the main fuel component for fire in the Poplar Box Grassy Woodland and the amount available is determined by grass species, hydrological regimes and shrub density. The dynamics of woody plant populations in woodlands are greatly influenced by grass fires. With the reduction in fire frequency related to excessive grazing pressures following European settlement in the 19th and mid 20th century, there has been a rapid increase in the density of unpalatable native shrubs (woody regrowth) within the range of the ecological community (Noble et al., 2007). Any potential grass fuel, particularly palatable perennial grasses, was largely consumed by large populations of domestic, and later feral herbivores, e.g. rabbits (*Oryctolagus cuniculus*) and goats (*Capra hircus*). With the development of permanent water supplies, rapidly increasing numbers of native herbivores such as the *Osphranter rufus* (red kangaroo), *Macropus giganteus* (eastern grey) and *Macropus fuliginosus* (western grey kangaroos), all contributed to the total grazing pressure within native grassy woodlands (Noble et al., 2007).

Native tussock grasses, such as curly windmill grass (*Enteropogon acicularis*) and kangaroo grass (*Themeda triandra*) are well adapted to regular burns and light grazing. Dense tussocks can also tolerate heat damage from fires. However, perennial grasses have high mortality rates with increasing grazing pressure and these effects can be exacerbated during droughts. In NSW, shrubby regrowth particularly affects the Western Plains and Cobar Peneplain Bioregion, although other inland areas are also affected. Most regrowth is of non-palatable shrubs such as *Senna*, *Eremophila* and *Dodonaea* species. Shrubs are less able to carry fire

within the landscape and therefore can further suppress the growth and regeneration of native grasses and forbs.

The potential fire frequency (based on average rates of fuel accumulation) varies between 5 and 20 years for woodlands such as the Poplar Box Grassy Woodland. However, if shrub density increases, the fire interval may become much greater ranging from 50 to 100 years.

Reduction in integrity through weed invasion

The Poplar Box Grassy Woodland has an extensive geographic range with many remnants now surrounded by a modified landscape of crops, pastures and developed or disturbed sites. As a result, patches of the ecological community are now exposed to, and threatened by, a wide range of invasive plants. Some of these are noted to be serious environmental weeds that impact upon a range of vegetation types, not just the Poplar Box Grassy Woodlands. For instance, parthenium weed (*Parthenium hysterophorus*), African boxthorn (*Lycium ferocissimum*) and prickly pear (*Opuntia* spp. and related genera) are all identified as Weeds of National Significance for their known detrimental impacts upon the environment and productivity.

The presence of any high impact weeds within remnants indicates a strong potential for further degradation if weeds are not appropriately managed to curb their future expansion. However, the effective long-term management of weeds is often resource intensive and needs considerable commitment and effort. Given that many of the weeds now present in the ecological community are highly invasive and problematic to manage, plus the threat from the establishment and spread of new weed species, weeds are highly likely to continue to contribute to the reduction in integrity of the ecological community well into the future.

Benson et al. (2006; 2010) noted that the NSW components of the Poplar Box Grassy Woodland generally exhibit a moderate weediness cover, as follows:

- VCA 56 - 5 to 15%;
- VCA 87 - 15 to 30%;
- VCA 101 - 15 to 30%; and
- VCA 244 - 15 to 30%.

It is presumed that the degree of weed infestation is at least similar for the ecological community in Queensland, given the nature of the weeds and landscape change that occur there. Some of the key weeds known to impact upon the ecological community are outlined below.

Buffel grass (Cenchrus ciliaris)

Buffel grass is a species native to Africa and southern Asia that was promoted as a pasture species suitable for the rangelands of northern and inland Australia. Its drought tolerance and ease of establishment resulted in the grass being widely planted (Franks, 2002). Agronomists even recommended that it be sown underneath poplar box trees to improve the establishment and yield of this pasture species in semi-arid areas (Christie, 1975).

Buffel grass is now recognised as a serious environmental weed that adversely impacts upon native biodiversity (Marshall et al., 2012). It is known to invade remnants of poplar box and increased cover of buffel grass in these woodlands is associated with a significant decline in plant species diversity (Franks, 2002). Cover of buffel grass may also influence the habitat preferences of ground reptile species in poplar box woodlands (Eyre et al., 2009). In the arid zone of central Australia, the presence of buffel grass and its displacement of native grasses has also been shown to influence the composition of native ground-dwelling bird and ant guilds (Smyth et al, 2007).

Coolatai grass (Hyparrhenia hirta)

Coolatai Grass is a drought, fire and herbicide tolerant tussock grass that grows up to 1.5 m in height. It is able to rapidly colonise disturbed sites, but can also invade adjacent undisturbed native vegetation where it can form dense swards that smother most native plants. Being drought

tolerant, Coolatai grass has the ability to rapidly respond to rain, producing new culms from the tussock base and flowering in a matter of weeks. It is well adapted to fire, with tussocks surviving hot burns. Since its introduction as a pasture species in the 1930s to 1960s it has spread extensively across northern and central NSW and into parts of southern Queensland. Although it has predominated in the southern winter rainfall zones of the Poplar Box Grassy Woodland, Coolatai grass has the potential to spread into the northern extent of the ecological community due to its C₄ metabolic pathway.

Studies in northern NSW have shown that Coolatai grass infestations have reduced the number of native plant, invertebrate and frog species in threatened White Box, Yellow Box and Blakeley's Red Gum Grassy Woodlands. Coolatai grass poses a huge risk to the biodiversity of the fragmented areas of native ecosystems remaining across NSW and Queensland as it easily invades even undisturbed ecosystems (McArdle et al., 2004; DPI, 2015a). It is highly likely that these impacts demonstrated in box gum grassy woodlands would also apply to other, adjacent grassy woodland systems such as the Poplar Box Grassy woodlands

Lippia (Phyla canescens)

Lippia is a prostrate perennial broadleaf herb that spreads both vegetatively or by seed and has the ability to form extensive mats over the ground surface. Seed can remain viable for up to 10 years and seed banks under infestations can contain up to 10 000 seeds per square metre. Seeds and fragments can be spread by vehicles, machinery and animals but also in response to flood events where it can quickly re-establish after floodwaters subside. Spread of lippia also appears to be accelerated by persistent heavy grazing (NSW Scientific Committee, 2009). It is a major threat to drainage areas, floodplains and pastoral areas along the inland river systems of NSW and Queensland. It is estimated 5.3 million hectares of floodplain grazing country in the Murray–Darling Basin are affected by lippia and it has the potential to continue spreading into other inland river and floodplain systems (DPI, 2015b).

In central NSW, lippia poses a major threat along the Lachlan River and floodplain systems west of Forbes, where the Poplar Box Grassy Woodland occurs. It is also known to invade remnants of poplar box in Queensland (Galea, 2014). Lippia causes major environmental impacts in several ways (Leigh and Walton, 2004). Where lippia occurs on floodplain or riparian soils, the deep root systems of lippia does not bind the soil but causes them to crack and dry out, unlike the extensive, fine root systems of native perennial plants. Flood and heavy rainfall events can more easily erode the soils beneath the lippia mats. Lippia can completely dominate the ground layer, if left unchecked, and in so doing reduces the diversity and cover of native plants, especially perennial grasses (Leigh and Walton, 2004). It is one of the few serious weeds that can displace native plants without prior disturbance to enable its establishment. The dense nature of the its ground cover and the soil drying effect of its deep root system can prevent native eucalypt seedlings from establishing, (Leigh and Walton, 2004).

African boxthorn (Lycium ferocissimum)

African boxthorn, a weed of national significance, is a perennial shrub that can grow up to 5m in height. It has an extensive, deep, branched taproot, spiky branches and fleshy fruits that can be widely dispersed by birds. African boxthorn occurs widely across southern Australia, extending into central and northern NSW and southern Queensland. African boxthorn grows on all soil types but establishes best on lighter soils, such as alluvial soils associated with the Poplar Box Grassy Woodland ecological community. It can form dense, spiky thickets which can outcompete grassy ecosystems such as the Poplar Box Grassy Woodland. The species also provides protective and breeding habitat for other invasive species, such as rabbits and foxes (DPI, 2015c). Highly invasive woody weeds, such as African boxthorn can alter an ecological community's structure from a predominantly grassy ground layer to a shrubby understorey.

Other weeds

While there are many other weeds known to occur in Poplar Box Grassy Woodlands, their specific impacts to the ecological community are less well studied. It is implied that any detrimental impacts observed in similar grassy systems or other adjacent woodland types would also apply to Poplar Box Grassy Woodlands. They contribute to the overall detrimental impacts of weeds generally upon the ecological community. Additional weeds of note include prickly pear (*Opuntia* spp.), mother of millions (*Bryophyllum delagoense*), African lovegrass (*Eragrostis curvula*), burr medic (*Medicago polymorpha*), Cretan weed (*Leontodon rhagadioloides*), flat weed (*Hypochaeris radicata*), parthenium weed (*Parthenium hysterophorus*), paspalum (*Paspalum dilatatum*) and small-flowered mallow (*Malva parviflora*).

Reduction in integrity through dieback

Dieback (canopy decline) in Queensland has been noted in a large range of tree species in surveys conducted during the early 1980s and late 1990s (Wylie et al., 1993; Fensham and Holman, 1999; Reid et al., 2007). Dieback was especially common in 20 Queensland shires including parts of the Darling Downs where the ecological community is known to occur. Dieback was more pronounced on smaller properties that were more intensively managed and had a greater proportion of their area cleared (Wylie et al., 1993). Although long or reoccurring droughts induce severe water stress that can lead to tree death, a study by Reid et al. (2007) found that multiple causes can act simultaneously leading to dieback of poplar box.

In NSW, dieback is particularly common in box woodland communities further inland. Dieback has intensified on many parts of the Liverpool Plains, with poplar box and *Eucalyptus camaldulensis* (river red gum) being two of the most affected species. Tree decline has also been noted since 1990 in the Gunnedah and Narrabri areas. Poplar box dieback is widespread in the lower Macquarie Valley (Hassall & Associates, 1996), as well as the Gwydir and Namoi Valleys.

The decline in tree and crown health of poplar box in the Namoi region was unusually severe in the 1990s and contrasted with the health of other trees in the same or nearby landscapes. The tree health survey of 40 sites in the middle Upper Namoi catchment in 1999 showed that poplar box on the flood plains, Liverpool Plains and Gunnedah region were most affected by dieback. (Reid et al., 2007). The study found that individual and cumulative impacts from multiple causes, particularly falling shallow water tables (especially during drought), insect and insecticide drift damage, along with defoliant and herbicide drift contributed to the severe decline of poplar box. Reid et al. (2007) also noted that in the Namoi Valley "dieback was found to be more severe on the floodplain in landscapes where farming, particularly irrigated cropping and fallows, and woodland fragmentation were extensive."

Reduction in integrity due to change in community structure and composition (including loss of fauna)

Reduction in extent and further fragmentation of the ecological community reduces its capacity to support a variety of faunal assemblages, removing the ecological services provided by these animal species. For example, the simplification of the bird assemblage can increase the risk to the community of *Eucalyptus* dieback associated with defoliation by insects, while other services such as pollination and seed dispersal may also be compromised (Maron and Lill., 2005; Briggs et al., 2007; Hannah et al., 2007; Reid et al., 2007; Ford, 2011; Ingwersen and Tzaros, 2015). Among the worst affected group of woodland birds are the ground-foragers, (particularly those species that feed on insects) such as *Pomatostomus temporalis temporalis* (greycrowned babbler).

