04586 – Singleton TA Bushfire Mitigation Works

Ecological Assessment

Department of Defence

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1 Abbreviations

Abbreviation	Definition
AWS	Automatic Weather Station
BC Act	Biodiversity Conservation Act 2016 (NSW)
BDAR	Biodiversity Development Assessment Report
BOM	Bureau of Meteorology
CEMP	Construction Environment Management Plan
EPA	Environment Protection Authority
EPBCAct	Environment Protection and Biodiversity Conservation Act 1999
EWP	Estate Works Program
GDE	Groundwater Depended Ecosystem
GPS	Global Positioning System
IBRA	Interim Biogeographic Regionalisation of Australia
MNES	Matters of National Environmental Significance
NSWDPI	NSW Department of Primary Industries
NSW DPIE	NSW Department of Planning, Industry and Environment
OEH	Office of Environment and Heritage
PCT	Plant Community Type
PMST	Protected Matters Search Tool
REO	Range Environmental Officer
SEPP	State Environmental Planning Policy
SMA	Singleton Military Area
STA	Singleton Training Area
TEC	Threatened Ecological Community
WONS	Weeds of National Significance

2 Introduction

2.1 Description of the proposal

Under the Estate Works Program (EWP) Project EST04585 (Singleton Bridge Replacement) and Project EST04586 (Singleton Training Area Bushfire Mitigation Works) are initiated to provide upgraded site access within Singleton Military Area (SMA).

Project EST04585 involves the new construction or upgrading of three bridge sites throughout SMA. The three sites are as follows:

- Mudies Creek Bridge – Three Span Bridge
  - Construction of a new 20t capacity three span single lane concrete bridge within the Singleton Training Area (STA) of SMA (see Figure 2-3)
- Doughboy Hollow Creek Crossing –Single Span Bridge
  - Construction of a new 20t capacity single lane concrete bridge within the Cantonment of SMA (see Figure 2-2)
- Timber Bridge Replacement – Two Span Bridge
  - Replacement of out of service timber bridge with a new two span concrete bridge within the STA of SMA (see Figure 2-4)

Project EST04586 aims to enhance accessibility for contracted staff and Rural Fire Service crew within the STA through the development of a new 3.2km fire trail. This fire trail intersects with Mudies Creek and as such compliments Project EST04585 (as the Mudies Creek Bridge development completes the new fire trail).

The locations of the works are shown in Figure 2-1 and photos of each site are shown in Appendix B.

Figure 2-1 Location of the proposed works

Figure 2-2 Mudies Creek Bridge (Proposed Three Span Bridge)

Figure 2-3 Doughboy Hollow Creek Crossing (Proposed Single Span Bridge)

Figure 2-4 Timber Bridge Replacement (Proposed Two Span Bridge)

2.2 Purpose and scope of the report

Threatened Ecological Communities (TEC's) listed as Matters of Environmental Significance (MNES) are identified within boundary of the scope of works for the Projects EST04585 and EST04586, and therefore a biodiversity assessment report is required prior to the beginning of construction.

This report is prepared to:

- Evaluate direct and indirect impacts as a result of construction and operation to determine the significance of ecological impact of the two projects, and to investigate whether either project requires further referral to the minister under the EPBC Act.
- Specify any further environmental constraints or risks that may affect construction of the project
- Detail areas of sensitivity and make recommendations for avoiding/minimising ecological impacts
- Identify any residual impacts and the necessity of potential biodiversity offsets under Commonwealth legislation

2.3 Background

As part of the 90% design report for EST04585 and EST04586, a preliminary background desktop ecological assessment was undertaken to identify the environmental constraints of the projects. While the fire trail alignment and location of the crossings selected minimises the need for vegetation clearance, the desktop assessment identified Doughboy Hollow Creek Crossing and Mudies Creek Bridge are both located in vegetation communities listed as a threatened ecological community (TEC) under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. The Timber Bridge Replacement project was also found to potentially impact upon land listed under the NSW *Biodiversity Conservation (BC) Act 2016*.

Whilst EST04586 scope was found to not directly impact upon listed species or communities, ecological issues may still be apparent where the project ties into the EST04585 Mudies Creek Crossing, in areas where ecological parameters haven't been mapped sufficiently in data used in the desktop assessment, or where mapped threatened communities are located adjacent to the project area.

Therefore, it is identified that an ecological assessment would be required prior to the beginning of construction for the two projects (EST04585 and EST04586).

2.4 Legislative context

2.4.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act serves as the commonwealths' main tool for environmental conservation and protection. As a federal instrument, the EPBC act focuses on actions located on or impacting upon commonwealth land, and on Matters of National Environmental Significance (MNES) for which the commonwealth government views as its responsibility regarding environmental protection. The listed MNES are:

- World heritage
- National heritage
- Ramsar wetlands
- Threatened species and communities
- Listed migratory species
- Protection from nuclear actions
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Water resources impacted by coal seam gas or other large coal mining development.

Actions which have the potential to impact upon any MNESs must be assessed to determine the significance of the impact. If the impact is found to be significant then the action must be referred to the Minister for approval. Significance of impact is determined via the following guidelines:

- *Significant impact guidelines 1.1: Matters of National Environmental Significance* (Commonwealth of Australia, 2013a)
- *Significant impact guidelines 1.2: Actions on, or impacting upon, Commonwealth land and actions by Commonwealth agencies* (Commonwealth of Australia, 2013b).

2.4.2 Biodiversity Conservation Act 2016 (NSW)

The BC Act serves as a key NSW legislative tool to protect threatened species, ecological communities, protected plants and animals, and identify associated key threatening processes.

As the proposal is located on Commonwealth owned Defence land, NSW environmental legislation does not apply to the proposal, therefore assessment under the BC Act and the preparation of a Biodiversity Development Assessment Report (BDAR) is not required. However, it is still considered environmental best practice to assess the impacts of ecological items that may be listed under the BC Act but not the EPBC Act.

2.4.3 Koala Habitat State Environmental Planning Policy

The Koala Habitat Protection State Environmental Planning Policy (SEPP) came into effect as of 1 March 2020, replacing the previous policy (SEPP 44 – Koala Habitat Protection). The new SEPP redefines 'core koala habitat' through the expansion of tree species suitable for koala habitat identified under the SEPP from 10 to 65. This SEPP is supported by up to date vegetation mapping data which identifies areas of potential koala habitat and areas identified for targeted investigation.

As the SEPP is legislated under Part 4 of the EP&A Act (NSW), and NSW legislation does not apply to Defence land, approval is not required. However, the SEPP planning map has been referenced as a useful tool in the identification of potential koala habitat.

The results of koala habitat mapping indicate that parts of the proposal is located within area defined as Koala Development Application Map, or has been identified as a site investigation area suitable for targeted surveys. As such field surveys also investigated for potential koala evidence. A copy of the map is in Appendix A.

3 Methods

3.1 Background research

A desktop assessment and literature review of the study area was undertaken prior to commencing field investigations. It was used to identify landscape and biodiversity attributes for confirmation during field assessments. Information sources used in the desktop assessment include:

- Recent ecological reports including Caderno Biosecurity Management Plan
- Office of Environment and Heritage (OEH) BioNet Atlas of NSW Wildlife for previous records of threatened species, populations and communities
- EPBC Protected Matters Tool for Matters of National Environmental Significance
- OEH vegetation mapping including vegetation formation, vegetation class and plant community type
- Bureau of Meteorology (BOM) Atlas of Groundwater Dependent Ecosystems
- NSW Department of Primary Industries (DPI) Priority weeds database

3.2 Field survey

Two Aurecon ecologists undertook a three-day vegetation and fauna surveys and habitat assessments including:

- Field validation (ground-truthing) of any existing vegetation classifications according to current Plant Community Type (PCT) descriptions via a random meander survey
- Targeted survey for threatened plant species which may be impacted by the proposed works
- Identification and mapping of any Threatened Ecological Communities, where relevant to project works
- Active searches for suitable habitat attributes that may indicate the presence of threatened fauna (such as. hollow bearing trees, decorticating bark)
- Active searches under loose rocks and tree bark, where present and accessible
- Active searches for scat and scratches on habitat trees
- Spotlighting and call playback on the proposed route over one nights
- Deployment of an Anabat ultrasonic bat recorder over two nights
- Deployment of two motion activated fauna cameras at Mudies Creek over two nights
- Opportunistic observations of fauna (both threatened and non-threatened)

Identification of weed species, including priority weeds and Weeds of National Significance within the project area.

3.3 Survey limitations

Surveys were conducted in August which was outside the normal flowering times for targeted threatened species such as:

- *Acacia bynoeana* (Bynoe's Wattle)
- *Prasophyllum petilum* (Tarengo Leek Orchid)
- *Syzygium paniculatum Gaertn* (Magenta Lilly Pilly)
- *Euphrasia arguta* R.Br.
- *Rutidosis heterogama* Philipson
- *Pterostylis Gibbosa* (Illawarra Greenhood)

As such, it is possible that evidence of these species may not have been recorded during the survey, however the majority of species are not cryptic and can be identified if they were within the project footprint.

Furthermore, additional survey limitations included:

- Windy weather during the field survey made bird and owl surveys difficult as these species tend to not be as active during strong winds
- Inability to access the proposed road location west of Mudies Creek due to live firing activities and presence of potential UXO. Therefore, it is assumed that the condition of the grassland western extent of the Mudies Creek fire trail upgrade will be of similar condition to the grassland to the east of Mudies Creek. Additionally, as the location of mapped TEC's could not be confirmed in the field in this area, woody vegetation in this region should be assumed to be a TEC due to the proximity to the mapped endangered community *Narrow-leaved Ironbark – Grey Box – Spotted Gum shrub – grass woodland of the Hunter valley (PCT 1604).*

4 Existing environment

4.1 Bioregion

Developed by *Thackway and Cresswell (1995)* the Interim Biogeographic Regionalisation of Australia (IBRA) serves as a continuously updated mapping project which divides Australia into Bioregions and associated subregion. By classifying an area's bioregion, broadscale assumptions can be made about the types of environmental processes, geophysical features and ecosystems might be expected to be found there.

Through this classification System, Singleton Military Area is located within the Hunter subregion of the Sydney Basin Bioregion. Table 4-1 explores in detail the types of features located in this subregion.

