

Stratford Mining Complex

Statement of Environmental Effects

APPENDIX E

TERRESTRIAL AND AQUATIC ECOLOGY ASSESSMENT



Stratford Mining Complex Modification: Terrestrial and Aquatic Ecology Assessment

Prepared by AMBS Ecology & Heritage Pty Ltd
for Yancoal Australia Limited

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Recipient:	Mark Jacobs, Yancoal Australia
Authors:	Belinda Pellow, Jemma Sargent, Ulrike Kloecker, Glenn Muir
Approved by:	Glenn Muir

Executive Summary

AMBS Ecology and Heritage Pty Ltd was commissioned by Yancoal Australia Limited to undertake a Terrestrial and Aquatic Ecological Assessment in relation to a Modification to the Stratford Mining Complex. The Modification relates to proposed interactions between the Stratford Mining Complex and a proposed open cut mine, the RHCP, located approximately 5 kilometres (km) north of the Stratford Mining Complex. The proposed interactions principally relate to the processing and transportation of RHCP run-of-mine (ROM) coal using Stratford Mining Complex infrastructure. The Terrestrial and Aquatic Ecological Assessment relates to the southern portion of a haul road within the Stratford Mining Complex mining lease areas (MLs).

The study area is located in the Gloucester local government area approximately 3 km north east of Stratford, New South Wales (NSW).

The Modification would include the extension of on-site haul roads to transport RHCP ROM coal to the Stratford Mining Complex. A portion of the Modification would occur along an already constructed haul road located in ML 1528 and ML 1409. The constructed haul road currently ends within the mine workings of ML 1528. The remaining unconstructed section of the proposed haul road heads east from this point to Wenham Cox Road with the final section heading east from Wenham Cox Road to the eastern edge of ML 1733. Dog Trap Creek traverses ML 1733 and the proposed haul road would cross this creekline. The portions of the haul road within ML 1528 and ML 1409 which consist of an already formed roadway were not assessed for the purposes of this report as there are no additional impacts to flora and fauna expected as a result of the Modification. Impacts associated with the additional portions of the haul road which would be constructed as part of the Modification were assessed for the purposes of this report.

The assessment undertaken for this report was primarily desktop based, utilising data and reports for the Stratford Extension Project and RHCP as well as aquatic data collected at the proposed Dog Trap Creek crossing in 2016. One field survey was undertaken to assess flora, and fauna and aquatic habitat.

The following conclusions have been made regarding the potential impacts of the proposed haul road construction within the study area (i.e. within ML 1733 and ML 1528):

- The vegetation which would be removed by the Modification consists of improved pasture, revegetated mining landscapes and a strip of degraded riparian vegetation.
- Two *Casuarina cunninghamii* (River She Oak) trees occur within the footprint of the proposed haul road extension and would be removed by the Modification.
- No threatened flora, fauna or aquatic species of significance listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or *Fisheries Management Act 1994* (FM Act) have been recorded within the study area and most are unlikely to occur, or likely to occur only as occasional visitors.
- Potential impacts on threatened fauna that may occur within the study area on more than just an occasional basis (such as the Grey-crowned Babbler [eastern subspecies] [*Pomatostomus temporalis temporalis*] and Southern Myotis [*Myotis macropus*]) are limited to the removal of one or two trees and a small area of poor quality habitat.

- There is no potential habitat for threatened flora, and limited potential habitat for threatened fauna and aquatic species listed under the TSC Act, EPBC Act or FM Act within the study area.
- Potential impacts on threatened species, populations or ecological communities are considered to be negligible.
- To minimise impacts to the aquatic environment of Dog Trap Creek, design concepts for the crossing should minimise potential for exacerbating flooding and minimise impacts on the creek bed and banks.
- Best practice erosion and sediment control measures should be used during the construction of the haul road and the creek crossing.

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1 Introduction

1.1 Background

AMBS Ecology and Heritage Pty Ltd (AMBS) was commissioned by Yancoal Australia Limited (Yancoal) to prepare a Terrestrial and Aquatic Ecology Assessment as supporting documentation for a Statement of Environmental Effects (SEE). Stratford Coal Pty Ltd (SCPL), a wholly owned subsidiary of Yancoal, is preparing the SEE to facilitate the modification of the Stratford Extension Project (SSD 4966) under section 96(2) of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) (the Modification).