Extensive clearing of eucalypt woodlands on the most fertile and productive soils, such as valley floors, floodplains and lower slopes, and degradation of the remaining habitat through

intensified agriculture has undoubtedly changed soil and ground litter properties, resulting in reduced food resources available to ground-feeding birds. The loss of eucalypts from lowland areas, especially those renowned for nectar and foliage insect resources has impacted on populations of nectar feeders such as *Anthochaera phrygia* (regent honeyeater) and *Lathamus discolor* (swift parrot). The conversion of structurally complex and floristically diverse grassy woodlands such as the ecological community, into highly simplified monocultures dominated by exotic annuals has also affected species such as *Stagonopleura guttata* (diamond firetail) and *Climacteris picumnus* (brown treecreeper) (Ingwersen and Tzaros, 2015).

Vegetation structure is also of overriding importance to the maintenance of fauna populations. The age and size of trees is important in terms of their ability to provide food and shelter requirements. Several arboreal mammals and bird species are dependent on tree hollows for shelter and nesting, including parrots, owls, possums, gliders and bats. If old growth trees are lost from woodlands, some animals may become locally extinct and may only recolonise areas once vegetation patches reach maturity and are within the dispersal range of the animal (Benson, 1999). In the agricultural landscape large eucalypts often remain as isolated individuals (paddock trees or small stands). These trees suffer increased mortality related to dieback causes, such as water stress, recurring insect attack and occasional lightning strike.

Mature trees with hollows are limited in many of the rural lands of Queensland, where widespread clearing has removed much of the mature vegetation. Hollows suitable for use by many fauna species do not form until eucalypts are at least 120 years old, with large hollows rare in trees under 220 years old (Gibbons and Lindenmayer, 2002). Therefore, lost hollows may not be replaced for very long periods. Even single or widely scattered mature hollow-bearing trees can be important habitat, such as for hollow-roosting bats. In a study by Rayner et al. (2013), it was noted that poplar box, which is a dominant eucalypt species from southern NSW to central Queensland, had one of the highest probabilities of containing large hollows at relatively small limb sizes. The study suggested that large-scale removal of poplar box trees greater than 20cm (DBH) would remove a large proportion of hollows from the landscape. The loss of large hollow-bearing poplar box trees, contributes to a loss of fauna and to a large reduction in ecological function within the ecological community.

Some ground-dwelling native animals such as *Vombatus ursinus* (common wombat) and *Tachyglossus aculeatus* (short-beaked echidna); as well as bandicoot species found (or formerly present) in the ecological community play an important ecological role in maintaining soil processes. In other locations in NSW it has been observed that soil disturbances created by these animals can provide benefits by assisting soil aeration, nutrient cycling and water infiltration, as well as the spread and establishment of seedlings (Martin, 2003). The loss of digging 'ecological engineers' may cause a reduction in the ecological function (and disrupt the regeneration) of the ecological community. In addition, with other modifications and ongoing threats to the ecological community, where soil disturbance occurs, rather than assisting recruitment of native flora, it can encourage weed invasion.

The ecological community supports populations of macropods that browse and graze on the mostly grassy understorey and occasional shrubs. These populations may significantly influence the floristics and structure of the ecological community and influence fire behaviour (for example, many grazers or browsers may favour a more grassy environment, which is relatively flammable, burns quickly with relatively low intensity and flame height relative to shrubby formations).

Although shrubs may naturally occur in the ecological community, they can shift from a typically sparse presence to dense localised cover, particularly in semi-arid areas. The increased shade from denser shrub canopies and greater competition for water and nutrients discourages the growth and spread of grass and forb species in the Poplar Box Grassy Woodland.

Encroachment can eventually result in structural transitions from a grassy woodland to shrubby

woodland. Shrub encroachment into the ecological community may be a response to naturally or artificially induced processes such as fluctuating hydrology, altered nutrients, loss of apex predators or altered fire regimes.

Pasture improvement techniques, such as fertiliser addition, can influence the composition of the vegetation and lead to a progressive loss of native flora species. Australian soils are generally poor in nitrogen and low levels of phosphorus to which native flora species have adapted. Consequently, some species will decline under increased soil fertility conditions. These impacts are exacerbated if fertiliser addition is accompanied by oversowing exotic pasture species. Pasture species and/or weeds, such as buffel grass, may have a competitive advantage over native species under conditions of improved soil fertility, displacing native perennial species.

Conclusion

Substantial clearing, severe fragmentation, weed invasion, inappropriate fire and grazing regimes, pasture improvement and associated changes to vegetation structure and loss of faunal components have substantially reduced the integrity of the ecological community. These losses may be compounded by climate change. The very long lag time to recover vegetation structure, with adequate representation of large old trees, limits the likelihood of recovery in the near future. The intractability of other problems, such as the regional loss of fauna, and the nature of existing land and water use in the ecological community's extent further reduces the potential for recovery.

The reduction in integrity experienced by the ecological community across most of its geographic distribution is **severe**, as indicated by **severe** degradation of the community and its habitat. Therefore, the ecological community is **eligible** for listing as **endangered** under this criterion.

Criterion 5 – Rate of continuing detrimental change

There is a degree of ongoing vegetation clearance of the ecological community. Reliable data on clearing and change in the extent of the ecological community since 1997 are available for Queensland (Table B6).

Table B6. Estimates of recent decline in Queensland regional ecosystems dominated by poplar box. Data were collated for the five regional ecosystems that correspond to the Poplar Box Grassy Woodland.

| Year | Extent (ha) | Period - % change / 4 yrs |
|------|-------------|---------------------------|
| 1997 | 679 868 | |
| 1999 | 631 567 | |
| 2001 | 600 813 | 1997-2001 – 11.60% |
| 2003 | 573 175 | |
| 2005 | 584 213 | 2001-2005 – 2.77% |
| 2009 | 579 768 | 2005-2009 – 0.76% |
| 2011 | 578 742 | |
| 2013 | 577 510 | 2009-2013 – 0.39% |

Source: Accad and Neldner (2015)

The available data shows a substantial decline in the relative extent of the ecological community during 1997 to 2005, equivalent to about 18.8% per decade. Decline was most evident during the first part of this period, in the late 1990s. That clearing occurred prior to the regulation of both broad scale vegetation clearing and the clearing of high value regrowth, introduced in 2006 and 2009 respectively (Maron et al., 2015). From 2005 to 2013, the degree of clearing of the ecological community was minor, in the order of only 1.4% per decade, and reflects the impact of regulating native vegetation clearing.

However, vegetation management regulations in Queensland were considerably weakened from 2012/13, prompting a likely return to extensive land clearing. The estimated extent in 2013 compiled by Accad et al (2015) likely does not yet cover the impacts of these subsequent legislative changes. But there are indications that the extent of overall native vegetation clearing across Queensland has markedly increased after 2013, at triple the clearing rate for 2010 (Maron et al, 2015). The actual clearing rates since 2013 are yet to be confirmed, as are estimates of how the Poplar Box Grassy Woodland was specifically impacted by recent changes in vegetation management laws. What is clear is that the ecological community occurs in a region that presently faces heavy development pressures for mining, coal-seam gas and high value agriculture (see Appendix A Key threats) and that such potential developments are likely to result in further detrimental impact to the ecological community.

No data on the recent extent of clearing are available for the NSW occurrences of the Poplar Box Grassy Woodlands.

There is evidence of ongoing clearing of the Poplar Box Grassy Woodland over the previous two decades for significant areas of the ecological community i.e. in Queensland, during that period. The nature of development pressures facing the region where the ecological community occurs indicates a likelihood of longer-term, landscape-level impacts to the ecological community or the surrounding region. Therefore the Committee recommends the ecological community meets this criterion as **vulnerable** for listing under Criterion 5.

Criterion 6 -- Quantitative analysis showing probability of extinction

There are no quantitative data available to assess this ecological community under this criterion. As such there is insufficient information to determine the eligibility of the ecological community for listing under any category of Criterion 6.

Appendix C – Indigenous cultural values and knowledge of the ecological community

Indigenous knowledge

The Indigenous people of NSW and Queensland understood and managed their natural landscapes for millennia. They established diverse and dynamic cultures and used a wide variety of plant and animal resources for food and materials. Some Indigenous plant resources were documented by Williams and Sides (2008).

Although there is little information specific to the Poplar Box Grassy Woodland, knowledge exists about the Indigenous uses of various plant and animal species that occur in the ecological community. The key Indigenous uses of plants present in the ecological community are summarised in Table 4c.

Key animal resources likely to occur in the ecological community that were used for food, hides and other resources include kangaroos, wallabies, wombats, possums and various woodland birds.

Table 4c. Known Indigenous uses of plant species that occur in the Poplar Box Grassy Woodland on Alluvial Plains ecological community

| Plant name | Indigenous use |
|---|--|
| <i>Acacia pendula</i> (weeping Myall, boree) | Food – seeds ground to make flour. Tools – boomerangs, digging sticks, waddies (clubs) |
| <i>Acacia stenophylla</i> (river cooba, river myall) | Food – seeds ground to make flour and baked as bread. Tools – boomerangs; ash mixed with pituri bark to make fish poison |
| <i>Allocasuarina luehmannii</i> (buloke) | Food – attacks many animals including possums and cockatoos Tools – boomerangs and clubs Medicine tree |
| <i>Amyema</i> spp., notably <i>Amyema cambagei</i> (needle-leaved mistletoe), <i>Amyema congener</i> (erect mistletoe), <i>Amyema gibberula</i> (hakea mistletoe), <i>Amyema miraculosa</i> (fleshy mistletoe), <i>Amyema quandang</i> (grey mistletoe) | Food – flowering parts Medicine – bruised leaves soaked in water to treat fevers |
| <i>Atalaya hemiglauca</i> (cattle bush) | Tools - spear shafts |
| <i>Brachychiton populneus</i> (kurrajong) | Food - seeds high in protein, fat, zinc and magnesium. Used to make coffee-like drink by grinding and adding to hot water. Young stems, leaves and roots eaten raw. Tools - fibres for fishing lines, dilly bags and nets. Resin used to making tools Medicine tree |
| <i>Bulbine bulbosa</i> (bulbine lily, native onion) | Food – bulbs roasted. |
| <i>Callitris glaucophylla</i> (white cypress pine) | Food – birds such as pink cockatoo and galahs nest in hollows; young and eggs. Tools – resin for glue; bark and roots for splints; bark used for carrying fire. Medicine - treatment for colds |