Table 4-1 Hunter sub region characteristics

Subregion	Geology	Characteristic landforms	Typical soils	Vegetation
Hunter	A complex of Permian shales, sandstones, conglomerates, volcanics and coal measures. Bounded on the north by the Hunter Thrust fault and on the south by cliffs of Narrabeen Sandstone. Pleistocene coastal barrier system in Newcastle bight.	Rolling hills, wide valleys, with a meandering river system on a wide flood plain. River terraces are evident, the highest with silicified gravels. Streams can be brackish or saline at low flow. Numerous small swamps in upper catchment, extensive estuarine swamps behind the coastal barrier of beach and dunes	A variety of harsh texture contrast soils on slopes and deep sandy loam alluvium on the valley floors. Small number of source bordering dunes on southern tr butaries of the Hunter. Deep sands with podsol profiles in dunes on the barrier, saline, organic muds in the estuary. Soil salinity is common on some bedrocks in the upper catchment.	Patches of rainforest brush in the lower valley. Forest and open woodland of white box, forest red gum, narrow-leaved ironbark, grey box, grey gum spotted gum, rough-barked apple and extensive of stands of swamp oak in upper reaches and foothills. River oak and river red gum along the streams. Coastal dune vegetation of blackbutt, smooth-barked apple, coast banksias and swamp mahogany. Mangroves, salt marsh and freshwater reed swamps in the estuary.

4.2 Climate

Cessnock Airport Bureau of Meteorology Automatic Weather Station (AWS – Station number 61260) was used to determine the climate of Singleton Military Area with rainfall and temperature data available from 1968 to present (Figure 4-1). Singleton Military area usually experiences warm wet summers with a maximum recorded temperature at 46.8°C on 11 February 2017, and mild to cold dry winters with minimum recorded temperature of -6.7°C recorded on the 26 August 1994.

Mean annual rainfall for the region is recorded at 720.5mm however 2019 saw driest year on record with annual rainfall recorded at 384.4mm. Rainfall has increased in 2020 with 568.6mm falling as of August 2020.

The prevailing weather conditions during the survey period (17th August to 19th August) was fine with an average temperature of 15°C, no rain and moderately windy conditions particularly in the evening with a max wind speed of 35km/hr.

Figure 4-1 Climate of Singleton Training Area (STA)

4.3 Watercourses

A key feature of the EST04585 and EST04586 involve the crossings of several watercourses. The watercourses that intersect the project works are:

4.3.1 Mudies Creek

Mudies creek is a large non-perennial watercourse flowing north to south in a meandering pattern throughout the STA. The Mudies Creek Bridge is being developed in a narrow section of the channel densely forested with swamp oak with a flood embankment depth of approximately 10m. Although the crossing is located in a section that is approximately 30m wide, adjacent areas of the creek are significantly wider featuring additional flood channels, trees within the embankment and fallen large woody debris. At the time of survey the creek contained highly turbid water which was travelling at a very low flow rate. Some evidence of recent flooding was apparent at approximately 1.5m above the existing waterline in the embankment.

4.3.2 Unidentified streams east of Mudies Creek

Two non-perennial streams unidentified streams are located east of Mudies Creek. These watercourses intersect with the proposed fire trail and will require minor crossings. The streams are narrow (<1m wide and very shallow) with only a minor water flow. Although mapped as grassland in state vegetation maps, the streams contained a greater abundance in trees, shrubs and other vegetation compared to the surrounding grassland.

4.3.3 Doughboy Hollow Creek

Doughboy Hollow Creek is a non-perennial stream located in the southwest region of the STA Cantonment. The single span bridge being constructed for the Doughboy Hollow Crossing will be located at the same location as a previous crossing which is decommissioned. The site is heavily modified with artificial stabilisation on the creek bank. During the site visit the creek had minimal flowing water and small to large pools were found within the embankment.

4.3.4 Un-named non perennial stream at Timber Bridge site

The Timber Bridge crosses over an unidentified non-perennial stream located in the north east region of the STA. On field inspection the creek was identified as having present but very turbid water within the stream. The bank height was approximately 4 m and the water depth was less than 1 m with a width of between .5 to 1.5m.

4.4 Groundwater dependent ecosystems

Groundwater plays a crucial role in ecosystem services and supplies some or if not all the necessary water supply for a vegetation community and associated ecological processes. To investigate any potential impact to an ecosystem through the disruption or contamination groundwater supply, the Bureau of Meteorology's Atlas of Groundwater Depended Ecosystems (GDEs) was used to determine the location of possible terrestrial and aquatic GDEs within SMA. The following possible GDE's were identified Table 4-2.

Table 4-2 Groundwater dependent ecosystems located within study area

PCT	Supplied ecosystem type	GDE potential	Groundwater management area
Narrow-leaved Ironbark/ Bull Oak/ Grey Box shrub/ grass open forest of the central and lower Hunter Valley	Hunter-Macleay Dry Sclerophyll Forests	Low potential GDE - from regional studies	NSW Great Artesian Basin Shallow Groundwater - Central
Spotted Gum/ Narrow-leaved Ironbark / Red Ironbark shrub/ grass open forest of the central and lower Hunter Valley	Hunter-Macleay Dry Sclerophyll Forests	Low potential GDE - from regional studies	NSW Great Artesian Basin Groundwater - Warrego
Swamp Oak/ Weeping Grass grassy riparian forest of the Hunter Valley	Coastal Swamp Forests	High potential GDE - from regional studies	North Coast Fractured and Porous Rock Groundwater Sources

Previously conducted geotechnical investigations of the three bridge sites encountered no groundwater from seven boreholes up to 10m deep, indicating relatively deep groundwater at these locations. However, the groundwater table is still able to rise and fall in accordance with rainfall patterns, and groundwater may still become exposed during construction excavations. As such, mitigations measures are described in Section 6.2 to minimise the potential risk of contamination to groundwater quality from construction activities.

4.5 Plant community types

A preliminary desktop assessment used the State Vegetation Type Map: Upper Hunter v1.0. VIS_ID 4894 dataset produced by the Office of Environment and Heritage (OEH) to identify predicted PCTs within the study area. The following PCTs have been mapped as occurring within the vicinity of the study area.

- PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley
- PCT 1604 - Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter
- PCT 1692 - Bull Oak grassy woodland of the central Hunter Valley
- PCT 42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley
- PCT 1731 – Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley

In addition, the state vegetation mapping dataset listed that the grassland surrounding Mudies Creek was non-native. However during field surveys the grasslands was identified to contain mostly of native species such as *Cymnophon refractus* (Barbed wire grass) and *Aristida ramose* (Purple wiregrass), with some occurances of weed species including *Senecio madagascariensis* (Fireweed). This is consistent *Dichelachne/ Linum/ Chloris/ Bothriochloa* Grassland mapped as part of previous vegetation mapping (SKM,

2012) and is the most widespread grassland type within SMA. This grassland community is not listed under the EPBC Act or the BC Act and no threatened species were identified during the field survey or in previous vegetation mapping studies.

PCT 1692 is mapped as intersecting with the Doughboy Hollow Creek Bridge design, with PCT 1800 occurring along the adjacent creek line. However, field surveys confirmed all vegetation adjacent to the bridge is analogous to PCT 1800 (and PCT 1692 is not present). Refer to images in Appendix D.

Areas mapped as PCT 42 are mostly accurate, however the extent mapped at the Timber Bridge site also includes disturbed areas such as the existing bridge structure and surrounding road. Therefore, actual PCT 42 present is less than is mapped, and as such the calculated impact area on the PCT will be less.

4.5.1 PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley

Vegetation Formation: Forested wetlands

Vegetation Class: Coastal floodplain wetlands

PCT: 1800

Conservation Status: This PCT is listed as a TEC under both the EPBC and BC Act.

Condition: Good

OEH Description:

This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which *Casuarina glauca* (swamp oak) is the dominant species northwards from Bermagui.

Other trees including *Acmena smithii* (lilly pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks) may be present as subordinate species and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and *Melaleuca ericifolia* is the only abundant tree in this community south of Bermagui.

The understorey is characterised by frequent occurrences of vines, *Parsonsia straminea, Geitonoplesium cymosum* and *Stephania japonica* var. discolor, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter.

The composition of the ground stratum varies depending on levels of salinity in the groundwater. Under less saline conditions prominent ground layer plants include forbs such *Centella asiatica, Commelina cyanea, Persicaria decipiens* and *Viola banksii; graminoids* such as *Carex appressa, Gahnia clarkei, Lomandra longifolia, Oplismenus imbecillis*; and the fern *Hypolepis muelleri*.

On the fringes of coastal estuaries, where soils are more saline, the ground layer may include the threatened grass species, *Alexfloydia repens*, as well as *Baumea juncea*, *Juncus kraussii, Phragmites australis, Selliera radicans* and other saltmarsh species.

Figure 4-2 PCT 1800 at Mudies Creek

4.5.2 PCT 1604 - Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions

Vegetation Formation: Grassy Woodlands

Vegetation Class: Coastal Valley Grassy Woodland

PCT: 1604

Conservation Status: This PCT is listed as a TEC under both the EPBC (Critically Endangered) and BC Act (Endangered).

Condition: Good

OEH Description:

Central Hunter Ironbark-Spotted Gum-Grey Box Forest typically forms an open forest or woodland dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*), Spotted Gum (*Corymbia maculata*) and Grey Box (*Eucalyptus moluccana*). Other tree species such as Red Ironbark (*Eucalyptus fibrosa*) and Forest Red Gum (*Eucalyptus tereticornis*) may be present, and occasionally dominate or co-dominate. A sparse layer of small trees including Bulloak (*Allocasuarina luehmannii*) or Silver-stemmed Wattle (*Acacia parvipinnula*) may be present in some areas. The shrub layer varies from sparse to moderately dense. Common shrub species include Gorse Bitter Pea (*Daviesia ulicifolia* subsp. *ulicifolia*), Grey Bush-pea (*Pultenaea spinosa*), Coffee Bush (*Breynia oblongifolia*), Needlebush (*Hakea sericea*) and Blackthorn (*Bursaria spinosa* subsp. *spinosa*). Ground cover can be sparse to moderately dense and consists of numerous forbs, a few grass species and occasional ferns and sedges. Common species include Poison Rock Fern (*Cheilanthes sieberi* subsp. *sieberi*), Barbed Wire Grass (*Cymbopogon refractus*), Whiteroot (*Pratia purpurascens*), Many-flowered Mat-rush (*Lomandra multiflora* subsp. *multiflora*), *Pomax umbellata, Glycine tabacina*, Blue Flax-lily (*Dianella revoluta*), Slender Wire Lily (*Laxmannia gracilis*), *Vernonia cinerea* var. *cinerea*, Slender Tick-trefoil (*Desmodium varians*) and Kidney Weed (*Dichondra repens*).