The existing and approved operations of the Stratford Mining Complex (SMC) incorporates the approved Stratford Extension Project (SSD-4966) (Figure 1). The approved Stratford Extension Project provides for the continuation and extension of open cut coal mining and processing at the SMC and was approved by the NSW Planning and Assessment Commission in May 2015.

The Modification relates to proposed interactions between the SMC and the Rocky Hill Coal Project (RHCP), a proposed open cut mining operation owned by Gloucester Resources Ltd located approximately 5 kilometres (km) north of the SMC. The proposed interactions principally relate to the processing and transportation of RHCP coal using SMC infrastructure.

Changes to the operation of the approved SMC associated with the Modification would involve the extension of on-site haul roads to accommodate RHCP trucks, receipt of coal from the RHCP during daytime hours (7.00 am to 6.00 pm) and the processing and transport of the coal. Given that the majority of the Modification would involve the use of existing infrastructure, any potential impacts on flora and fauna would be associated with the construction of the haul road between the RHCP and the SMC.

A portion of the haul road is located within the approved SMC (over parts of Mining Lease [ML] 1528 and ML 1409) and is already constructed and in use. The constructed haul road currently ends within the mine workings of ML 1528. As a result of the Modification, the constructed haul road would be extended east from the mine workings to Wenham Cox Road, with the final section heading east from Wenham Cox Road to the eastern edge of ML 1733 (Figure 2), where it would join a haul road being constructed by the RHCP. The haul road to be constructed as part of the RHCP is not assessed within this report.

The assessment undertaken for this report focussed on potential impacts from the Modification which may occur where the haul road is extended through the north-east of ML 1528 and across ML 1733 (the study area). The proposed haul road extension would be located in cleared paddocks and has one crossing of Dog Trap Creek (Figure 2).

The following information relates to the construction of the haul road extension:

- The creek crossing would either be a box culvert or prefabricated steel frame bridge.
- The haul road would be comparable in design to a public road, approximately 7 metres (m) wide, with 1.5 m wide unsealed shoulders and road drainage.
- Construction of the haul road would involve areas of cut and areas of fill.
- The haul road within ML 1733 would be sealed.
- The haul road would not require artificial lighting.

1.2 Study Area

The study area is located in the Gloucester local government area approximately 3 km north east of Stratford, New South Wales (NSW) (Figure 2). The proposed haul road construction extends from an existing haul road which ends within the mine workings of ML 1528 (Figure 2). The proposed haul road extension continues east from this point and passes through an area of revegetated mine works to Wenham Cox Road with the final section of the proposed haul road heading east from Wenham Cox Road to the eastern edge of ML 1733 (the study area).

A number of previous surveys and assessments have been undertaken in the vicinity of the study area. These surveys and assessments have therefore been used to inform the preparation of this report. It is assumed that the reports and data provided are accurate and correct and AMBS takes no responsibility for the comprehensiveness or accuracy of data collected or reports prepared by other parties.