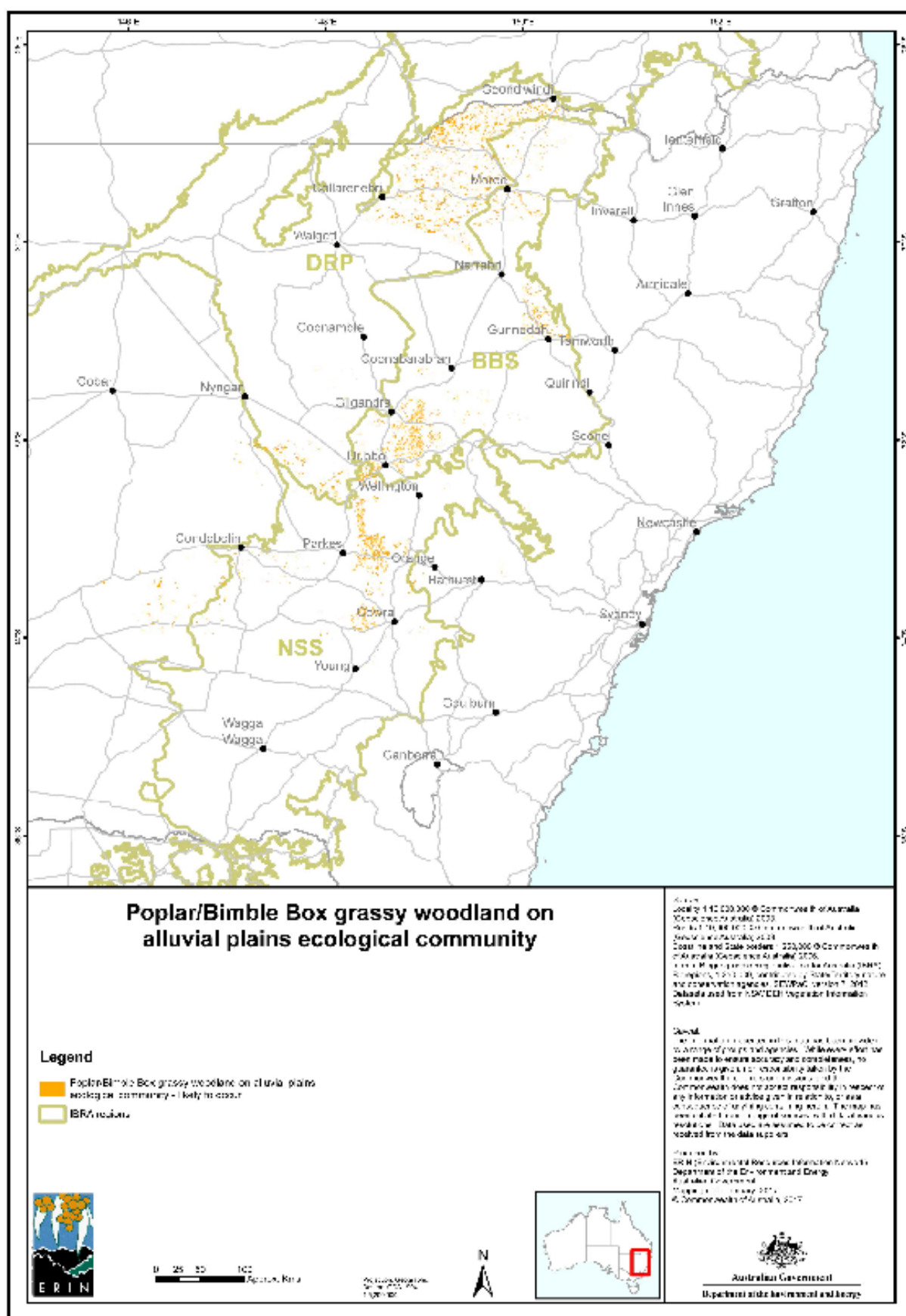
| Plant name | Indigenous use |
|---|--|
| <i>Carissa ovata</i> (currant bush) (NSW) | Food - berries |
| <i>Carissa spinarum</i> (currant bush) (Qld) | Food - berries |
| <i>Chenopodium curvispicatum</i> (cottony saltbush) | Food - berries |
| <i>Chloris truncata</i> (windmill grass) | Food – seeds used for flour |
| <i>Daucus glochidiatus</i> (Australian carrot) | Food - tubers |
| <i>Dianella longifolia</i> (flax-lily) | Food – berries Tools – leaves used for weaving baskets |
| <i>Dianella revoluta</i> (black-antler flax-lily) | Food - berries |
| <i>Dodonaea viscosa</i> (broad leaf hopbush) | Tools - clubs |
| <i>Duma florulenta</i> (lignum) | Food – young shoots eaten; attracts birds such as ibis, grey teal (duck), pink-eared duck; bird eggs. |
| <i>Enchylaena tomentosa</i> (barrier saltbush, ruby saltbush) | Food – berries Tools - dye |
| <i>Eremophila bignoniiflora</i> (dogwood) | Medicine – leaves crushed for a laxative and to help with digestion and constipation. |
| <i>Eremophila longifolia</i> (berrigan) | Food – nectar from flowers, fruit Medicine – used to treat skin problems and stomach ulcers |
| <i>Eucalyptus albens</i> (white box) | Food – source of bird eggs Tools – bark for bowls and canoes. Resin for sealing containers. Medicine tree. |
| <i>Eucalyptus coolabah</i> (coolabah) | Tools - fish poison. |
| <i>Eucalyptus melliodora</i> (yellow box) | Tools Medicine tree |
| <i>Eucalyptus populnea</i> (poplar box, bimbale box) | Food – attacks birds and bats; bird eggs. Tools – bark used for coolamons and large canoes. Resin to seal containers and canoes. |
| <i>Geijera parviflora</i> (wilga) | Food – shelter tree for animals; flowers attract native bees which produce sweet but strong smelling honey. Tools – boomerangs, leaves used to sleep on, bark and roots used to make splints. |
| <i>Lomandra filiformis</i> (wattle mat-rush) | Food – seeds and young leaves eaten like celery; indicates burrowing mammals such as bilbies Tools – leaves made into string, rope and used for weaving baskets and jewellery Medicine – roots used for bites and stings |
| <i>Marsilea drummondii</i> (common nardoo) | Food – seeds ground to make flour |
| <i>Pittosporum angustifolium</i> (weeping pittosporum) | Tools – stone axe handles and shields. |

| Plant name | Indigenous use |
|---|--|
| | Medicine – dried seeds ground into powder for aphrodisiac use; leaves, twigs and seeds boiled as a tea for internal pains and cramps |
| <i>Rhagodia spinescens</i> (berry saltbush) | Food – berries indicate birds likely to be nearby Tools - dye |
| <i>Santalum acuminatum</i> (quandong) | Food – fruit Tools – seed used as toy and ornaments Medicine tree |
| <i>Solanum esuriale</i> (potato bush) | Food – fruit after treatment to remove toxins |

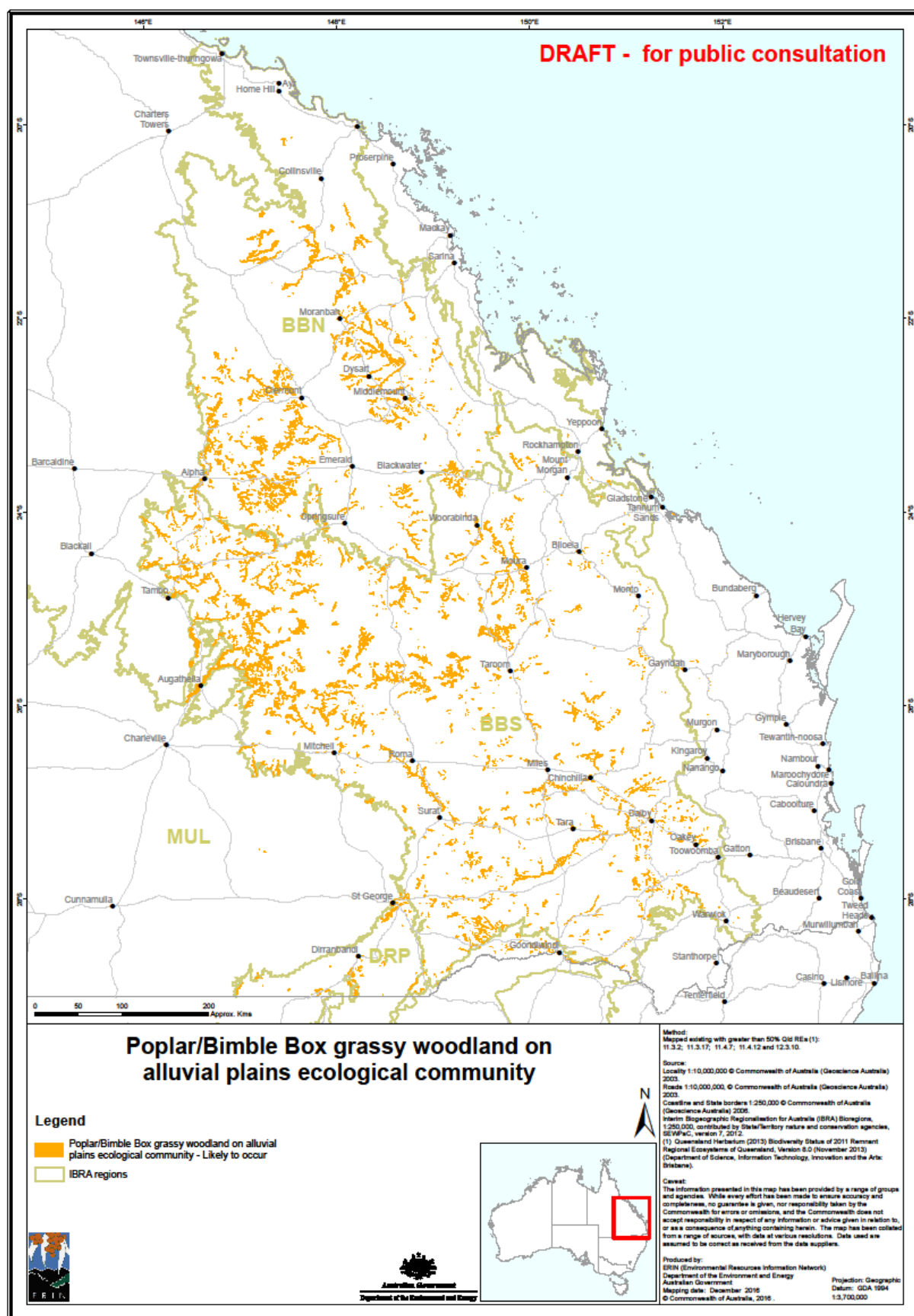


Scar tree near Jondaryan Queensland. (Photo credit: Anthony Hoffman)

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Appendix D2 – Potential distribution map of Poplar Box Grassy Woodlands in Queensland



Appendix E – Species lists

Table E1. Characteristic plant species of the Poplar Box Grassy Woodlands

This is a characteristic rather than comprehensive list of plant species that may be present in the ecological community. Patches may not include all species on the list or may include other species not listed.

Source: Source: Beeston et al., 1980; Walker et al., 1981; Downey, 1998; Prober and Thiele, 2004; Benson et al., 2006; Wang et al., 2008; Benson, 2010; Accad and Neldner, 2015.