4.5.3 PCT 42 - River Red Gum / River Oak riparian woodland wetland in the Hunter Valley

Vegetation Formation: Forested wetlands

Vegetation Class: Eastern Riverine Forests

PCT: 42

Conservation Status: This PCT is associated with the BC Act listed TEC *Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions*. This PCT is not listed as a TEC under the EPBC Act

Condition: Good

OEH Description (of Hunter Lowland Redgum Forest Community):

Hunter Lowland Redgum Forest is an open forest where the most common canopy tree species are *Eucalyptus tereticornis* (Forest Red Gum) and *E. punctata* (Grey Gum). Other frequently occurring canopy species are *Angophora floribunda* (Rough-barked Apple), *E. crebra* (Narrow-leaved Ironbark), *E. moluccana* (Grey Box) and *Corymbia maculata* (Spotted Gum). The shrub layer is open and common shrub species include *Breynia oblongifolia* (Coffee Bush), *Leucopogon juniperinus* (Prickly Beard-heath), *Daviesia ulicifolia* (Gorse Bitter Pea) and *Jacksonia scoparia* (Dogwood). The ground cover typically comprises grasses and herbs with common species being *Microlaena stipoides* var. *stipoides* (Forest Weeping Grass), *Pratia purpurascens* (Whiteroot), *Lomandra multiflora* (Many-flowered Mat-rush), *Cymbopogon refractus* (Barbed Wire Grass), *Cheilanthes sieberi* (Poison Rock Fern) and *Dichondra repens* (Kidney Weed).

4.5.4 PCT 1692 - Bull Oak grassy woodland of the central Hunter Valley

Vegetation Formation: Grassy Woodlands

Vegetation Class: Coastal Valley Grassy Woodlands

PCT: 1692

Conservation Status: This PCT is associated with the EPBC and BC Act listed *Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions*

Condition: Good

OEH Description:

This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which Casuarina glauca (swamp oak) is the dominant species northwards from Bermagui.

Other trees including *Acmena smithii* (lilly pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks) may be present as subordinate species and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and *Melaleuca ericifolia* is the only abundant tree in this community south of Bermagui.

The understorey is characterised by frequent occurrences of vines, *Parsonsia straminea, Geitonoplesium cymosum* and *Stephania japonica* var. *discolor,* a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter.

The composition of the ground stratum varies depending on levels of salinity in the groundwater. Under less saline conditions prominent ground layer plants include forbs such *Centella asiatica, Commelina cyanea, Persicaria decipiens* and *Viola banksii*; *graminoids* such as *Carex appressa, Gahnia clarkei, Lomandra longifolia, Oplismenus imbecillis*; and the fern Hypolepis muelleri.

On the fringes of coastal estuaries, where soils are more saline, the ground layer may include the threatened grass species, *Alexfloydia repens*, as well as *Baumea juncea, Juncus kraussii, Phragmites australis, Selliera radicans* and other saltmarsh species.

4.6 Priority weeds

A number of introduced plant species were recorded during the site investigation. Of those three species are listed as Weeds of National Significance (WONS) and listed as priority weeds under the *Biosecurity Act* 2015 by NSW Department of Planning, Industry and Environment (DPIE). A further two species are listed only in NSW. A list of those species and the locations is provided below.

Table 4-3 Priority weeds identified during site visit

Common Name	Scientific name	Location	Listing	Biosecurity duty
Lycium ferocissimum	African Boxthorn	Mudies Creek	WoNS & Biosecurity Act	All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose.
Solanum americanum	Glossy Nightshade	Mudies Creek	Biosecurity Act	Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land.
Opuntia stricta	Prickly Pear	Grassland near Mudies Creek	WoNS & Biosecurity Act	All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose.
Heliotropium amplexicaule	Blue heioltrope	Grassland near Mudies Creek	Biosecurity Act	Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land.
Senecio madagascariensis	Fireweed	Grassland near Mudies Creek	WoNS & Biosecurity Act	All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose.

4.7 Threatened ecological communities

A summary of TECs under both the EPBC and BC Acts located with SMA is provided in Table 4-4 below. Impacts on any TECs must be assessed to determine the level of significance the proposed works may have on the survival and health of those communities. Any impact which may have a significant impact must be referred to the Commonwealth for approval.

Table 4-4 Threatened ecological communities located within study area

PCT	NSW Listing	EPBC Status
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Endangered	Endangered
PCT 1604 - Central Hunter Ironbark—Spotted Gum-–Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions	Endangered	Critically endangered
PCT 42 - River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	Endangered	Not listed
PCT 1692 - Bull Oak grassy woodland of the central Hunter Valley	Endangered	Critically endangered

4.8 Terrestrial threatened species

The EPBC protected matters search tool found 38 listed threatened species which have the potential to occur within 10 km of the study area, the Protected Matters Search Tool (PMST) search is based on likelihood of suitable habitat and is not records based. Additionally, a BioNet Atlas search was conducted to identify records of BC-listed species within a 10 km radius of Mudies Creek Crossing study area (which encompassed the other two bridge sites and the proposed fire trail alignment). Evidence of these species and their associated habitat was investigated during surveys to determine the likelihood of occurrence within the proposed works area which is shown in Appendix B.

During the survey the threatened terrestrial species recorded within the area of works were three individual *Eucalyptus glaucina* (Slaty Red Gum) located on the northern edge of the Timber Bridge. The location of these individuals was geotagged, and their location can be seen in Figure 5-4. There was a potential sighting of a New Holland Mouse on the eastern bank of Mudies Creek which has previously been recorded at the southern end of STA. Additional surveys were conducted which determined that the species is not present at Mudies Creek as possible sighting was found instead to be the common House Mouse *(Mus musculus)* (Appendix E – New Holland Mouse Survey).

4.9 Fauna observations during the site assessment

During the field survey, fauna observations were conducted through opportunistic surveys, spotlighting and listening to bird calls. From this, one threatened fauna species as listed under the EPBC or the BC Act was identified. Whilst not listed as a threatened species under the EPBC a family of Grey-crowned babblers were noted on the drive to the Timber bridge site this species is listed as vulnerable under the BC Act. Table 4-5 lists the fauna species identified at each the project locations.

Table 4-5 Fauna observations recorded during field survey

Mudies Creek		
Scientific name	Common name	Type of observation
*Pseudomys novaehollandiae**	New Holland Mouse	Visual * Potential only may have been House mouse
Macropus giganteus	Eastern grey Kangaroo	Visual

Vombatus ursinus	Common Wombat	Burrows and scat
Cracticus tibicen	Australian Magpie	Aural/Visual
Rhipidura albiscapa	Grey Fantail	Aural
Cracticus nigrogularis	Pied Butcherbird	Visual
Doughboy Hollow Creek Single Span Bridge		
Scientific name	Common name	Type of observation
Rhipidura albiscapa	Grey Fantail	Aural
Cracticus torquatus	Grey butcher bird	Aural
Rhipidura leucophrys	Galah	Overhead
Manorina melanocephala	Noisy Miner	Overhead
Cracticus tibicen	Australian Magpie	Aural/Visual
Dacelo novaeguineae	Kookaburra	Aural
Corcorax melanorhamphos	Chough	Aural
Trichoglossus moluccanus	Rainbow Lorikeet	Overhead
Grallina cyanoleuca	Peewee/ Magpie-lark	Aural
Corvus coronoides	Raven	Visual
Malurus splendens	Splendid blue fairy wren	Overhead
Rhipidura leucophrys	Willy wag tail	Aural
Pomatostomus sp.	Babblers	Aural
Oryctolagus cuniculus	Rabbit	Visual/scat/warren
Macropus giganteus	Eastern grey Kangaroo	Visual
Timber Bridge		
Scientific name	Common name	Type of observation
Pardalotus puncatus	Spotted pardalote/ peep-wren	Aural/Visual
Rhipidura leucophrys	Galah	Overhead
Chenonetta jubata	Australian wood duck	Overhead
Grallina cyanoleuca	Peewee/ Magpie-lark	Aural
Limnodynastes tasmaniensis	Spotted Marsh Frog	Aural/Visual
Crinia significa	Common Eastern Froglet	Aural
Incidental		
Scientific name	Common name	Type of observation
Pomatostomus temporalis	Grey-crowned babbler	Visual
Macropus giganteus	Eastern grey Kangaroo	Visual
Vanellus miles	Masked lapwing	Visual
Elanus sp.	Kite	Visual
Manorina melanocephala	Noisy Miner	Overhead

Notes - * Potentially only may have been House mouse

Targeted motion cameras were installed at the Mudies Creek Bridge site in areas deemed probable to capture evidence of fauna (one installed in front of small burrows, another installed adjacent to animal track) however there was no fauna recorded by the cameras.

Bat observations were undertaken overnight at Mudies Creek Bridge and the Timber Bridge site using Anabat passive monitoring equipment (Titley Scientific Anabat Swift). Recorded bat calls were analysed in Anabat Insights software to determine species. The results are listed in Table 4-6.

Table 4-6 Bat species recorded at the Mudies Creek and Timber Bridge sites

Site	Scientific Name	Common Name
Mudies Creek	*Tadarida australis*	White striped freetail bat
	Ozimops planiceps	Southern freetail bat
	Scotorepens balstoni	Inland broadnosed bat
	Vespadelus regulus	Southern forest bat
Timber Bridge	*Tadarida australis*	White striped freetail bat
	Scotorepens balstoni	Inland broadnosed bat
	Nyctophilus sp	Long eared bat
	Vespadelus sp	A forest bat

Some species of Nyctophilus and Vespadelus are listed as vulnerable within NSW however the variation of acoustic signals between several species are not distinct enough to be able to identify calls to species level. In such cases, if a threatened species was considered to be at risk, an active capture program may be recommended. Given the type of works proposed and the unsuitability of the Timber Bridge as habitat (no fairy martin nest or suitable other gaps) it is not considered likely that the bridge is utilised as roosting habitat for threatened species, and the individuals recorded, threatened or otherwise, most likely make use of existing hollows and fissures outside of the project area.