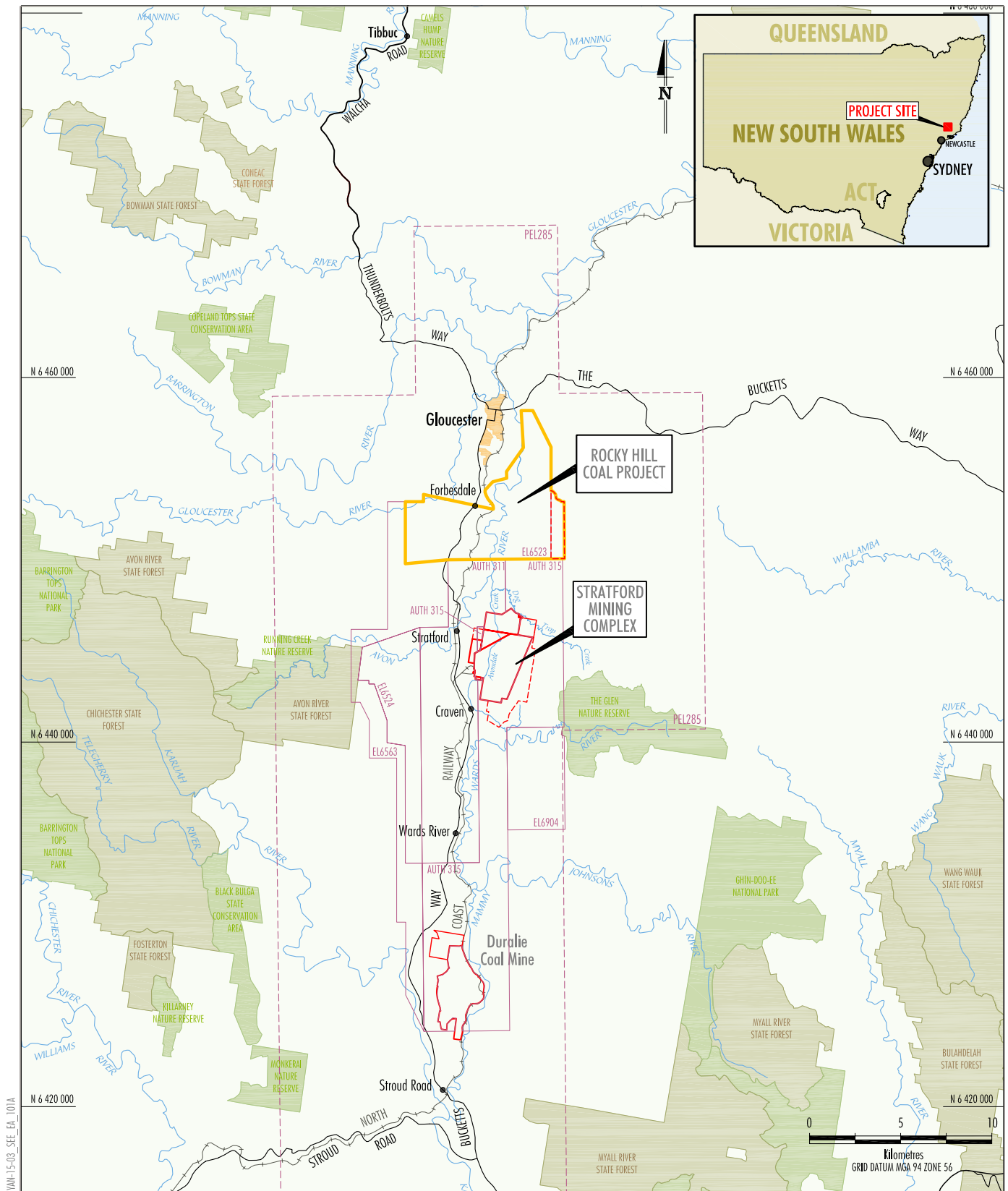
1.3 Definitions

Some common terms used in this report are defined below.

The **study area** is defined in this report as the area that was surveyed by AMBS for the purpose of this assessment (Figure 2).

The **locality** is defined as the 10 km area outside the study area.

Significant is defined as “important, notable or of consequence having regard to its context or intensity”.



2 Methodology

2.1 Desktop Assessment

A desktop assessment reviewed previous reports and vegetation mapping relevant to the survey area. These included:

- Stratford Extension Project Flora Assessment (FloraSearch 2012).
- Stratford Extension Project Terrestrial Fauna Assessment (AMBS 2012).
- Stratford Extension Project Fauna Survey Report (EcoBiological 2011a).
- Stratford Extension Project Aquatic Ecology Assessment (frc environmental 2012).
- Dog Trap Creek Water Quality and Habitat Assessments collected in February 2016 by Cardno (Cardno 2016).
- Rocky Hill Coal Mine Proposal - Supplementary Ecological Assessment of Potential Haul Road Corridor (Biosis Pty Ltd 2015).
- Gloucester Valley Terrestrial Fauna Survey (AMBS 2011).
- Stratford Coal Mine New Holland Mouse Targeted Survey Programme (EcoBiological 2011b).
- Stratford Coal Mine Arboreal Mammal Targeted Survey Programme (EcoBiological 2011c).
- Stratford Coal Mine New Holland Mouse (*Pseudomys novaehollandiae*) Targeted Survey Programme (Kerle 2011).