| Scientific name | Common name |
|--|----------------------------------|
| Upper layer (canopy) [trees typically > 10m] | |
| <i>Acacia harpophylla</i> | brigalow |
| <i>Acacia pendula</i> | weeping myall, boree |
| <i>Alectryon oleifolius</i> | western rosewood |
| <i>Allocasuarina luehmannii</i> | buloke |
| <i>Angophora leiocarpa</i> | |
| <i>Atalaya hemiglauca</i> | whitewood |
| <i>Callitris glaucophylla</i> | white cypress pine |
| <i>Casuarina cristata</i> | belah |
| <i>Corymbia tessellaris</i> | carbeen |
| <i>Eucalyptus albens</i> | white box |
| <i>Eucalyptus chloroclada</i> | Baradine red gum |
| <i>Eucalyptus coolabah</i> | coolabah |
| <i>Eucalyptus crebra</i> | grey ironbark |
| <i>Eucalyptus largiflorens</i> | black box |
| <i>Eucalyptus melliodora</i> | yellow box |
| <i>Eucalyptus melanophloia</i> | silver-leaved ironbark |
| <i>Eucalyptus microcarpa</i> | western grey box |
| <i>Eucalyptus moluccana</i> | grey box |
| <i>Eucalyptus populnea</i> (Dominant) | poplar box, bumble box |
| <i>Eucalyptus woollsiana</i> (formerly <i>pilligaensis</i>) | grey box, narrow leaved grey box |
| Mistletoes | |
| <i>Amyema cambagei</i> | needle-leaved mistletoe |
| <i>Amyema congener</i> | erect mistletoe |
| <i>Amyema gibberula</i> | hakea mistletoe |
| <i>Amyema linophylla</i> | bulake mistletoe |
| <i>Amyema maidenii</i> | pale-leaved mistletoe |
| <i>Amyema miquelii</i> | box mistletoe |
| <i>Amyema miraculosa</i> | fleshy mistletoe |
| <i>Amyema preissii</i> | wire-leaved mistletoe |

| Scientific name | Common name |
|--|-----------------------------------|
| <i>Amyema quandang</i> | grey mistletoe |
| <i>Dendrophthoe glabrescens</i> | smooth mistletoe |
| <i>Diplatia grandibractea</i> | coolabah mistletoe |
| <i>Lysiana exocarpi</i> | harlequin mistletoe |
| <i>Lysiana spathulata</i> | |
| <i>Lysiana subfalcata</i> | northern mistletoe |
| <i>Muellerina bidillii</i> | |
| <i>Viscum articulatum</i> | square-stemmed mistletoe |
| <i>Viscum whitei</i> | |
| Mid layer [small trees, medium shrubs typically 1–10m] | |
| <i>Abutilon macrum</i> | |
| <i>Abutilon oxycarpum</i> | flannel weed |
| <i>Abutilon oxycarpum</i> var. <i>subsagittatum</i> | flannel weed |
| <i>Acacia aneura</i> | mulga |
| <i>Acacia curranii</i> | curly-bark wattle |
| <i>Acacia elongata</i> | |
| <i>Acacia excelsa</i> | brigalow |
| <i>Acacia lauta</i> | Tara wattle |
| <i>Acacia stenophylla</i> | river cooba, river myall, belalie |
| <i>Acacia victoriae</i> subsp. <i>arida</i> | prickly wattle |
| <i>Alectryon oleifolius</i> subsp. <i>canescens</i> | rosewood |
| <i>Alectryon oleifolius</i> subsp. <i>elongatus</i> | |
| <i>Allocasuarina muelleriana</i> | slaty sheoak, common oak-bush |
| <i>Alstonia constricta</i> | bitter bark |
| <i>Atalaya hemiglauca</i> | cattle bush |
| <i>Atalaya salicifolia</i> | brush whitewood |
| <i>Apophyllum anomalum</i> | broom bush, warrior bush |
| <i>Brachychiton populneus</i> | kurrajong |
| <i>Bridelia leichhardtii</i> | Leichardt's ironbark |
| <i>Capparis lasiantha</i> | bush caper, nepine |
| <i>Capparis mitchellii</i> | bimbil, native orange |
| <i>Chenopodium album</i> | fat hen |
| <i>Chenopodium nitrariaceum</i> | branching goosefoot |
| <i>Citrus glauca</i> | (Australian) desert lime |
| <i>Denhamia cunninghamii</i> (synonym <i>Maytenus cunninghamii</i>) | |
| <i>Denhamia oleaster</i> | |

| Scientific name | Common name |
|---|---------------------------------|
| <i>Dysphania pumilio</i> (formerly <i>Chenopodium carinatum</i>) | keeled goosefoot |
| <i>Dodonaea viscosa</i> | broad leaf hopbush |
| <i>Dodonaea viscosa</i> subsp. <i>angustissima</i> | narrow-leaf hop-bush |
| <i>Dodonaea viscosa</i> subsp. <i>spatulata</i> | sticky hop-bush |
| <i>Duma florulenta</i> (synonym <i>Muehlenbeckia florulenta</i>) | lignum |
| <i>Enchylaena tomentosa</i> | barrier saltbush, ruby saltbush |
| <i>Eremophila bignoniiflora</i> | dogwood |
| <i>Eremophila debilis</i> | winter apple, amulla |
| <i>Eremophila deserti</i> | turkeybush |
| <i>Eremophila longifolia</i> | berrigan, emubush |
| <i>Eremophila mitchellii</i> | bastard sandalwood, budda |
| <i>Exocarpus aphyllus</i> | leafless ballart |
| <i>Geijera parviflora</i> | wilga |
| <i>Grevillea parallela</i> | beefwood |
| <i>Grevillea striata</i> | beef oak |
| <i>Hakea tephrosperma</i> | hooked needlewood |
| <i>Hibiscus trionum</i> | flower-of-an-hour |
| <i>Homopholis belsonii</i> | Belson's panic |
| <i>Jasminum didymum</i> subsp. <i>lineare</i> | desert jasmine |
| <i>Maireana brevifolia</i> | cottonbush |
| <i>Maireana decalvans</i> | black cotton bush |
| <i>Maireana microphylla</i> | eastern cottonbush |
| <i>Myoporum acuminatum</i> | boobialla |
| <i>Myoporum montanum</i> | boobialla |
| <i>Myoporum platycarpum</i> subsp. <i>perbellum</i> | |
| <i>Notelaea microcarpa</i> | native olive |
| <i>Notelaea microcarpa</i> var. <i>microcarpa</i> | velvet mock olive |
| <i>Olearia pimeleoides</i> | burrabunga |
| <i>Owenia acidula</i> | emu apple |
| <i>Pandorea pandorana</i> | inland wonga vine |
| <i>Pimelea neo-anglica</i> | poison pimelea |
| <i>Pittosporum angustifolium</i> | weeping pittosporum |
| <i>Rhagodia spinescens</i> | berry saltbush |
| <i>Santalum acuminatum</i> | quandong |
| <i>Santalum lanceolatum</i> | blue bush, northern sandalwood |
| <i>Sclerolaena birchii</i> | blue burr |

| Scientific name | Common name |
|--|--|
| <i>Sclerolaena muricata</i> | black roly-poly |
| <i>Senna artemisioides</i> subsp. <i>x petiolaris</i> | woody cassia |
| <i>Senna artemisioides</i> subsp. <i>zygophylla</i> | |
| <i>Sclerolaena muricata</i> | black roly-poly |
| <i>Spartothamnella juncea</i> | bead bush |
| <i>Tephrosia dietrichiae</i> | |
| <i>Templetonia stenophylla</i> | leafy templetonia |
| <i>Ventilago viminalis</i> | barndaragu |
| Ground layer [herbs and shrubs typically <1m] | |
| <i>Achyranthes aspera</i> | chaff flower |
| <i>Actinobole uliginosum</i> | camel dung, flannel cudweed |
| <i>Ajuga australis</i> | austral bugle |
| <i>Alternanthera denticulata</i> | lesser joyweed |
| <i>Alternanthera nana</i> | hairy joyweed |
| <i>Alternanthera nodiflora</i> | common joyweed |
| <i>Apophyllum anomalum</i> | broom bush, warrior bush, currant bush |
| <i>Apowollastonia spilanthis</i> | |
| <i>Atriplex leptocarpa</i> | creeping saltbush |
| <i>Atriplex stipitata</i> | bitter saltbush |
| <i>Brachyscome chrysoglossa</i> (formerly <i>Brachyscome heterodonta</i> var. <i>heterodonta</i>) | yellow-tongue daisy |
| <i>Brunoniella australis</i> | blue trumpet |
| <i>Bulbine alata</i> | native leek |
| <i>Bulbine bulbosa</i> | bulbine lily, native onion |
| <i>Calandrinia eremaea</i> | small purlane |
| <i>Calocephalus sonderi</i> | pale beauty heads |
| <i>Calotis cuneifolia</i> | bindi-eye |
| <i>Calotis hispidula</i> | bogan flea, bogan flea |
| <i>Calotis lappulacea</i> | mallee burr-daisy |
| <i>Carissa ovata</i> (Qld) | currant bush |
| <i>Carissa spinarum</i> (NSW) | currant bush |
| <i>Cheilanthes distans</i> | |
| <i>Cheilanthes sieberi</i> | mulga fern |
| <i>Chenopodium curvispicatum</i> | cottony saltbush |
| <i>Chenopodium desertorum</i> | desert goosefoot |
| <i>Chenopodium desertorum</i> subsp. <i>anidiophyllum</i> | |
| <i>Chenopodium desertorum</i> subsp. <i>desertorum</i> | frosted goosefoot |

| Scientific name | Common name |
|---|------------------------|
| <i>Chrysocephalum apiculatum</i> | common everlasting |
| <i>Commelina cyanea</i> (formerly <i>Commelina diffusa</i>) | forget-me not |
| <i>Commelina lanceolata</i> | |
| <i>Convolvulus clementii</i> | desert bindweed |
| <i>Convolvulus erubescens</i> | blushing bindweed |
| <i>Convolvulus graminetinus</i> | grassland bindweed |
| <i>Cotula australis</i> | bachelor's buttons |
| <i>Crassula sieberiana</i> | austral crassula |
| <i>Cyanthillium cinereum</i> | ironweed |
| <i>Cyperus betchei</i> subsp. <i>betchei</i> | |
| <i>Daucus glochidiatus</i> | Australian carrot |
| <i>Desmodium brachypodum</i> | large tick-trefoil |
| <i>Desmodium rhytidophyllum</i> | |
| <i>Desmodium varians</i> | slender tick trefoil |
| <i>Dianella longifolia</i> | flax-lily |
| <i>Dianella revoluta</i> | black-anther flax-lily |
| <i>Dichondra</i> spp. | kidney weed |
| <i>Dipelachne muelleri</i> (NSW) (synonym <i>Dipelachne. fusca</i> subsp. <i>muelleri</i>) | |
| <i>Dipelachne fusca</i> subsp. <i>muelleri</i> (Qld) (synonym <i>Diplachne muelleri</i>) | |
| <i>Diuris tricolor</i> | spotted-throat cowslip |
| <i>Dysphania melanocarpa</i> (formerly <i>Chenopodium melanocarpum</i>) | |
| <i>Dysphania pumilio</i> | clammy goosefoot |
| <i>Einadia hastata</i> | berry saltbush, saloop |
| <i>Einadia nutans</i> subsp. <i>nutans</i> | nodding saltbush |
| <i>Erodium crinitum</i> | blue storkbill |
| <i>Eremophila bignoniiflora</i> | berrigan |
| <i>Eremophila debilis</i> (formerly <i>Myoporum debile</i>) | winter apple |
| <i>Eremophila deserti</i> | turkey-bush |
| <i>Eremophila glabra</i> | black fuchsia |
| <i>Eremophila longifolia</i> | berrigan |
| <i>Eremophila mitchellii</i> | bastard sandalwood |
| <i>Euphorbia dallachyana</i> (synonym <i>Chamaesyce dallachyana</i>) | caustic weed |
| <i>Euphorbia drummondii</i> | balsam |

| Scientific name | Common name |
|---|-----------------------|
| <i>Exocarpus aphyllus</i> | currant bush |
| <i>Flindersia dissosperma</i> | scrub leopardwood |
| <i>Galium gaudichaudii</i> | rough bedstraw |
| <i>Glycine canescens</i> | silky glycine |
| <i>Glycine tabacina</i> | glycine pea |
| <i>Goodenia cycloptera</i> | cut-leaf goodenia |
| <i>Goodenia fascicularis</i> | silky goodenia |
| <i>Goodenia pinnatifida</i> | cut-leaf goodenia |
| <i>Hyalosperma semisterile</i> | |
| <i>Lepidium aschersonii</i> | spiny peppercress |
| <i>Lobelia concolor</i> (formerly <i>Pratia concolor</i>) | poison pratia |
| <i>Malvastrum coromandelianum</i> | prickly malvastrum |
| <i>Maireana coronata</i> | crown fissure-weed |
| <i>Maireana decalvans</i> | black cotton bush |
| <i>Maireana enchylaenoides</i> | wingless fissure-weed |
| <i>Maireana humillima</i> | |
| <i>Maireana longate</i> | crown fissure-weed |
| <i>Maireana microphylla</i> | small-leaf bluebush |
| <i>Marsdenia australis</i> | doubah |
| <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> | native pear |
| <i>Menkea australis</i> | fairy spectacles |
| <i>Osteocarpum acropterum</i> var. <i>acropterum</i> | water weed |
| <i>Oxalis chnoodes</i> | |
| <i>Oxalis corniculata</i> | clover sorrel, oxalis |
| <i>Panicum effusum</i> | branched panic |
| <i>Phyllanthus virgatus</i> | |
| <i>Plantago turrifera</i> | crowned plantain |
| <i>Plantago varia</i> | variable plantain |
| <i>Portulaca oleracea</i> | pig weed |
| <i>Psydrax johnsonii</i> | |
| <i>Psydrax odorata</i> | lamboto |
| <i>Psydrax oleifolia</i> (synonym <i>Canthium oleifolium</i>) | |
| <i>Pterocaulon sphacelatum</i> | applebush |
| <i>Ptilotus nobilis</i> subsp. <i>nobilis</i> (formerly <i>Ptilotus exaltatus</i> var. <i>exaltatus</i>) | pink mulla mulla |
| <i>Pycnosorus globosus</i> | drumsticks |
| <i>Rostellularia adscendens</i> subsp. <i>adscendens</i> | |