4.10 Aquatic ecological communities

Water was present in all three creeklines and each site contained emergent vegetation and fallen timber which would provide potential habitat for small fish and other aquatic animals. Mudies Creek and Doughboy Hollow Creek were flowing at the time of the site visit. The water was clear at Doughboy Hollow Creek and very turbid at Mudies Creek. Doughboy Hollow Creek was very shallow with water in most parts less than 10cm deep, with some small deeper pools were present. The water at Mudies Creek was flowing and while the depth was not checked it appeared to be less than 60cm deep in most places. Due to the turbidity of the water the presence of deeper pools was not noted, although some would be expected to occur. Water was not flowing at Timber Bridge though it was present in several small shallow pools. No fish were noted at any locations though frogs were heard at both the Timber Bridge and Mudies Creek.

4.11 Hollow-bearing trees

Hollow-bearing trees provide potential breeding and roosting habitat to numerous species, and therefore the loss of hollow bearing trees is identified as a Key Threatening Process by NSW Department of Primary Industries and Environment (DPIE). As such, hollow-bearing trees were targeted during site surveys.

In general, Casuarina regrowth is dominant at each site, and its age and density provides limited opportunity for the development of trees with hollows. For all sites only three hollow bearing trees were recorded, one at Mudies Creek, two at Doughboy Hollow Creek and none at the Timber Bridge site (Table 4-7). Example photos of hollow-bearing trees are shown in Appendix D.

Table 4-7 Hollow-bearing trees located during field surveys

Site	Species	Hollowsizes approx. (cm)	Comments
Mudies Creek – West Bank	Casuarina stag	10 x 5 7 x 5 7 x 5 5 x 2 5 x 2	Two small lizards noted within hollows possibly *Ctenotus sp.*
Doughboy Hollow Creek Single Span Bridge	Casuarina stag x 2	7 x 5 5 x 3	Within waterway
Timber bridge	-	Nil	None within works area but several outside

4.12 Matters of National Environmental Significance (MNES)

Two EPBC Act Protected Matters searches were undertaken as part of the preliminary desktop assessment for both EST04585 and EST04586 to identify potential presence of MNES within the surrounding area. The EST04585 search was conducted via a 10 km buffer around Mudies Creek Crossing and encompasses the majority of SMA, including the other two bridge replacement sites. The EST04586 search was a narrower search focusing on a 5km buffer around the approximate proposed fire trail alignment.

Table 4-8 provides a summary of potential MNES impacts within the two search areas. Table 4-9 describes the applicable MNES and their relevance to the project at each site.

Table 4-8 Potential impacts to Matters of National Environmental Significance

Factor	Potential Impact
Any impact on world heritage property?	No
Any impact on a National Heritage place?	No
Any impact on a wetland of international importance?	Yes
Any impact on a listed threatened species or communities?	Yes
Any impact on listed migratory species?	Yes
Any impact on a Commonwealth marine area?	No
Does the proposal involve a nuclear action (including uranium mining?)	No
Additionally, any impact (direct or indirect) on commonwealth land?	Yes
Any impact on a water resource, in relation to coal seam gas development, or large coal mining development?	No

Table 4-9 Matters of National Environmental Significance

EST04585 - Singleton Bridge Replacement		
Category	**MNES**	**Relevance to project**
Wetlands of National Importance	Hunter Estuary Wetlands	The Hunter Estuary Wetlands are located over 50 km to the south east of the project. No significant impacts are anticipated.
Listed Threatened Ecological Communities (TECs)	4 listed TECs	The vegetation surrounding the Doughboys Hollow Creek Doughboy Hollow Creek Single Span Bridge and the Mudies Creek Crossing Bridge is consistent with the EPBC TEC *Coastal (Casuarina glauca) Forest of New south Wales and South East Queensland ecological community*. The total area of clearing is 0.0762 ha Works must be limited to those areas shown within the mapping below. Any work outside of these areas has not been assessed.
Listed threatened species	38 listed threatened species, including 9 birds, 5 amphibians, 2 reptiles, 9 mammals and 13 plant species	Vegetation clearing and disturbance during construction is required. Works must be limited to those areas shown within the mapping below. Any work outside of these areas has not been assessed.
Listed migratory species	16 listed migratory species	Suitable habitat is present to support some of the listed species. However, large tracts of suitable habitat are present within other sections of Singleton Military Area. Significant impacts are unlikely.
Listed marine species	21 listed marine species	No suitable habitat features are present to support marine species. No impacts are anticipated.
Invasive species	41 invasive species	Several listed invasive species are likely to utilise the sites. Disturbance from construction has the potential to increase prevalence of species, particularly flora species. Mitigation measures to minimise impacts of invasive species are listed in Section 6.2.
Commonwealth Land	Singleton Military Area Lone Pine Barracks	The project would be undertaken on Commonwealth Land to better facilitate site operations and increase safety of site access. No significant impacts to the environment, history or changes to the existing land use are expected.
EST04586 - Singleton Bushfire Mitigation Works		
Category	**MNES**	**Relevance to Project**
Wetlands of National Importance	Hunter Estuary Wetlands	The Hunter Estuary Ramsar Wetlands are located over 50 km to the south east of the project. No significant impacts are anticipated.
Listed Threatened Ecological Communities (TECs)	4 listed TECs	The works will directly impact one area of mapped EPBC listed TEC at Mudies Creek. Additionally, the EPBC listed TEC Narrow-leaved Ironbark – Grey Box – Spotted Gum shrub – grass woodland of the Hunter valley (PCT 1604). Provided all works is limited to those areas shown within the mapping below significant impact is not expected. Any work outside of these areas has not been assessed.
Listed threatened species	31 listed threatened species, including 9 birds, 2 amphibians, 1 reptile, 8 mammals and 11 plant species	Minimal vegetation clearing and disturbance during construction is required. However due to the minor nature of works, significant impact to threatened species is considered unlikely.

Listed migratory species	15 listed migratory species	Minimal vegetation clearing and disturbance during construction is required. A significant impact to threatened species is considered unlikely as large tracts of suitable habitat are present within other sections of the site.
Commonwealth Land	Singleton Military Area Lone Pine Barracks	The project is undertaken on Commonwealth Land with the objective to improve site operations and increase safety of site access. No significant impacts to the environment, history or changes to the existing land use are expected.

4.13 Habitat assessment

STA contains a variety of potential fauna habitat throughout the training area. The potential habitat around the location of project works include:

- Native grassland – The road design passes through native grassland, dominated by Barbed Wire Grass *(Cymbopogon refractus)*, and other native species. This grassland was commonly used by local kangaroo populations. Grasslands provide habitat for numerous species including birds, for both nesting and foraging, reptiles for foraging and concealment and small marsupials for foraging and concealment. It is noted that there was a very dense population of Cobblers Pegs present throughout the grassland however, due to the season, these were not live at the time of the site visit, allowing for the native herbs and forbs to be seen.
- Creekside vegetation – Dominated by Swamp Oak (*Casuarina glauca*). These locations provide a variety of habitats for threatened and non-threatened species through fallen timber, hollows in stags, waterways and small scattered shrubs and vines. Wombat hollows were noted within habitat area around Mudies Creek (Appendix D).
- Grassy Woodland – Dominated by eucalypt species such as Narrow-leaved Ironbark *(Eucalyptus creba)* and Spotted gum *(Corymbia maculata)* which would not be impacted as part of the works. These woodlands provide numerous hollows of varying sizes, fallen timber, tussock grasses, shrubs and flowering vines.

5 Impact assessment

The impact area of the three bridge projects and the fire trail on TECs are shown in Figure 5-1 to Figure 5-4.