The NSW Government BioNet portal (Office of Environment and Heritage [OEH] 2016a) and the *Threatened Species Profiles* database (OEH 2016b) were accessed to obtain information on species and communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act). BioNet provides information via the Atlas of NSW Wildlife, and records of threatened entities within a 10 km radius of the study area were downloaded (OEH 2016a). The Department of the Environment's (DotE) *Protected Matters Search Tool* (DotE 2016a) was also used to search for relevant Matters of National Environmental Significance (threatened species, populations and ecological communities and migratory species listed on the *Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act]) within a 10 km radius of the study area.

Database searches for aquatic threatened species included a search of the NSW Fisheries' *Threatened and Protected Species* database as well as the EPBC *Protected Matters Search* (DotE 2016a) and *BioNet Atlas of NSW Wildlife* search (OEH 2016a) described above. The information from previous reporting and database searches was used to guide the aquatic habitat assessment.

2.2 Survey Techniques and Effort

2.2.1 Terrestrial Ecology

Flora

Previous studies of the flora in the surrounds of the proposed haul road and the wider region included FloraSearch (2012), which mapped the vegetation within the study area including along Dog Trap Creek. The study by FloraSearch (2012) stated that "the level of flora survey for the Project has exceeded the minimum survey effort prescribed in the OEH biodiversity survey guidelines".

A field survey of the study area was undertaken on 18 April 2016 by botanist Belinda Pellow and ecologist Chantelle Doyle. The area surveyed was primarily within ML 1733 (Figure 2). The survey covered all of the study area within ML 1733 and was sufficient to identify plant species and vegetation communities present at the time of the survey. The eastern section of the study area within ML 1528 was also inspected to confirm the area was mine revegetation.

The study area was surveyed by walking parallel transects along the proposed haul road corridor. Notes were made on the flora, vegetation and fauna habitat present.

Any significant features i.e. noxious weeds, tree hollows, mature trees were recorded using a hand held GPS.

A flora species list was compiled for the preparation of vegetation community descriptions.

Fauna

Considerable fauna survey effort has been undertaken previously in the surrounds of the proposed haul road and the wider region for RHCP and SMC (Section 2.1). These surveys have documented the threatened species likely to occur within the vicinity of the study area. This report relies on this previously collected data.

The Terrestrial Fauna Assessment for the Stratford Extension Project (AMBS 2012) documents the survey effort that has previously been undertaken for fauna in and around the SMC. The majority of field surveys were performed between 2007 and 2010 by EcoBiological (EcoBiological 2011a). Fauna survey work was designed with reference to the relevant NSW and Commonwealth guidelines. Fauna surveys were performed using standard techniques and other than a few minor exceptions, survey effort was generally more than the minimum recommendations of the OEH guidelines (DEC 2004). Survey techniques included: Elliot traps (A, B, ground and arboreal), cage traps, hair tubes (ground and arboreal), spotlighting, harp traps, Anabat bat detection system, diurnal bird surveys, owl-call playback, opportunistic encounters, and frog and reptile searches.

A site inspection and habitat assessment was undertaken by AMBS on 18 April 2016 to ground-truth the current condition of fauna habitat within the study area and assess the nature and extent of habitat features that may be used by threatened fauna known to occur in the vicinity.

2.2.2 Aquatic Ecology

Previous surveys have been conducted which describe the aquatic ecology values of the study area (frc environmental 2012, Cardno 2016). Most recently, Cardno (2016) sampled two sites within close proximity to each other within the study area, where the proposed haul road crosses Dog Trap Creek. The site location details are provided in Table 2.1 and in Figure 3.

Table 2.1: Cardno (2016) Survey Site Locations

Site name	Site Code(s)	Site Description	Easting	Northing
Dog Trap Creek	DT1 and DT2	Proposed haul road crossing	403864	6446728



YAW-15-03_SEE_EA_2038

- | | |
|--|--|
| <p>LEGEND</p> <p> Mining Lease Boundary</p> <p> Study Area</p> <p> Indicative Proposed Private Haul Road Boundary</p> <p> Indicative Private Haul Road Alignment including Road Shoulders</p> <p> Approved Wenham Cox Road Realignment (Indicative)</p> <p> Aquatic Survey Site (Cardno 2016)</p> | <p>Vegetation Mapping</p> <p> Degraded Riparian Vegetation</p> <p> Improved Pasture</p> <p> Revegetated Mine Workings</p> |
|--|--|