| Scientific name | Common name |
|---|-----------------------------|
| <i>Rumex</i> spp. | swamp dock |
| <i>Sclerolaena bicornis</i> | flannel burr |
| <i>Sclerolaena decurrens</i> | green copper burr |
| <i>Sclerolaena diacantha</i> | grey copper burr |
| <i>Sclerolaena muricata</i> | black roly-poly |
| <i>Sclerolaena stelligera</i> | star copperburr |
| <i>Sclerolaena tricuspidata</i> | giant red burr |
| <i>Sida ammophila</i> | sand sida |
| <i>Sida corrugata</i> | corrugated sida |
| <i>Sida cunninghamii</i> | |
| <i>Sida</i> sp. Musselbrook (Synonym <i>Sida filiformis</i>) | fine sida |
| <i>Sida spinosa</i> | Paddy's lucerne |
| <i>Sida trichopoda</i> | high sida |
| <i>Solanum esuriale</i> | potato bush |
| <i>Stackhousia monogyna</i> | candles, creamy stackhousia |
| <i>Stuartina muelleri</i> | spoon cudweed |
| <i>Swainsona murrayana</i> | slender Darling pea |
| <i>Tetragonia moorei</i> | annual spinach |
| <i>Velleia paradoxa</i> | spur velleia |
| <i>Vittadinia dissecta</i> var. <i>hirta</i> | |
| <i>Vittadinia sulcata</i> | furrowed New Holland daisy |
| <i>Wahlenbergia communis</i> | tufted bluebell |
| <i>Wahlenbergia fluminalis</i> | river bluebell |
| <i>Wahlenbergia gracilis</i> | Australian bluebell |
| <i>Wahlenbergia luteola</i> | |
| Graminoids (grasses and grasslike plants) | |
| <i>Alternanthera denticulata</i> | lesser joyweed |
| <i>Anthosachne scabra</i> (<i>Elymus scaber</i>) | common wheatgrass |
| <i>Ancistrachne uncinulata</i> | hooked-hairy panic grass |
| <i>Aristida behriana</i> | bunch wiregrass |
| <i>Aristida benthamii</i> var. <i>benthamii</i> | |
| <i>Aristida calycina</i> var. <i>Calycina</i> | dark wiregrass |
| <i>Aristida caput-medusae</i> | many headed wiregrass |
| <i>Aristida echinata</i> | blue wire-grass |
| <i>Aristida jerichoensis</i> | Jericho wiregrass |
| <i>Aristida jerichoensis</i> var. <i>jerichoensis</i> | longat wiregrass |

| Scientific name | Common name |
|---|--|
| <i>Aristida personata</i> | purple wire-grass |
| <i>Aristida ramosa</i> | purple wire-grass |
| <i>Aristida vagans</i> | three-awned spear grass |
| <i>Arundinella nepalensis</i> | Dardy's oats |
| <i>Austrostipa aristiglumis</i> | plains grass |
| <i>Austrostipa bigeniculata</i> | |
| <i>Austrostipa scabra</i> subsp. <i>scabra</i> | rough speargrass |
| <i>Austrostipa setacea</i> | corkscrew grass |
| <i>Austrostipa verticillata</i> | slender bamboo grass |
| <i>Bothriochloa decipiens</i> | pitted bluegrass |
| <i>Bothriochloa ewartiana</i> | |
| <i>Carex inversa</i> | knob sedge |
| <i>Chloris truncata</i> | windmill grass |
| <i>Chloris ventricosa</i> | plump windmill grass |
| <i>Chrysopogon fallax</i> | golden beardgrass |
| <i>Cymbopogon ambiguus</i> (formerly <i>Cymbopogon</i> indet) | lemon grass |
| <i>Cymbopogon refractus</i> | barbed wire grass |
| <i>Cyperus betchei</i> | |
| <i>Cyperus bifax</i> | downs nut-grass |
| <i>Cyperus fulvus</i> | sticky sedge |
| <i>Cyperus gracilis</i> | slender flat-sedge |
| <i>Cyperus laevis</i> | |
| <i>Dichanthium sericeum</i> subsp. <i>sericeum</i> | silky blue-grass, Queensland bluegrass |
| <i>Dichanthium setosum</i> | bluegrass |
| <i>Digitaria ammophila</i> | cotton panic |
| <i>Digitaria brownii</i> | cotton grass |
| <i>Digitaria divaricatissima</i> | umbrella grass |
| <i>Digitaria hystrichoides</i> | umbrella grass |
| <i>Digitaria parviflora</i> | small-flowered finger grass |
| <i>Digitaria porrecta</i> | finger panic grass |
| <i>Eleocharis plana</i> | flat spike-sedge |
| <i>Enteropogon acicularis</i> | curly windmill grass |
| <i>Enneapogon gracilis</i> | slender bottle-washers |
| <i>Eragrostis elongata</i> | clustered lovegrass |
| <i>Eragrostis eriopoda</i> | woollybutt grass |
| <i>Eragrostis lacunaria</i> | purple lovegrass |
| <i>Eragrostis leptostachya</i> | paddock lovegrass |

| Scientific name | Common name |
|---|--------------------------------------|
| <i>Eragrostis parviflora</i> | weeping lovegrass |
| <i>Eriochloa pseudoacrotricha</i> | early spring grass |
| <i>Eulalia aurea</i> (formerly <i>Eulalia fulva</i>) | silky browntop |
| <i>Homopholis belsonii</i> | Belson's panic |
| <i>Iseilema membranaceum</i> | small Flinders grass |
| <i>Isoetopsis graminifolia</i> | grass cushions, grass cushion |
| <i>Juncus aridicola</i> | tussock rush |
| <i>Juncus subsecundus</i> | finger rush |
| <i>Lomandra filiformis</i> | wattle mat-rush |
| <i>Lomandra multiflora</i> | |
| <i>Lomandra teres</i> | |
| <i>Marsilea drummondii</i> | common nardoo |
| <i>Monachather paradoxus</i> | |
| <i>Oxalis chnoodes</i> | |
| <i>Oxalis exilis</i> | |
| <i>Oxalis perennans</i> | |
| <i>Paspalidium caespitosum</i> | Brigalow grass |
| <i>Paspalidium jubiflorum</i> | warrego grass |
| <i>Poa sieberiana</i> | |
| <i>Rytidosperma</i> (formerly <i>Austrodanthonia</i>) spp. | wallaby grass |
| <i>Rytidosperma auriculatum</i> | |
| <i>Rytidosperma fulvum</i> | wallaby grass |
| <i>Rytidosperma longata</i> | ringed wallaby grass |
| <i>Rytidosperma setacea</i> | smallflower wallaby grass |
| <i>Sporobolus actinocladius</i> | katoora grass |
| <i>Sporobolus creber</i> | slender rat's tail grass |
| <i>Sporobolus caroli</i> | fairy grass |
| <i>Thellungia advena</i> | coolibah grass |
| <i>Triptilodiscus pygmaeus</i> | common sunray |
| <i>Themeda triandra</i> (formerly <i>T. australis</i>) | kangaroo grass |
| <i>Thyridolepis mitchellianna</i> | mulga Mitchell grass |
| <i>Tragus australianus</i> | small burrgrass |
| <i>Tricoryne elatior</i> | yellow autumn-lily, yellow rush-lily |
| <i>Vittadinia cuneata</i> | fuzzweed |
| <i>Walwhalleya proluta</i> | |

Table E2. Threatened plant species that may occur in the Poplar Box Grassy Woodlands

| Scientific name | Common name | NSW TSC Act | QLD NC Act | EPBC Act |
|-----------------------------|---------------------|-------------|---------------|------------|
| <i>Acacia curranii</i> | curly-bark wattle | vulnerable | vulnerable | vulnerable |
| <i>Acacia lauta</i> | Tara wattle | | vulnerable | vulnerable |
| <i>Dichanthium setosum</i> | bluegrass | vulnerable | least concern | vulnerable |
| <i>Digitaria porrecta</i> | finger panic grass | endangered | endangered | |
| <i>Diuris tricolour</i> | pine donkey orchid | vulnerable | least concern | |
| <i>Homopholis belsonii</i> | Belson's panic | endangered | endangered | vulnerable |
| <i>Lepidium aschersonii</i> | spiny peppergrass | vulnerable | | vulnerable |
| <i>Lomandra teres</i> | | | vulnerable | |
| <i>Swainsona murrayana</i> | slender Darling pea | vulnerable | vulnerable | vulnerable |

NSW TSC Act: New South Wales *Threatened Species Conservation Act 1995*; QLD NC Act: Queensland *Nature Conservation Act 1992*; EPBC Act: National *Environment and Biodiversity Conservation Act 1999*.

Table E3. Native fauna that may occur in the Poplar Box Grassy Woodlands.

Some species may be resident in eucalypt woodlands and use it as key habitat while other species may only be transient within the ecological community. The scientific and common names and national distributions of species were checked using The Atlas of Living Australia website.

Source: Anstis, 2002; Gibbons and Lindenmeyer, 2002; Sass, 2006; Churchill, 2008; Morcombe, 2010; Wilson and Swan, 2010; Curtis et al., 2012.