Figure 5-1 Fire Trail impact area

Figure 5-2 Mudies Creek Bridge impact area

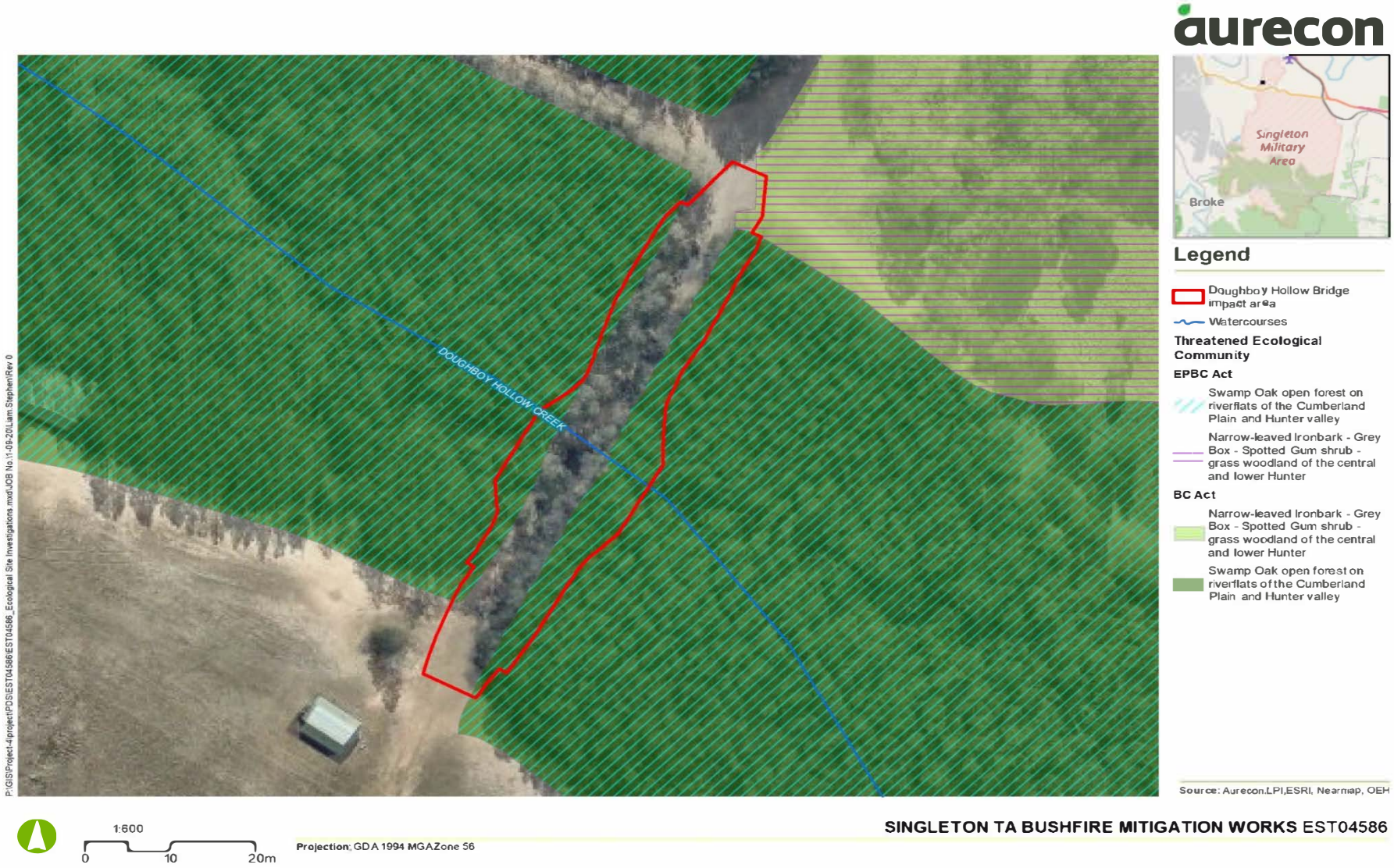

Figure 5-3 Doughboys Hollow Creek Bridge impact area

Figure 5-4 Timber Bridge impact area

5.1 Construction impacts

5.1.1 Removal of native vegetation

The construction of the three new bridges and the fire trail will involve the unavoidable of removal of small areas of native vegetation. The extent and type of vegetation clearance associated with each part of the projects at each location is outlined below and listed in Table 5-1. Figure 5-1 to Figure 5-4 show the impact area in relation to mapped vegetation at each site.

5.1.1.1 Mudies Creek Bridge

The design of the bridge exists almost exclusively within area defined as EPBC and BC Act listed TEC Swamp Oak Floodplain Forest. Approximately 0.3 ha of native vegetation will be potentially impacted in the construction of this bridge.

5.1.1.2 Doughboy Hollow Creek (Single Span Bridge)

The design of the bridge will involve removal of native vegetation in an area defined as EPBC and BC Act listed TEC Swamp Oak Floodplain Forest. Approximately 0.4 ha of native vegetation will be potentially impacted in the development of this bridge.

5.1.1.3 Timber Bridge

The works at timber bridge will remain within existing cleared areas. A few semi-mature eucalypt trees may be required to be removed in order to safely replace the existing structure. Two Salty gums located adjacent to the works have been marked with pink flagging tape, GPS recorded and photographed to ensure they are not removed or disturbed during the works. Approximately 0.0524 ha of native vegetation will be potentially impacted in the construction of this bridge.

Table 5-1 Area of impact for each works area

Site	PCT impacted	Impacted area (ha)	Mapped PCT area within SMA (ha)	% of local population cleared
Mudies Bridge	PCT 1800	0.03	437.27	<0.01%
Timber bridge	No defined PCT	0.024	n/a	n/a
	PCT42	0.052	14.19	0.04%
	PCT 1604	0.0004	217.11	<0.001%
Fire trail construction	Grassland PCT	2.59	4502.24	0.6%
	PCT1800	0.0058	437.27	<0.001%
Single span Bridge	Existing Road	0.049	n/a	n/a
	PCT 1604	0.001	217.11	<0.001%
	PCT 1800	0.039	437.27	<0.01%

Note: Mapped PCT area within SMA values are sourced from SKM, 2012

5.1.2 Removal of threatened fauna habitat

One threatened EPBC listed fauna species, New Holland Mouse (*Pseudomys novaehollandiae*), was potentially observed within the project area, further to this there had been recent, 2020, sightings of Regent Honeyeater to the south of the STA. As such high consideration was placed on the location of any flowering gums and mistletoes.

Additional survey for New Holland Mouse was conducted to determine presence or absence of the species. The results found that the species is not present at the Mudies Creek site (Appendix E – New Holland Mouse Survey). The majority of mistletoes noted within vegetation to be removed is either dead or in poor health. This may be due to an extended drought within the region. An assessment noted two mistletoes at Doughboy Creek and ten at Mudies Creek, with none were recorded within the Timber Bridge project site. Given that mistletoes form only a part of the diet of Regent Honeyeater the removal of 12 mistletoes from the area is not considered as likely to impact the survival of the species.

5.1.3 Removal of threatened flora

Three Slatey Red Gum trees were recorded in the vicinity of Timber Bridge. One is a mature tree which will not be impacted by the works and two are juveniles, all of which have been photographed and tagged to ensure they are protected during works.

No other threatened species were recorded during the survey. Given the bridge works will mostly occur within existing cleared areas and the sites were well surveyed no further threatened species are expected to occur in those areas.

For works constructing the new fire trail safe access was only available to the section east of Mudies Creek, the alignment was walked, and no threatened species were noted. While the western section has not been surveyed, due to live firing events, there are no records of threatened species occurring in the vicinity of the proposed fire trail. If possible, a survey should be conducted prior to works commencing to ensure no threatened forbs occur in that region and to identify the location of woody vegetation within the proximity of the impact area which could possibly be EPBC-listed TEC Narrow-leaved Ironbark – Grey Box – Spotted Gum shrub – grass woodland of the Hunter valley (PCT 1604).

5.1.4 Injury and mortality

Provided standard environmental management mitigation measures are fully implemented, works are not considered likely to result in the injury or death of any threatened flora or fauna. Should the New Holland Mouse be present on-site additional clearing and revegetation methodology will be developed for the protection of the species. As the field survey confirmed that the New Holland Mouse is not present at Mudies Creek, additional clearing and revegetation methodology will not be required for the purposes of the species (Appendix E – New Holland Mouse Survey).

5.2 Indirect/operational impacts

5.2.1 Wildlife connectivity and habitat fragmentation

The existing grassland will be dissected by the fire trail which will generally be 4m wide except where 2m passing bays are located (every 250m) which will increase the road width to 6m. Additionally the turnaround bays which are 8m wide will be located every 500m. This could impede upon wildlife connectivity for smaller species such as lizards, amphibians, small mammals or snakes who may be impacted particularly by lack of vegetative cover increasing the potential for predation rather than moving traffic on the new road.

Although Doughboy Hollow Creek is unlikely to support threatened aquatic populations (such as Murray Cod) the original proposed box culvert bridge design would have had fragmentation concerns for any potential aquatic species. However, the change to a single span bridge design reduces fragmentation concerns and will minimise impacts associated with changes to flow and water quality which would otherwise impact upon downstream receivers.

The new 4.5m bridge being constructed at the Timber Bridge site will be replacing an existing bridge structure, as such it is unlikely to fragment existing habitat any further than it currently is.

Mudies Creek Bridge will involve the development of 2 concrete piles within the embankment. These piles have been designed to be located either side of the existing water level, as such non-flood level water flow will not be impacted upon, minimising the potential for aquatic fragmentation. The creation of the bridge will result in the clearing of 0.03 ha of native vegetation including *Casuarina glaucina* (Swamp Oak). The bridge and access track is approximately 4.5m wide and due the limited amount of use and distance between remaining trees it is considered unlikely to impact terrestrial wildlife connectivity. The access track will be constructed using natural materials which will also reduce the amount of disruption which occurs.

5.2.2 Invasion and spread of weeds

The introduction of invasive weed species has the potential to occur during the construction phase as weeds and pest species are introduced through earthworks, movement of soil and through attachment of seeds to vehicles and machinery.

Mitigation measures to prevent the invasion and spread of weeds are described in Section 6.2 and will be detailed in the Construction Environment Management Plan (CEMP) for these projects.

5.2.3 Invasion and spread of pests

SMA contains known presence of invasive pest species such as feral pigs (*Sus scrofa*), rabbits (*Oryctolagus cuniculus*), wild dogs (*Canis lupus*) and cats (*Felis catus)*. During field surveys evidence of species was found near the works area including rabbit warrens, pig digging sites and sightings of rabbits.

Whilst the construction of the bridge over Mudies Creek may allow increased connectivity for pest species to cross Mudies Creek, it is unlikely to significantly increase invasive populations within the SMA.

5.2.4 Invasion and spread of pathogens and disease

A biosecurity management plan has been previously developed for STA (Cardno, 2016), and provided the requirements of this are incorporated in the CEMP, including that all imported material is clean, then the risk of new pathogens and disease is low.

5.2.5 Noise, light and vibration

During construction fauna may be temporarily disturbed due to increased noise and vibration involved with the operation of machinery and equipment. These potential impacts are expected to be minimised through compliance with the following procedures and guidelines where applicable:

- *AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites*
- The development of a noise and vibration control plan
- NSW Department of Environment and Conservation *Assessing Vibration: A Technical Guideline (2006)*
- NSW Environment Protection Authority (EPA) *Interim Construction Noise Guideline (2009)*

There is not expected to be any significant long-term operational noise and vibration impacts caused by the project.

5.3 Cumulative impacts

These works are limited in nature and while they do require some vegetation removal the remaining areas and existing regeneration are likely to compensate for that removal. No hollow bearing trees are proposed for removal during the site inspection and the number of healthy mistletoe to be removed (<12) is negligible when compared to remaining populations across the STA.

5.4 Assessments of significance

An assessment of significance has been undertaken in accordance with the *Significant impact guidelines 1.1: Matters of National Environmental Significance (Commonwealth of Australia, 2013a)* to determine whether the impacts to EPBC listed TECs are significant enough to warrant further referral. This assessment is detailed in Table 5-2 and Table 5-3.

Due to the limited extent of works, compared to the local and total extent of the TEC, there is not expected to be a significant impact to EPBC listed TECs. As such further referral of the project is not required.