STRATFORD MODIFICATION 1

Vegetation of the Study Area
and Location of Aquatic Survey Site

Source: LPI (2016); Geoscience Australia (2006); NSW Department of Industry (2016); SCPL (2016); GTA (2016); Cardno (2016)

Figure 3

Water Quality

In situ water quality sampling was undertaken on 2 February 2016 by Cardno (2016) using the following methods. A hand held Hydrolab QUANTA multi-parameter water quality probe at two locations in the study area on Dog Trap Creek (Site codes DT1 and DT2 [Table 2.1]). Water quality readings were recorded at surface and depth, twice at each location. The water quality results were analysed against the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Environment and Conservation Council [ANZECC] 2000), for aquatic ecosystems: default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems: Lowland Rivers.

Habitat Assessments

Habitat assessments were conducted by Cardno (2016) on 2 February 2016 and by AMBS on 18 April 2016 to assess the nature and condition of the aquatic habitat present and to determine the potential for the creek crossing and its surrounds to support threatened species listed under the EPBC Act, TSC Act or *Fisheries Management Act 1994* (FM Act).

The habitat assessments were undertaken using a modified Riparian, Channel and Environmental Inventory (RCE) (Chessman et al. 1997) (Appendix D). The RCE provides a standardised descriptor of aquatic habitats, which are scored based on quality and integrity. The scores for each descriptor are summed to determine an RCE ranking of aquatic habitat quality. The maximum score of 52 indicates a stream that is without any obvious alterations from its natural condition and the lowest RCE score of 13 indicates a stream that is heavily impacted upon and retains very few natural features.

An assessment of fish habitat using classification criteria for watercourses (Table 2.2; Fairfull and Witheridge 2003) was undertaken by Cardno (2016) at the creek crossing to determine the fish habitat classification of Dog Trap Creek.

Assessment on fish species present is based on images provided by Cardno (2016). Information on method of catch and numbers was not included.

Table 2.2: Waterway Classifications (Source: Fairfull and Witheridge, 2003)

Classification	Characteristics of Waterway Type
Class1: Major fish habitat/ Highly sensitive key fish habitat	Major permanently or intermittently flowing waterway (e.g. river or major creek); habitat of a threatened fish species or critical habitat. Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 millimetres (mm) in two dimensions, snags greater than 300 mm in diameter or 3 m in length, or native aquatic plants.
Class 2: Moderate fish habitat/ Moderately sensitive key fish habitat	Named permanent or intermittent stream, creek or waterway with clearly defined bed and banks and semi-permanent or permanent waters in pools or in connected wetland areas. Marine or freshwater aquatic vegetation is present. Known fish habitat and /or fish observed inhabiting the area. Freshwater habitats and brackish wetlands, lakes and lagoons other than those defined in TYPE 1. Weir pools and dams up to full supply level where the weir or dam is across a natural waterway.
Class 3: Minimal fish habitat/ Minimally sensitive key fish habitat	Name or unnamed waterway with intermittent flow and potential refuge, breeding or feeding areas for some aquatic fauna (e.g. fish, yabbies). Semi-permanent pools from within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or recognised aquatic habitats. Coastal and freshwater habitats not included in TYPES 1 or 2. Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation.
Class 4 Unlikely fish habitat	Named or unnamed waterway with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free standing water pools after rain events (e.g. dry gullies or shallow floodplain depressions with no permanent aquatic flora present).

2.3 Limitations

The assessment for fauna and aquatic impacts was primarily based on a desktop assessment of previous reports that covered a larger area than the area which is the subject of this assessment. Substantial survey effort recording the fauna in the vicinity of the SMC has previously been undertaken and therefore additional targeted fauna surveys were not undertaken for this assessment. The results of previous surveys and the habitat assessment undertaken for this assessment are considered sufficient for the purposes of this report.

The flora survey was sufficient to identify the vegetation communities and plant species present at the time of the survey. The survey was undertaken in Autumn, and so some plant species that occur within the study area, but are difficult to detect in Autumn, may not have been recorded. However, no threatened plant species that are difficult to detect in Autumn are likely to occur within the study area.