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|--|---------------------------------------|---------------------|-------------|-----------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| Mammals | | | | | |
| <i>Aepyprymnus rufescens</i> | rufous bettong | | Vulnerable | | |
| <i>Canis familiaris</i> | dingo | | | | |
| <i>Chalinolobus gouldii</i> | Gould’s wattled bat | | | | Y |
| <i>Chalinolobus picatus</i> | little pied bat | | Vulnerable | Near threatened | Y |
| <i>Isodon obesulus obesulus*</i> | southern brown bandicoot | Endangered | Endangered | | |
| <i>Macropus giganteus</i> | eastern grey kangaroo | | | | |
| <i>Macrotis lagotis*</i> | greater bilby | Vulnerable | Extinct | Endangered | |
| <i>Mormopterus planiceps</i> | inland freetail bat | | | | Y |
| <i>Miniopterus schreibersii oceanensis</i> | eastern bentwing-bat | | Vulnerable | | |
| <i>Notamacropus rufogriseus</i> (synonym <i>Macropus rufogriseus</i>) | red-necked wallaby | | | Least concern | |
| <i>Notamacropus parryi</i> (synonym <i>Macropus parryi</i>) | whiptail wallaby, pretty face wallaby | | | Least concern | |
| <i>Nyctophilus corbeni</i> | south-eastern long-eared bat | Vulnerable | Vulnerable | Vulnerable | |
| <i>Nyctophilus geoffroyi</i> | lesser long-eared bat | | | | Y |
| <i>Nyctophilus goudi</i> | Gould's long-eared bat | | | | Y |
| <i>Onychogalea fraenata</i> | bridled nailtail wallaby | Endangered | Extinct | Endangered | |
| <i>Osphranter robustus</i> (synonym <i>Macropus robustus</i>) | common wallaroo, euro | | | Least concern | |
| <i>Osphranter rufus</i> | red kangaroo | | | | |
| <i>Petaurus breviceps</i> | sugar glider | | | | Y |
| <i>Petaurus norfolcensis</i> | squirrel glider | | Vulnerable | | Y |

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|----------------------------------|------------------------------|---|-------------|---------------------------------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| <i>Phascolarctos cinereus</i> | koala | Vulnerable (combined populations of Qld, NSW and the ACT) | Vulnerable | Vulnerable (only in SE Qld Bioregion) | |
| <i>Planigale tenuirostris</i> | narrow-nosed planigale | | | Least concern | |
| <i>Pteropus poliocephalus</i> | grey-headed flying-fox | Vulnerable | Vulnerable | | |
| <i>Phascogale tapoatafa</i> * | brush-tailed phascogale | | Vulnerable | | |
| <i>Pseudomys delicatulus</i> | delicate mouse | | | Least concern | |
| <i>Saccolaimus flaviventris</i> | yellow-bellied sheaftail bat | | | | Y |
| <i>Scoteanax rueppellii</i> | greater broad-nosed bat | | Vulnerable | | Y |
| <i>Scotorepens balstoni</i> | inland broad-nosed bat | | | | Y |
| <i>Scotorepens greyii</i> | little broad-nosed bat | | | | Y |
| <i>Sminthopsis crassicaudata</i> | fat-tailed dunnart | | | | |
| <i>Sminthopsis macroura</i> | stripe-faced dunnart | | Vulnerable | | |
| <i>Sminthopsis murina</i> | common dunnart | | | | |
| <i>Tachyglossus aculeatus</i> | short-beaked echidna | | | | |
| <i>Tadarida australis</i> | white-striped freetail-bat | | | | Y |
| <i>Trichosurus vulpecula</i> | common brushtail possum | | | | |
| <i>Vespadelus baverstocki</i> | inland forest bat | | | | Y |
| <i>Vespadelus vulturnus</i> | little forest bat | | | | Y |
| <i>Wallabia bicolor</i> | swamp wallaby, black wallaby | | | | |
| Birds | | | | | |
| <i>Acanthiza apicalis</i> | inland thornbill | | | | |
| <i>Acanthiza chrysorrhoa</i> | yellow-rumped thornbill | | | | |
| <i>Acanthiza nana</i> | little (yellow) thornbill | | | | |

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|---|---|-----------------------|-----------------------|---------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| <i>Acanthiza pusilla</i> | inland thornbill | | | | |
| <i>Accipiter fasciatus</i> | brown goshawk | | | | |
| <i>Aegotheles cristatus</i> | Australian owl-nightjar | | | | Y |
| <i>Alisterus scapularis</i> | Australian king-parrot | | | | Y |
| <i>Anthochaera carunculata</i> | red wattlebird | | | | |
| <i>Anthochaera phrygia</i> | regent honeyeater | Critically Endangered | Critically Endangered | Endangered | |
| <i>Anthus novaeseelandiae</i> | Australasian darter | | | Least concern | |
| <i>Aprosmictus erythropterus</i> | red-winged parrot | | | | Y |
| <i>Aquila audax</i> | wedge-tailed eagle | | | | |
| <i>Ardeotis australis</i> | Australian bustard | | Endangered | | |
| <i>Artamus cyanopterus</i> | dusky woodswallow | | | | |
| <i>Artamus leucorhynchus</i> | white-breasted woodswallow | | | | |
| <i>Artamus personatus</i> | masked woodswallow | | | | |
| <i>Artamus superciliosus</i> | white-browed woodswallow | | | | |
| <i>Aviceda subcristata</i> | Pacific baza | | | | |
| <i>Barnardius barnardi</i> | mallee ringneck | | | | |
| <i>Burhinus grallarius</i> | bush stone-curlew | | Endangered | | |
| <i>Cacatua galerita</i> | sulphur-crested cockatoo | | | | Y |
| <i>Calyptrorhynchus banksii samueli</i> | red-tailed black-cockatoo (inland subspecies) | | Vulnerable | | Y |
| <i>Calyptrorhynchus funereus</i> | yellow-tailed black-cockatoo | | | | Y |
| <i>Calyptrorhynchus lathamii</i> | glossy black cockatoo | | Vulnerable | Vulnerable | Y |
| <i>Centropus phasianinus</i> | pheasant coucal | | | | |
| <i>Chalcites minutillus</i> | little bronze-cuckoo | | | | |
| <i>Chenonetta jubata</i> | Australian wood duck | | | | |

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|----------------------------------|--|---------------------|-------------|---------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| <i>Chthonicola sagittata</i> | speckled warbler | | | | |
| <i>Cincloramphus mathewsi</i> | rufous songlark | | | | |
| <i>Climacteris picumnus</i> | brown treecreeper (eastern subspecies) | | | | Y |
| <i>Colluricincla harmonica</i> | grey shrike-thrush | | | | Y |
| <i>Coracina maxima</i> | ground cuckoo-shrike | | | | |
| <i>Coracina novaehollandiae</i> | black-faced cuckoo-shrike | | | | |
| <i>Coracina papuensis</i> | white-bellied cuckoo-shrike | | | | |
| <i>Corcorax melanorhamphos</i> | white-winged chough | | | | |
| <i>Cormobates leucophaea</i> | white-throated treecreeper | | | | |
| <i>Corvus coronoides</i> | Australian raven | | | | |
| <i>Corvus mellori</i> | little raven | | | | |
| <i>Corvus orru</i> | Torresian crow | | | | |
| <i>Coturnix ypsilophora</i> | brown quail | | | Least concern | |
| <i>Cracticus nigrogularis</i> | pied butcherbird | | | | |
| <i>Cracticus tibicen</i> | Australian magpie | | | | |
| <i>Cracticus torquatus</i> | grey butcherbird | | | | |
| <i>Dacelo novaeguineae</i> | laughing kookaburra | | | | Y |
| <i>Daphoenositta chrysoptera</i> | varied sitella | | | | |
| <i>Dicaeum hirundinaceum</i> | mistletoebird | | | | |
| <i>Dicrurus bracteatus</i> | spangled drongo | | | | |
| <i>Dromaius novaehollandiae</i> | emu | | | | |
| <i>Egretta novaehollandiae</i> | white-faced heron | | | | |
| <i>Entomyzon cyanotis</i> | blue-faced honeyeater | | | | |
| <i>Eolophus roseicapillus</i> | galah | | | | Y |
| <i>Eopsaltria australis</i> | eastern yellow robin | | | | |
| <i>Eurostopodus mystacalis</i> | white-throated nightjar | | | | |

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|--|-----------------------------------|---------------------|-------------|-----------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| <i>Eurystomus orientalis</i> | dollarbird | | | | Y |
| <i>Falco berigora</i> | brown falcon | | | | |
| <i>Falco hypoleucos</i> | grey falcon | | Endangered | Vulnerable | |
| <i>Falco longipennis</i> | Australian hobby | | | | |
| <i>Falco subniger</i> | black falcon | | | | |
| <i>Gavicalis virescens</i> | singing honeyeater | | | | |
| <i>Geopelia cuneata</i> | diamond dove | | | | Y |
| <i>Geopelia humeralis</i> | bar-shouldered dove | | | | |
| <i>Geopelia placida</i> | peaceful dove | | | | |
| <i>Geopelia striata</i> | peaceful dove | | | | |
| <i>Geophaps scripta scripta</i> | squatter pigeon (southern) | Vulnerable | Endangered | Vulnerable | |
| <i>Gerygone olivacea</i> | white-throated gerygone | | | | |
| <i>Grallina cyanoleuca</i> | magpie-lark | | | | |
| <i>Grantiella picta</i> | painted honeyeater | Vulnerable | Vulnerable | Vulnerable | |
| <i>Gymnorhina tibicen</i> | Australian magpie | | | | |
| <i>Haliastur spheurnus</i> | whistling kite | | | | |
| <i>Hirundo neoxena</i> | welcome swallow | | | | |
| <i>Lalage sueurii</i> | white-winged triller | | | | |
| <i>Lathamus discolor</i> | swift parrot | Endangered | Endangered | Endangered | Y |
| <i>Lichmera indistincta</i> | brown honeyeater | | | | |
| <i>Lophochroa leadbeateri</i> | Major Mitchell's cockatoo | | Vulnerable | Vulnerable | Y |
| <i>Lophoictinia isura</i> | square-tailed kite | | Vulnerable | Near Threatened | |
| <i>Malurus leucopterus</i> | white-winged fairy-wren | | | | |
| <i>Manorina flavigula</i> | yellow-throated miner | | | | |
| <i>Manorina melanocephala</i> | noisy miner | | | | |
| <i>Melanodryas cucullata cucullata</i> | hooded robin (south-eastern form) | | Vulnerable | | Y |
| <i>Melithreptus brevirostris</i> | brown-headed honeyeater | | | | |

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|---|---|---------------------|-------------|------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| <i>Melithreptus gularis gularis</i> | black-chinned honeyeater (eastern subspecies) | | Vulnerable | | |
| <i>Melopsitta undulatus</i> | budgerigar | | | | Y |
| <i>Merops ornatus</i> | rainbow bee-eater | | | | |
| <i>Microeca fascians</i> | Jacky winter | | | | |
| <i>Milvus migrans</i> | black kite | | | | |
| <i>Myiagra inquieta</i> | restless flycatcher | | | | |
| <i>Myiagra rubecula</i> | leaden flycatcher | | | | |
| <i>Neophema pulchella</i> | turquoise parrot | | Vulnerable | | Y |
| <i>Nesoptilotis penicillatus</i> | white-plumed honeyeater | | | | |
| <i>Ninox connivens</i> | barking owl | | Vulnerable | | Y |
| <i>Ninox novaeseelandiae</i> | masked owl | | | | Y |
| <i>Northiella haematogaster</i> | blue bonnet | | | | Y |
| <i>Nycticorax caledonicus</i> | nankeen night heron | | | | |
| <i>Nymphicus hollandicus</i> | cockatiel | | | | Y |
| <i>Ocyphaps lophotes</i> | crested pigeon | | | | |
| <i>Oreoica gutturalis</i> | crested bellbird | | | | Y |
| <i>Pachycephala rufiventris</i> | rufous whistler | | | | |
| <i>Pardalotus striatus</i> | striated pardalote | | | | Y |
| <i>Phaps chalcoptera</i> | common bronzewing | | | | |
| <i>Philemon citreogularis</i> | little friarbird | | | | |
| <i>Philemon corniculatus</i> | noisy friarbird | | | | |
| <i>Platycercus adscitus</i> | pale-headed rosella | | | | Y |
| <i>Plectorhyncha lanceolata</i> | striped honeyeater | | | | |
| <i>Podargus strigoides</i> | tawny frogmouth | | | | |
| <i>Polytelis swainsonii</i> | superb parrot | Vulnerable | Vulnerable | | |
| <i>Pomatostomus superciliosus</i> | white-browed babbler | | | | |
| <i>Pomatostomus temporalis temporalis</i> | grey-crowned babbler (eastern subspecies) | | Vulnerable | | |
| <i>Psephotus haematonotus</i> | red-rumped parrot | | | | Y |