Table 5-2 Assessment of significance for EPBC listed threatened ecological communities

TEC	reduce the extent of an ecological community	fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	adversely affect habitat critical to the survival of an ecological community	modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	cause a substantial reduction in the quality or integrity of an occurrence of an ecological community including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established, or – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community,	interfere with the recovery of an ecological community.
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	The Mudies Creek Bridge, Doughboy Hollow Creek Single Span Bridge and the Fire Trail sites will each only reduce <1% of surrounding vegetation. The total area of PCT 1800 cleared will be 0.0748 ha whilst the total estimated area of EPBC listed Swamp Oak forest is estimated to be 31 950 ha[1]. As such the removal of this vegetation is not expected to significantly reduce the extent of the TEC	The dominant species of the PCT 1800 *Casuarina glauca* (Swamp oak) main form of dispersal is through wind action. As such the introduction of the bridge is unlikely to cause fragmentation	There is no critical habitat that will be impacted as a result of the works	The projects may have the potential to temporarily interrupt surface water flows within creek lines. Doughboy Hollow Creek Single Span Bridge is already a highly modified site with artificial channel structures. The new bridge will be located where previous structure was located and therefore water flows should not be significantly altered. Mudies Creek bridge may have the potential to cause minor a modification in surface water flow actions within the creek with the introduction of piers within the embankment. However, this is considered to be low risk as there are multiple stags and living trees which are located within the main creek channel.	There is not expected to be a substantial change in species composition as a result of the works	Vehicles have the potential to disperse weed species during the construction and operation of the project. As the vehicles entering the area will have navigated via road, the likelihood of this occurring will be minimised. Furthermore, a vehicle wash down point is available at STA and can be used if there are concerns over contaminated vehicles. Chance of pollution has the potential to occur during construction, however mitigation measures detailed in the CEMP should mitigate this	Each site has shown strong signs recovery with regrowth of key species occurring. Although recovery will be limited in the localised area of works, recovery of the surrounding environment is unlikely to be impacted upon.
PCT 1604 - Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions	The Timber Bridge and Doughboy Hollow Creek Single Span Bridge sites will each only reduce <1% of surrounding vegetation. The total area of PCT 1604 cleared will be 0.0014 hectares. As this is only a minor amount, the removal of this vegetation is not expected to significantly reduce the extent of the TEC	The Timber Bridge and Doughboy Hollow Creek Single Span Bridge only impact a very small section on the edge of the mapped community. This is will not cause any additional fragmentation of the community.	There is no critical habitat that will be impacted as a result of the works	The project is not expected to impact abiotic factors that will affect the survival of this community	There is not expected to be any change in species composition as a result of the works	As above	Each site has shown strong signs recovery with regrowth of key species occurring. Although recovery will be limited in the localised area of works, recovery of the surrounding environment is unlikely to be impacted upon.

[1]Department of Agriculture, Water and the Environment: *Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community* http://www.environment.gov.au/biodiversity/threatened/communities/pubs/141-conservation-advice.pdf

Table 5-3 Assessment of significance for EPBC listed fauna species

Species Name	lead to a long-term decrease in the size of an important population of a species	reduce the area of occupancy of an important population	fragment an existing important population into two or more populations	adversely affect habitat critical to the survival of a species	disrupt the breeding cycle of an important population	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	introduce disease that may cause the species to decline	interfere substantially with the recovery of the species
New Holland Mouse[2] *Pseudomys novaehollandiae*	The population at STA has not been recoded as an 'important population'. Should the species be present at Mudies Creek the works are not expected to cause a long-term decrease in the size of the population.	The population at STA has not been recoded as an 'important population'. Should the species be present at Mudies Creek the works will reduce the area of occupancy by under 0.05 of a Ha which is not considered significant.	Should the species be present at Mudies Creek the works will create a divide between the population of approximate 4.5m, which is not considered limiting to dispersal of the species.	The population at STA has not been recoded as an 'important population'. Should the species be present at Mudies Creek the works will reduce the area of occupancy by under 0.05 of a Ha which is not considered significant.	Should the species be present at Mudies Creek the works will create a divide between the population of approximate 4.5m, which is not considered limiting to breeding potential.	Should the species be present at Mudies Creek the works will create a divide between the population of approximate 4.5m, which is not considered limiting to breeding potential.	The proposed works are not considered likely to increase the presence of predators which have already been recorded within the STA.	The proposed works are not considered likely to increase the risk of disease introduction within the STA.	Should the species be present at Mudies Creek the works will create a divide between the population of approximate 4.5m, which is not considered limiting to breeding potential.
Regent Honeyeater *Anthochaera phrygia*	Several individuals of the species were observed within the STA the week prior to the site investigation. None were observed within the vicinity of any proposed works. The proposed works will remove less than 12 mistletoe plants and only two eucalypts trees which may provide foraging habitat. The works are not expected to negatively impact the species.	Several individuals of the species were observed within the STA the week prior to the site investigation. None were observed within the vicinity of any proposed works. The proposed works will remove less than 12 mistletoe plants and only two eucalypts trees which may provide foraging habitat. The works are not expected to negatively impact the species.	Given the highly mobile nature of the species the proposed works will not result in the fragmentation of the population.	The proposed works will remove less than 12 mistletoe plants and only two eucalypts trees which may provide foraging habitat. The works are not expected to negatively impact the species.	The proposed works are located over 100km from the nearest know breeding location, Capertree Valley, therefore they are not expected to impact the breeding cycle of the species.	The proposed works will remove less than 12 mistletoe plants and only two eucalypts trees which may provide foraging habitat. The works are not expected to negatively impact the species.	The proposed works are not considered likely to increase the presence of predators which have already been recorded within the STA.	The proposed works are not considered likely to increase the risk of disease introduction within the STA.	The proposed works are located over 100km from the nearest know breeding location, Capertree Valley, therefore they are not expected to impact the breeding cycle of the species, nor reduce its access to suitable feed sources.

[2] Note: Additional surveys confirmed the New Holland Mouse is not present at Mudies creek (Appendix E – New Holland Mouse Survey). As such, there will be no significant impact on the species.

6 Avoid, minimise and mitigate impacts

6.1 Avoidance and minimisation

The field survey confirmed that STA contains several TECs and whilst the state vegetation mapping was mostly found to be accurate, evidence of regrowth and spread of these TECs was apparent. As such, all trees present (including planted trees) are to be considered part of a TEC. Therefore, any impact to tree species must only occur in defined impact area (as per designs updated July 2020) and minimised within this area where possible.

An area where field surveys were unable to confirm potential impacts is the western end of the new fire trail (west of Mudies Creek), where the impact area is located within close proximity to area defined as the EPBC listed critically endangered TEC *Narrow-leaved Ironbark – Grey Box – Spotted Gum shrub – grass woodland of the Hunter valley* (PCT 1604) (Figure 6-1). Aerial imagery indicates that the extent of this TEC could further than is mapped through state vegetation data, however this was not able to be confirmed in the field due to safe access issues. As such, it is essential works stay within existing track footprint with this area otherwise it will likely impact upon tress defined as TECs.

Should the New Holland Mouse be present additional vegetation clearing requirements will be developed for those areas in line with advice from Dr F. Ford, an expert on the species. As additional surveys determined that the New Holland Mouse is not present, additional vegetation clearing requirements for the species will not be required (Appendix E – New Holland Mouse Survey).

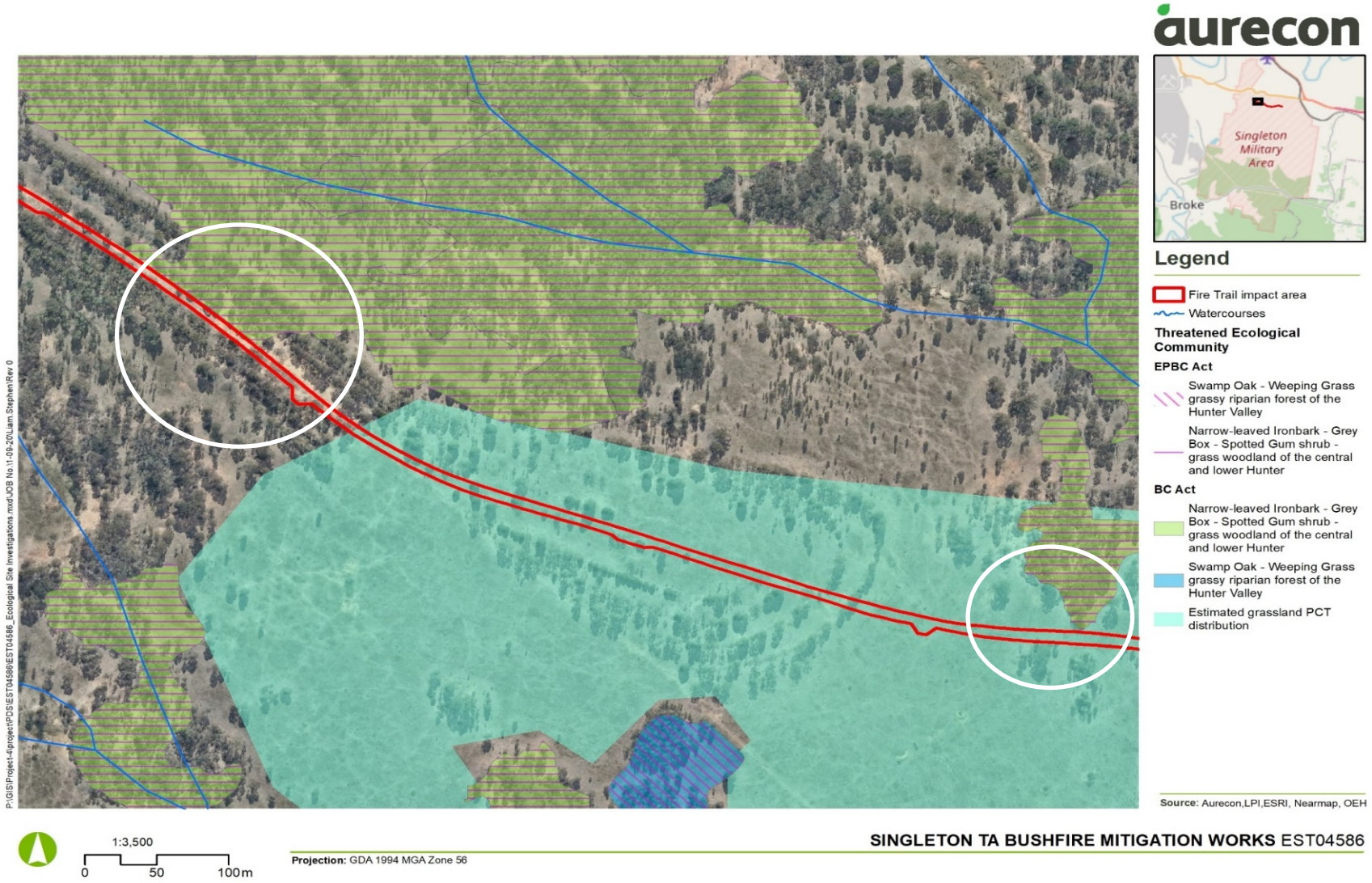

Figure 6-1 Identified key areas to avoid (white circles) at the western end of the fire trail.