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|---------------------------------------|--------------------------------------|---------------------|-------------|---------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| <i>Ptilonorhynchus maculate</i> | Spotted bowerbird | | | | |
| <i>Ptilotula penicillatus</i> | white-plumed honeyeater | | | | |
| <i>Rhipidura fuliginosa</i> | grey fantail | | | | |
| <i>Rhipidura leucophrys</i> | willie wagtail | | | | |
| <i>Scythrops novaehollandiae</i> | channel-billed cuckoo | | | | |
| <i>Smicrornis brevirostris</i> | weebill | | | | |
| <i>Stagonopleura guttata</i> | diamond firetail | | Vulnerable | | |
| <i>Stizoptera bichenovii</i> | double-barred finch | | | | |
| <i>Strepera graculina</i> | pied currawong | | | | |
| <i>Struthidea cinerea</i> | apostlebird | | | | |
| <i>Tachybaptus novaehollandiae</i> | Australasian grebe | | | Least concern | |
| <i>Taeniopygia guttata</i> | zebra finch | | | | |
| <i>Todiramphus sanctus</i> | sacred kingfisher | | | | Y |
| <i>Trichoglossus chlorolepidotus</i> | scaly-breasted lorikeet | | | | Y |
| <i>Trichoglossus haematodus</i> | rainbow lorikeet | | | | |
| <i>Turnix varius</i> | painted button-quail | | | | |
| <i>Turnix velox</i> | little button-quail | | | | |
| <i>Tyto alba</i> | barn owl | | | | Y |
| <i>Tyto javanica</i> | eastern barn owl | | | | |
| <i>Tyto novaehollandiae</i> | masked owl | | Vulnerable | | |
| <i>Vanellus miles novaehollandiae</i> | masked lapwing (southern subspecies) | | | | |
| Amphibians | | | | | |
| <i>Crinia sloanei</i> | Sloane's froglet | | Vulnerable | | |
| <i>Cyclorana novaehollandiae</i> | New Holland frog | | | Least concern | |
| <i>Cyclorana platycephala</i> | water-holding frog | | | | |
| <i>Cyclorana verrucosa</i> | rough frog | | | | |
| <i>Limnodynastes fletcheri</i> | barking frog | | | Least concern | |

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|------------------------------------|--|---------------------|-------------|---------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| <i>Limnodynastes tasmaniensis</i> | spotted grass frog | | | Least concern | |
| <i>Limnodynastes terraereginae</i> | northern banjo frog | | | Least concern | |
| <i>Litoria caerulea</i> | green tree frog | | | | Y |
| <i>Litoria latopalmata</i> | broad-palmed frog | | | Least concern | |
| <i>Litoria peronii</i> | Peron's tree frog | | | Least concern | Y |
| <i>Litoria rubella</i> | desert tree frog | | | Least concern | Y |
| <i>Neobatrachus sudellae</i> | Sudells burrowing frog | | | | |
| <i>Platyplectrum ornatum</i> | ornate burrowing frog | | | Least concern | |
| <i>Uperoleia laevis</i> | smooth toadlet | | | Least concern | |
| <i>Uperoleia rugosa</i> | wrinkled toadlet | | | Least concern | |
| Reptiles | | | | | |
| <i>Acritoscincus platynotum</i> | red-throated skink | | | | |
| <i>Amalosia rhombifer</i> | zigzag velvet gecko | | Endangered | | Y |
| <i>Amphibolurus burnsi</i> | Burn's dragon | | | | |
| <i>Amphibolurus muricatus</i> | jacky lizard | | | | |
| <i>Anilios affinis</i> | small-headed blind snake | | | | |
| <i>Anilios proximus</i> | proximus blind snake | | | | |
| <i>Anilios unguirostris</i> | claw-snouted blind snake | | | | |
| <i>Anilios wiedii</i> | brown-snouted blind snake | | | | |
| <i>Anilios ligatus</i> | robust blind snake | | | | |
| <i>Anomalopus brevicollis</i> | short-necked worm-skink | | | | |
| <i>Anomalopus leuckartii</i> | two-clawed worm-skink | | | Least concern | |
| <i>Anomalopus mackayi</i> | five-clawed worm-skink, long-legged worm-skink | Vulnerable | Endangered | Endangered | |
| <i>Anomalopus verreauxii</i> | three-clawed worm-skink | | | Least concern | |
| <i>Antaresia maculosa</i> | spotted python | | | | |

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|-----------------------------------|----------------------------------|---------------------|-------------|-----------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| <i>Aspidies melanocephalus</i> | black-headed python | | | | |
| <i>Aspidites ramsayi</i> | woma | | Vulnerable | Near threatened | |
| <i>Bellatorias frerei</i> | major skink | | | | |
| <i>Boiga irregularis</i> | brown tree snake | | | | |
| <i>Brachyuophis australis</i> | Australian coral snake | | | | |
| <i>Carlia munda</i> | shaded-litter rainbow-skink | | | | |
| <i>Carlia pectoralis</i> | open-litter rainbow-skink | | | | |
| <i>Carlia rubigo</i> | orange-flanked rainbow skink | | | Least concern | |
| <i>Carlia schmeltzii</i> | robust rainbow skink | | | | |
| <i>Carlia tetradactyla</i> | southern rainbow-skink | | | | |
| <i>Carlia vivax</i> | lively rainbow skink | | | Least concern | |
| <i>Christinus marmoratus</i> | marbled gecko (possible) | | | | |
| <i>Cryptoblepharus australis</i> | inland snake-eyed skink | | | | |
| <i>Cryptoblepharus carnabyi</i> | Carnaby's Skink | | | | Y |
| <i>Cryptoblepharus metallicus</i> | metallic snake-eyed skink | | | | |
| <i>Cryptoblepharus pannosus</i> | ragged snake-eyed skink | | | | |
| <i>Cryptoblepharus pulcher</i> | elegant snake-eyed skink | | | | |
| <i>Cryptophis boschmai</i> | Carpentaria snake | | | | |
| <i>Cryptophis nigrescens</i> | eastern small-eyed snake | | | | |
| <i>Ctenotus allotropis</i> | brown-blazed wedgesnout ctenotus | | | | |
| <i>Ctenotus ingrami</i> | unspotted yellow-sided ctenotus | | | | |

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|-----------------------------------|--------------------------------------|---------------------|-------------|---------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| <i>Ctenotus regius</i> | royal ctenotus, pale-rumped ctenotus | | | | |
| <i>Ctenotus robustus</i> | eastern striped skink | | | | |
| <i>Ctenotus spaldingi</i> | Spalding's ctenotus | | | Least concern | |
| <i>Delma inornata</i> | patternless delma | | | | |
| <i>Delma tincta</i> | excitable delma | | | | |
| <i>Demansia psammophis</i> | yellow-faced whipsnake | | | | |
| <i>Dendrelaphis punctulata</i> | green tree snake | | | | |
| <i>Denisonia devisi</i> | De Vis' banded snake, mud adder | | | | |
| <i>Denisonia maculata</i> | ornamental snake | Vulnerable | | Vulnerable | |
| <i>Diplodactylus tessellatus</i> | tesselated gecko | | | | |
| <i>Diplodactylus vittatus</i> | wood gecko, eastern stone gecko | | | Least concern | |
| <i>Diporiphora australis</i> | tommy roundhead | | | | Y |
| <i>Diporiphora nobbi</i> | nobbi dragon | | | | |
| <i>Egernia rugosa</i> | yakka skink | Vulnerable | | Vulnerable | |
| <i>Egernia striolata</i> | tree skink | | | | Y |
| <i>Eremiascincus richardsonii</i> | broad-banded sand-swimmer | | | Least concern | |
| <i>Furina barnardi</i> | yellow-naped snake | | | | |
| <i>Furina diadema</i> | red-naped snake | | | | |
| <i>Furina dunmalli</i> | Dunmall's snake | Vulnerable | | Vulnerable | |
| <i>Gehyra catenata</i> | chain-backed tree dtella | | | Least concern | |
| <i>Gehyra dubia</i> | dubious dtella | | | | Y |
| <i>Gehyra variegata</i> | tree dtella | | | | Y |
| <i>Gehyra versicolor</i> | | | | | |
| <i>Hemiaspis damelii</i> | grey snake | | | Endangered | |
| <i>Heteronotia binoei</i> | Bynoe's gecko, prickly gecko | | | | |
| <i>Hoplocephalus bitorquatus</i> | pale-headed snake | | Vulnerable | | Y |
| <i>Lampropholis guichenoti</i> | grass skink | | | | |

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|--------------------------------|-------------------------------|---------------------|-------------|---------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| <i>Lerista fragilis</i> | eastern mulch-slider | | | | |
| <i>Lerista muelleri</i> | wood mulch slider | | | | |
| <i>Lerista punctatovittata</i> | eastern robust slider | | | | |
| <i>Lerista timida</i> | timid slider | | | | |
| <i>Lialis burtonis</i> | Burton's snake-lizard | | | | |
| <i>Liopholis modesta</i> | eastern ranges rock-skink | | | | |
| <i>Liopholis whitii</i> | White's skink | | | | |
| <i>Lophognathus burnsi</i> | Burn's dragon | | | | |
| <i>Lucasium damaeum</i> | beaded gecko | | | | |
| <i>Lucasium steindachneri</i> | box-patterned gecko | | | Least concern | |
| <i>Lygisaurus foliorum</i> | tree-base litter-skink | | | | |
| <i>Menetia greyii</i> | common dwarf skink | | | | |
| <i>Morelia spilota</i> | diamond python | | | | Y |
| <i>Morethia boulengeri</i> | Boulenger's skink | | | | |
| <i>Morethia taeniopleura</i> | fire-tailed skink | | | | |
| <i>Nebulifera robusta</i> | robust velvet gecko | | | Least concern | Y |
| <i>Oedura marmorata</i> | marbled velvet gecko | | | | Y |
| <i>Oedura monilis</i> | ocellated velvet gecko | | | | Y |
| <i>Paradelma orientalis</i> | Brigalow scaly-foot | | | Least concern | |
| <i>Parasuta dwyeri</i> | Dwyer's snake | | | | |
| <i>Parasuta spectabilis</i> | spectacled hooded snake | | | | |
| <i>Pogona barbata</i> | eastern bearded dragon | | | | Y |
| <i>Pseudechis australis</i> | king brown snake, mulga snake | | | | |
| <i>Pseudonaja textilis</i> | eastern brown snake | | | | |
| <i>Pygopus lepidopodus</i> | common scaly-foot | | | | |

| Scientific name | Common name | Conservation status | | | Likely to use tree hollows |
|--------------------------------|---|---------------------|-------------|---------------|----------------------------|
| | | EPBC Act | NSW TSC Act | QLD NC Act | |
| <i>Pygopus schraderi</i> | eastern hooded scaly-foot | | | | |
| <i>Rhynchoedura ormsbyi</i> | eastern beaked gecko | | | Least concern | |
| <i>Rhynchoedura ornata</i> | beaked gecko | | | | |
| <i>Strophurus intermedius?</i> | southern spiny-tailed gecko | | | | |
| <i>Strophurus intermedius</i> | eastern spiny-tailed gecko | | | | Y |
| <i>Strophurus williamsi</i> | eastern spiny-tailed gecko | | | | |
| <i>Suta suta</i> | curl snake | | | | |
| <i>Tiliqua rugosa</i> | shingleback lizard | | | | |
| <i>Tiliqua scincoides</i> | blue-tongue | | | | |
| <i>Underwoodisaurus milii</i> | thick-tailed gecko, barking gecko (W&S) | | | | |
| <i>Varanus gouldii</i> | sand goanna | | | | |
| <i>Varanus panoptes</i> | yellow-spotted monitor | | | | |
| <i>Varanus tristis</i> | freckled monitor | | | | Y |
| <i>Varanus varius</i> | lace monitor | | | | Y |
| <i>Vermicella annulata</i> | bandy-bandy | | | | |

Table E4. Weed species that may occur in the Poplar Box Grassy Woodlands.
Source: Benson et al., 2006; Wang et al., 2008; Benson, 2010.

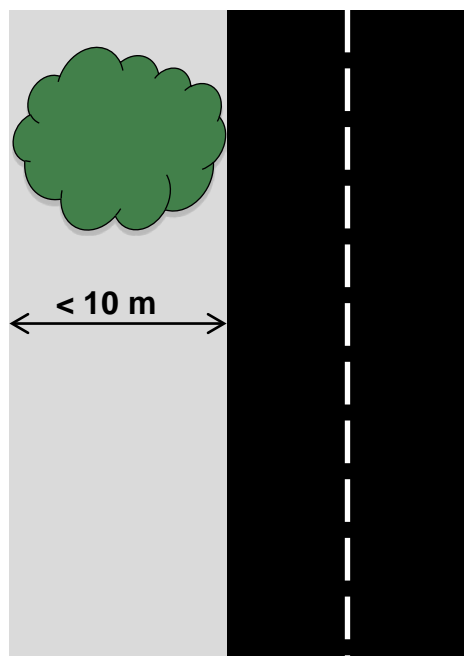
| Scientific Name | Common Name |
|---|------------------------------------|
| <i>Ammi majus</i> | bishop's-weed, bullwort |
| <i>Asphodelus fistulosus</i> | |
| <i>Avena ludoviciana</i> | ludo, wild oats |
| <i>Bryophyllum</i> spp. | mother of millions |
| <i>Carthamus lanatus</i> | saffron thistle |
| <i>Cenchrus ciliaris</i> | buffel grass |
| <i>Centaurium tenuiflorum</i> | |
| <i>Chondrilla juncea</i> | skeleton weed |
| <i>Cirsium vulgare</i> | spear thistle |
| <i>Conyza bonariensis</i> | flaxleaf fleabane |
| <i>Echium plantagineum</i> | salvation Jane |
| <i>Eragrostis cilianensis</i> | stinkgrass |
| <i>Eragrostis curvula</i> | African lovegrass |
| <i>Erodium cicutarium</i> | common storksbill, common crowfoot |
| <i>Hordeum leporinum</i> | barley grass |
| <i>Ehrharta calycina</i> | perennial veldt grass |
| <i>Eragrostis curvula</i> | coolatai grass |
| <i>Hypochaeris glabra</i> | smooth catsear |
| <i>Hypochaeris radicata</i> | catsear, flatweed |
| <i>Lactuca serriola</i> | prickly lettuce |
| <i>Lepidium africanum</i> | |
| <i>Leontodon rhagadioloides</i> | Cretan weed |
| <i>Leontodon rhagadioloides</i> subsp. <i>cretica</i> | Cretan weed |
| <i>Lolium perenne</i> | perennial ryegrass |
| <i>Lolium rigidum</i> | Wimmera ryegrass |
| <i>Lycium ferocissimum</i> | African boxthorn |
| <i>Malva parviflora</i> | small-flowered mallow |
| <i>Malvastrum americanum</i> | spiked malvastrum |
| <i>Medicago polymorpha</i> | burr medic |
| <i>Medicago minima</i> | woolly burr medic |
| <i>Opuntia aurantiaca</i> | tiger pear |
| <i>Opuntia stricta</i> | spiny pest pear |
| <i>Opuntia tomentosa</i> | velvety tree pear |

| Scientific Name | Common Name |
|--|----------------------------|
| <i>Parthenium hysterophorus</i> | parthenium weed |
| <i>Paspalum didatum</i> | paspalum |
| <i>Pavonia hastata</i> | |
| <i>Petrorhagia nanteuilii</i> | |
| <i>Phyla canescens</i> | lipia |
| <i>Rapistrum rugosum</i> | turnip weed, giant mustard |
| <i>Salsola kali</i> | soft roly-poly |
| <i>Sisymbrium irio</i> | London rocket |
| <i>Sonchus oleraceus</i> | common sowthistle |
| <i>Spergularia diandra</i> | |
| <i>Themeda quadrivalvis</i> | grader grass |
| <i>Trifolium angustifolium</i> | narrow-leaved clover |
| <i>Trifolium glomeratum</i> | clustered clover |
| <i>Vernena aristigera</i> | Mayne's pest |
| <i>Verbena gaudichaudii</i> | |
| <i>Verbesina encelioides</i> subsp. <i>encelioides</i> | |
| <i>Vulpia myuros</i> | rat's tail fescue |
| <i>Zinnia peruviana</i> | wild zinia |

Appendix F – Remnant roadside vegetation

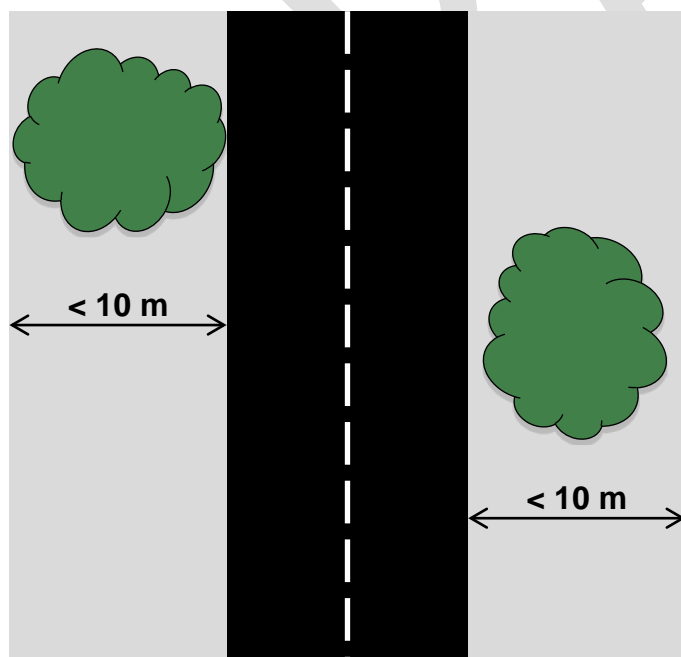
When considering a roadside patch of remnant vegetation, the description, key diagnostic characteristics and condition thresholds should be taken into account while also considering the following scenarios:

Diagram F1 Remnant roadside patch containing Poplar Box Grassy Woodland < 10m in width



☐ Not the ecological community

Diagram F2 Remnant roadside patch containing Poplar Box Grassy Woodland < 10m in width



☐ Not the ecological community

Diagram F3 Remnant roadside patch containing Poplar Box Grassy Woodland $\geq 15\text{m}$ in width

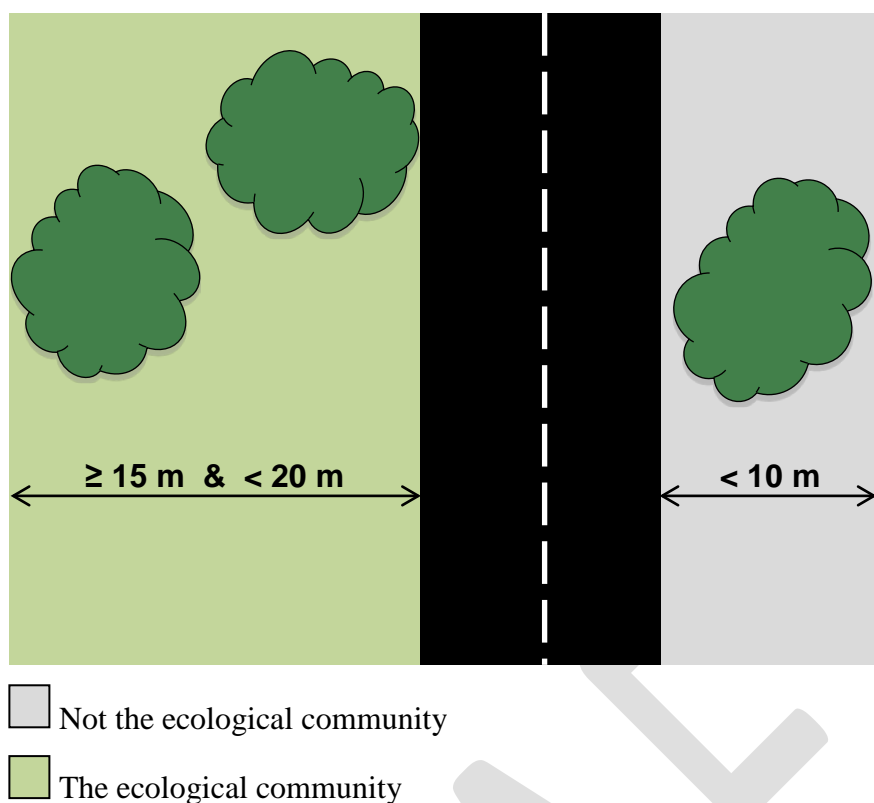
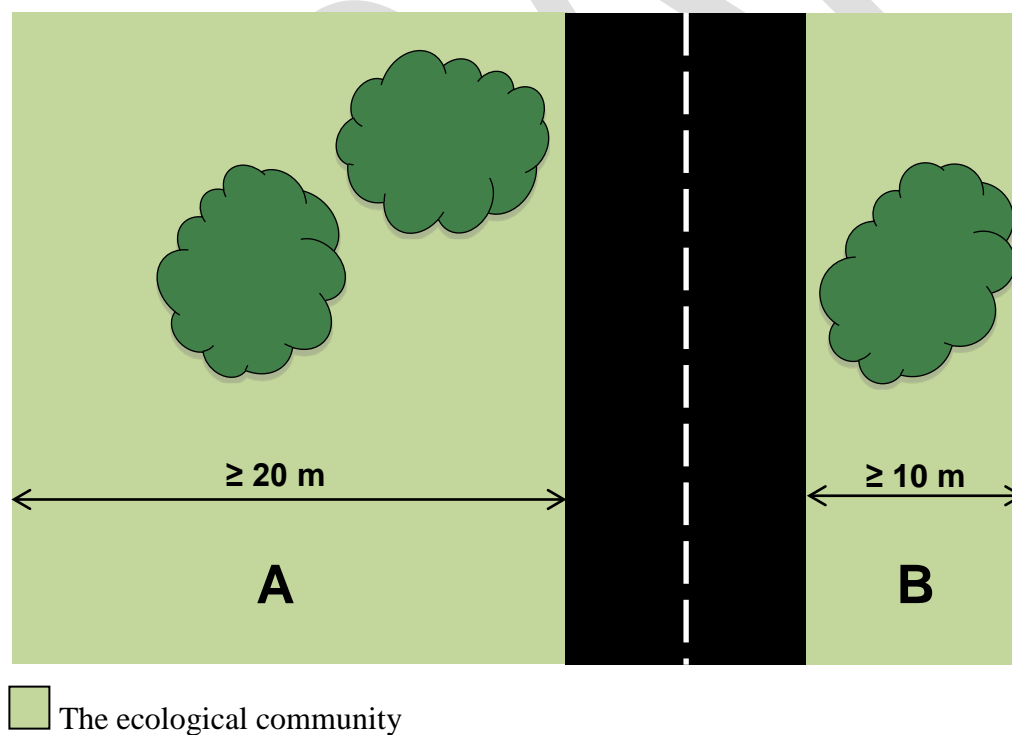


Diagram F4 Remnant roadside patch containing Poplar Box Grassy Woodland $\geq 20\text{m}$ in width



N.B. Patch B is considered part of Patch A

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