(Note: avoidance of native vegetation outside the impact area is not limited to these areas)

6.1.1 Trees to avoid

Three *Eucalyptus glaucina* (Slaty Red Gum) individuals (one mature and two juveniles) are located at the Timber Bridge site. This species is listed as vulnerable under both the EPBC Act and the BC Act and therefore should be protected from the impact of the works. Prior to construction these trees are to be identified and isolated from active works area.

The location of the trees are provided in Figure 5-4 and coordinates are listed in Table 6-1. The juveniles are pictured in Figure 6-2. Whilst the two juveniles are located outside the impact area of the design, the mature individual is located at the edge of the design impact.

An individual *Corymbia maculata* (Spotted Gum) is located on the northeast side of the Timber Bridge within the creek embankment. Although there are no legislative requirements to protect this tree, if possible, impact should be avoided due to the occurrence of scratches of unknown origin which potentially indicates use by fauna species.

Table 6-1 Location of trees to be avoided

Site	Scientific Name	Common Name	Location	Comment
Timber Bridge	*Eucalyptus glaucina*	Slaty Redgum	32º 41.546'S 151º14.613E	Mature redgum on northeast side of bridge adjacent to the boundary fence
Timber Bridge	*Eucalyptus glaucina*	Slaty Redgum	32º 41.549'S 151º14.609E	Two juvenile slaty Redgums on the northwest side of the bridge

Figure 6-2 Two juvenile Slaty Red Gums - located behind person

6.2 Recommended mitigation measures

The following recommendations can reduce both direct and indirect potential impacts of the proposal on biodiversity:

- Should the New Holland Mouse be present additional vegetation clearing and revegetation requirements will be developed for those areas in line with advice from Dr F. Ford of Department of Defence, an expert on the species. As additional surveys determined that the New Holland Mouse is not present, additional vegetation clearing requirements for the species will not be required (Appendix E – New Holland Mouse Survey).
- No clearing or modification of native vegetation is to be undertaken outside of the impact area shown in the maps above
- Threatened Slaty Red Gum tree species at the Timber Bridge site are not to be removed, modified or trimmed, and an adjoining Spotted Gum is also to be retained.
- Any hollow logs encountered should be retained and placed outside area to be cleared
- Clearing is to occur in a manner which allows any fauna present to vacate prior to clearing commencing, this may include 'bumping' of trees prior to felling
- If fauna is observed within the study area during clearing works, works will cease and the animal allowed to move on at its own pace. Alternatively, if the animal is injured or disinclined to leave then a wildlife carer should be contacted
- If any additional threatened flora or fauna species are identified during construction, works should cease until an assessment of the potential impacts is made by a suitably experienced ecologist
- Plant and equipment used during construction will be free from vegetative material and soil that may contain weed seeds or soil-borne diseases prior to entering the site.
- Cleared native vegetation should be mulched and removed from site, except where it can be used for weed suppression or be placed to act as habitat as approved by the RESO.
- Stockpiles and ancillary facilities must be located within already disturbed areas and at least two metres from native vegetation to be retained
- No stockpiling to occur next to waterways
- All temporary access roads and worksites must include temporary and permanent erosion and sediment control measures identified in the 'Blue Book' Vol.2C (DECC 2008) and meet the Department of Defence fire trail construction standards (as detailed in Soil Conservation Service (2017)).
- Vehicles are to keep to existing tracks where possible
- No parking or stockpiling to occur beneath trees
- Effective waste management to occur on site to reduce occurrence of pest species
- Future projects within STA are to consider the cumulative impacts to impacted communities to ensure they are not significantly impacted over the long term through multiple minor impacts

It is recommended that the above mitigation measures be included within a construction environmental management plan (CEMP) to be developed for each site.

7 Conclusion

In summary, the works will result in the removal of 0.0762 ha of EPBC Act listed communities, 0.1282 ha of BC Act listed communities and 2.59 ha of unlisted native grasslands. Due to the limited and localised extent of impact, it is unlikely that any listed TECs or threatened species will be significantly impacted by the works.

Through the application of recommended mitigation measures above, along with appropriate standard environmental controls through the construction phase, impacts to biodiversity are likely to be minimised.

8 References

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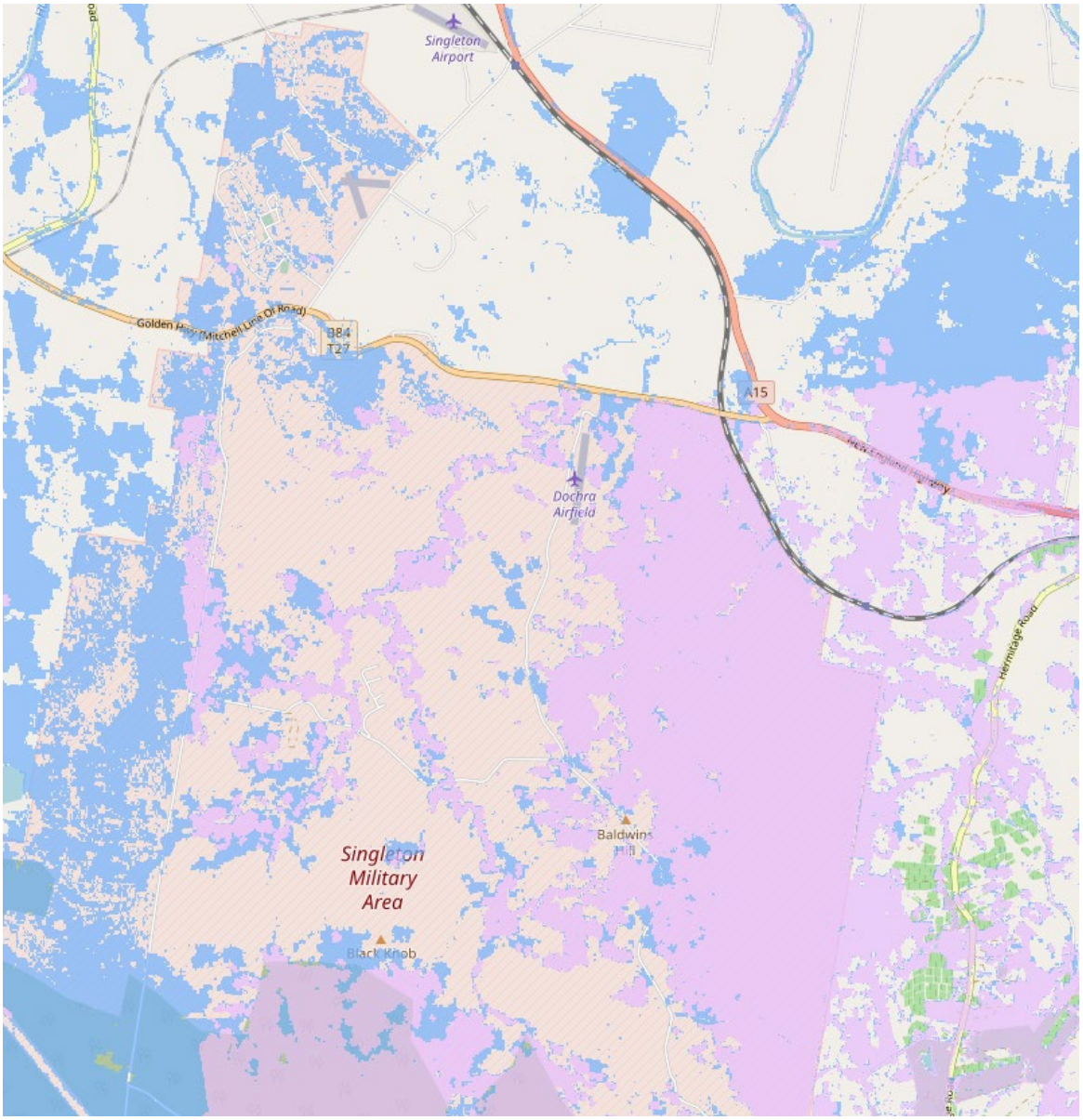
Appendix A – Database search results



Koala habitat protection SEPP mapping

Note: *Pink represents Koala Development application map, whilst Blue indicates site investigation area for Koala plans of management.*

Appendix B – Likelihood of occurrence tables

Species name	Common name	NSW Status	EPBC Status	Records within 10km	Likelihood of occurrence	Rationale for likelihood	Habitat Description
Birds							
Anthochaera phrygia	Regent Honeyeater	CE	CE	Yes: August 2011 Note: the species was found within STA the week prior to field work (August 2020), although report has not been submitted yet	Moderate - High	The species is known to occur within the southern section of the STA as recently as the week prior to field surveys. However, none were sighted at project sites during the field surveys and is unlikely to occur within these areas due to the high mortality of mistletoe at these sites and no suitable flowering trees present.	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes
Botaurus poiciloptilus	Australasian Bittern	E	E	No	Low	Favoured habitat (mainly permanent wetlands) are not present within the study area.	Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (Typha spp.) and spikerushes (Eleocharis spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails.
Calidris ferruginea	Curlew Sandpiper	E	CE	No	Low	No known sightings or suitable habitat found during field surveys	The Curlew Sandpiper is distributed around most of the Australian coastline (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin.

Species name	Common name	NSW Status	EPBC Status	Records within 10km	Likelihood of occurrence	Rationale for likelihood	Habitat Description
Erythrotriorchis radiatus	Red Goshawk	CE	V	No	Low	The study area is located outside the known distribution of the species. However, the mosaic vegetation landscapes of STA and the riparian setting of Mudies creek may provide suitable habitat and food sources for the species.	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers.
Grantiella picta	Painted Honeyeater	V	V	Yes – Jan 1968	Low	Species unlikely to occur within study area as there has been no sightings for over 50 years and preferred mistletoe food source had high mortality where present at each sight However, the box-ironbark forest may still provide suitable foraging habitat.	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema. Insects and nectar from mistletoe or eucalypts are occasionally eaten.
Hirundapus caudacutus	White-throated Needletail	P	V	Yes – Dec 2018	Moderate	Species is known to occur in the area however limited permanent habitat is found within the study area. Area within the grasslands may be used as a foraging area.	White-throated needletail migrates to Australia from October to April from its breeding grounds in central Asia and Southern Siberia. Birds are mostly seen overhead around hilltops and timbered ranges where it feeds on airborne insects and only occasionally roosts in trees.

Species name	Common name	NSW Status	EPBC Status	Records within 10km	Likelihood of occurrence	Rationale for likelihood	Habitat Description
Lathamus discolor	Swift Parrot	E	CE	Yes – August 2017	Moderate to high	Known sightings of the swift parrot are found within STA cantonment and within 4km of the Timber bridge. Dry sclerophyll woodlands of STA may provide suitable habitat, particularly around Timber Bridge site. The survey occurred during migration period, however there was no sightings of the species.	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. Swift Parrots are found in dry sclerophyll forests and woodlands, suburban parks and gardens and flowering fruit trees. They roost communally, often in the same tree each night. They are almost always in trees, only coming to ground to drink.
Numenius madagascariensis	Eastern Curlew	-	CE	No	Low	Unlikely to occur within study area due to absence of preferred habitat such as estuaries, tidal mudflats, sandspits, saltmarshes or mangroves	The Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Eastern Curlews are rarely recorded inland. In NSW the species occurs across the entire coast but is mainly found in estuaries such as the Hunter River, Port Stephens, Clarence River, Richmond River and ICOLLs of the south coast.
Rostratula australis	Australian Painted Snipe	E	E	No	Low	No habitat within the study area to support this species. No records of this species within 10km of the study area	The Australian Painted Snipe is restricted to Australia. Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys.

Species name	Common name	NSW Status	EPBC Status	Records within 10km	Likelihood of occurrence	Rationale for likelihood	Habitat Description
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Yes– July 1999	Moderate	Known sightings of species within 10km and watercourses within study area may provide suitable habitat however the creeks are very narrow with overhead vegetation which is not preferred habitat for the species	Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.
Frogs							
Heleioporus australiacus	Giant Burrowing Frog	V	V	No	Low	No known sightings of the species within 10km, no sightings during field survey. Dry sclerophyll around the Timber Bridge site may provide sufficient leaf litter and pools for species	Distributed in south eastern NSW and Victoria the Giant Burrowing Frog appears to exist in two distinct populations. The northern population is largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla. The southern population occurring from north of Narooma to Walhalla, Victoria. Inhabiting heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. While not breeding the Giant Burrowing Frog burrows below the soil surface or in the leaf litter. Breeding habitat is generally soaks or pools within first or second order streams, also commonly recorded in hanging swamp seepage lines.

Species name	Common name	NSW Status	EPBC Status	Records within 10km	Likelihood of occurrence	Rationale for likelihood	Habitat Description
Litoria aurea	Green and Golden Bell Frog	E	V	No	Low	No sightings within 10km. Proffered habitat of *Typha sp* containing stream sides were found at Mudies Creek and the Timber Bridge site.	Formerly distributed from the NSW north coast near Brunswick Heads, southwards along the NSW coast to Victoria where it extends into east Gippsland. Records from west to Bathurst, Tumut and the ACT region. Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spikerushes (Eleocharis spp.). Optimum habitat includes waterbodies that are unshaded, free of predatory fish such as Plague Minnow (Gambusia holbrooki), have a grassy area nearby and diurnal sheltering sites available.
Litoria booroolongensis	Booroolong Frog	E	E	No	Low	No sightings within 10km. All watercourses are defined as non-perennial and may not provide permanent stream source for habitat.	Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge. Sometimes bask in the sun on exposed rocks near flowing water during summer.

Species name	Common name	NSW Status	EPBC Status	Records within 10km	Likelihood of occurrence	Rationale for likelihood	Habitat Description
Litoria littlejohni	Littlejohn's Tree Frog	V	V	No	Low - moderate	Species or species habitat may occur within area however it has not been recorded to date.	This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath-based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.
Mixophyes balbus	Stuttering Frog	E	V	No	Low	No sightings within 10km. Rainforest habitat not found at study area.	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Feed on insects and smaller frogs. Breed in streams during summer after heavy rain. Eggs are laid on rock shelves or shallow riffles in small, flowing streams.
Mammals							
Chalinolobus dwyeri	Large-eared Pied Bat,	V	V	Yes – April 2005	Moderate to high for foraging habitat	Nearby mine site west of STA provides suitable habitat for bats where there have been numerous records of the species. Study area may be used for foraging as a sighting of the species has been recorded 200m from the Timber Bridge. The Genus was not noted during surveys.	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features.

Species name	Common name	NSW Status	EPBC Status	Records within 10km	Likelihood of occurrence	Rationale for likelihood	Habitat Description
Dasyurus maculatus maculatus (SE mainland population)	Spot-tailed Quoll	V	E	Yes – Jan 2018	Moderate	Several records of the species occurring within a 10km radius of the study area. This species requires large areas of intact vegetation and an array of habitats to source prey. It may utilise the area as part of a large home range as species is known to traverse creek lines. Limited evidence of suitable den habitat (small caves, rock outcrops etc) found near the three sites.	The range of the Spotted-tailed Quoll has contracted considerably since European settlement. It is now found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Only in Tasmania is it still considered relatively common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares. Are known to traverse their home ranges along densely vegetated creeklines.
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	No	Moderate to high	Nyctophilus sp was recorded at site but was not able to be identified to species level without capturing in hand.	Inhabits a variety of vegetation types, including mallee, bulloke Allocasuarina leuhmanni and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark.

Species name	Common name	NSW Status	EPBC Status	Records within 10km	Likelihood of occurrence	Rationale for likelihood	Habitat Description
Petauroides Volans	Greater Glider	-	V	No	Low to moderate	No records of species within 10km. Lack of suitable habitat within the three sites (particularly lack of diversity of eucalypt species and relatively few hollows apparent)	The greater glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. The distribution may be patchy even in suitable habitat. The greater glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species.
Petrogal Penicillata	Brush-tailed Rock-wallaby	E	V	No	Low	No sightings within 10km. Lack of suitable habitat at each of the three sites.	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night when foraging. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)	Koala	V	V	Yes – December 2014	Low to moderate	Species or species habitat known to occur within area Sightings of the species have been recorded within STA. Evidence of koalas such as scat or scratches on feed trees was not found at any of the sites.	Koalas live in eucalypt woodlands and forests. Home range size varies according to quality of habitat, ranging from less than two hectares to several hundred hectares.

Species name	Common name	NSW Status	EPBC Status	Records within 10km	Likelihood of occurrence	Rationale for likelihood	Habitat Description
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	No	Low	No recorded sightings within 10km. Outside of known and expected regional distribution.	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.
Pseudomys novaehollandiae	New Holland Mouse, Pookila	-	V	Yes - June 2005	Moderate to high	Species is known to occur in the southern region of STA. Suitable habitat may be present at the site with small burrows of unknown origin present at Mudies creek.	Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. It is a social animal, living predominantly in burrows shared with other individuals
Pteropus poliocephalus	Grey-headed Flying Fox	V	V	Yes – June 2016	Moderate to High for foraging	Multiple recordings of species within STA. Timber Bridge site contains suitable vegetation for foraging, whilst doughboy hollows creek and Mudies Creek to contain sufficient food sources. No colonies were present at any site during the site visit.	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.
Plants							

Species name	Common name	NSW Status	EPBC Status	Records within 10km	Likelihood of occurrence	Rationale for likelihood	Habitat Description
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	V	V	No	Low	No records within 10km. Was not found during survey. The species is not cryptic so should have been noted if it was present.	Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.
Allocasuarina glareicola	-	E	E	No	Low	No records within 10km, lack of suitable habitat within study area (no Castlereagh woodland), outside of known or predicted regional distribution. Not found during survey.	Grows in Castlereagh woodland on lateritic soil. Found in open woodland with Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla and Melaleuca decora. Common associated understorey species include Melaleuca nodosa, Hakea dactyloides, Hakea sericea, Dillwynia tenuifolia, Micromyrtus minutiflora, Acacia elongata, Acacia brownei, Themeda australis and Xanthorrhoea minor.
Cynanchum elegans	White-flowered Wax Plant	E	E	No	Low	No records within 10km. Not found during survey	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree Leptospermum laevigatum – Coastal Banksia Banksia integrifolia subsp. integrifolia coastal scrub; Forest Red Gum Eucalyptus tereticornis aligned open forest and woodland; Spotted Gum Corymbia maculata aligned open forest and woodland; and Bracelet Honeymyrtle Melaleuca armillaris scrub to open scrub.

Species name	Common name	NSW Status	EPBC Status	Records within 10km	Likelihood of occurrence	Rationale for likelihood	Habitat Description
Eucalyptus glaucina	Slaty Red Gum	V	V	Yes- April 2015	Definite	Species was recorded at Timber Bridge site.	Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils.
Eucalyptus pumila	Pokolbin Mallee	V	V	Yes – July 2018	Low	Only known population located approximately 10km south of the timber bridge. Species was not found during survey.	The single known population occupies north-west-facing slopes derived from sandstone. Present as a mid-canopy species to a height of 6 m within dry sclerophyll woodland which has a canopy comprising Eucalyptus fibrosa, Callitris endlicheri and, to a lesser extent, Corymbia maculata.
Euphrasia arguta	-	CE	CE	No	Low	No records within 10km, species not found during survey	Historic records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers'. Plants from the Nundle area have been reported from eucalypt forest with a mixed grass and shrub understorey; here, plants were most dense in an open disturbed area and along the roadside, indicating the species had regenerated following disturbance.
Persoonia hirsute	Hairy Geebung	E	E	No	Low	No records within 10km, species not found during survey	The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. It is usually present as isolated individuals or very small populations.