3 Results

3.1 Desktop Assessment

3.1.1 Terrestrial Ecology

Flora

A review of the previous flora report prepared for the study area (FloraSearch 2012) identified the following plant communities as occurring: *River Oak Riparian Woodland of the North Coast and Northern Sydney Basin*, and unmapped introduced pasture and scattered native trees. FloraSearch (2012) recorded no threatened flora species or threatened ecological communities during surveys conducted in 2012.

Fauna

Previous fauna surveys conducted in the locality were extensively reviewed by AMBS (2012) for the Stratford Extension Project. In summary, the majority of the fauna surveys were undertaken between 2007 and 2010 by EcoBiological (2011a), with survey efforts that generally exceeded the minimum recommendations of the OEH guidelines (DEC 2004). Various additional surveys, including targeted surveys for the New Holland Mouse (*Pseudomys novaehollandiae*), arboreal mammals and threatened frogs were performed during 2010 and 2011 by various ecological consultants (AMBS 2011; Kerle 2011; EcoBiological 2011b and c). A habitat assessment for the Koala (*Phascolarctos cinereus*) was undertaken in 2008.

A review of studies previously conducted in the surrounds of the study area as well as a search of the BioNet database (OEH, 2016a) and the EPBC *Protected Matters Search* (DotE 2016a) identified a list of threatened and migratory species that have been recorded or are considered to have potential to occur in the study area or immediate surrounds (Appendix A). The review identified three threatened species of frog, 23 threatened species of bird, 18 threatened species of mammal and one species of threatened reptile that could potentially occur in the vicinity of the study area. The likelihood that these species would occur within the study area itself and/or be impacted by the proposed Modification was assessed following the site visit and the results are presented in Appendix A. In addition, 14 species of migratory bird could potentially occur in the vicinity of the study area. These are listed in Appendix A together with an assessment of whether the study area contains important habitat for these species.

Aquatic Ecology

The aquatic assessment specifically reviewed the Stratford Extension Project Aquatic Ecology Assessment (frc environmental 2012), which included aquatic flora and fauna surveys of a site on Dog Trap Creek approximately 700 m downstream of the study area. Aquatic ecology surveys (water quality, macroinvertebrates and fish) have been undertaken at this site from 2000-2010 (frc environmental 2012). Water quality, habitat and fish data collected in the study area from two locations at the creek crossing by Cardno (2016), was analysed for this assessment.

3.2 Field Survey Results

The following field survey results were obtained in the study area where the haul road would be constructed.

3.2.1 Terrestrial Ecology

A total of 17 native flora species and 22 exotic flora species were recorded. A list of flora species recorded is provided in Appendix C. Nomenclature for flora species follows that of PlantNet (2016).

The flora of the study area consists primarily of exotic species with remnant *Eucalyptus amplifolia* (Cabbage Gum) and *Casuarina cunninghamii* (River She Oak) occurring occasionally over pasture.

Scattered occurrences of *Eucalyptus amplifolia* and a row of *Araucaria bidwillii* (Bunya Pine) were observed outside of the study area.

The Noxious weeds recorded are primarily associated with Dog Trap Creek and include *Salix fragilis* (Crack Willow), *Xanthium occidentale* (Noogoora Burr) and *Ligustrum sinense* (Small-leaved Privet). *Senecio madagascariensis* (Fireweed) was recorded across the area of Improved Pasture within the study area.

The creekline within the study area supported aquatic and terrestrial native species such as *Ludwigia peploides* (Floating Primrose), *Schoenoplectus pungens* (Sharp Club-rush), *Vallisneria australis* (Ribbonweed), *Paspalum distichum* (Water Couch), *Potamogeton sulcatus* (Pondweed), *Persicaria hydropiper* (Water Pepper), *Persicaria subsessilis* (Hairy Knotweed), *Ranunculus plebeius* (Forest Buttercup), *Commelina cyanea* (Native Wandering Jew) and the fern *Arthropteris beckleri*.

3.2.2 Aquatic Ecology

Water Quality

The water quality data indicates that the creek crossing on Dog Trap Creek, within the study area, support *in situ* water quality levels that fall outside the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) for all variables (Table 3.1). Water quality data from the sample locations presented:

- levels of electrical conductivity well above the guideline range, indicating saline conditions;
- slightly lower levels of pH than the guideline range, indicating slightly sodic conditions;
- dissolved oxygen levels below the guideline range, indicating depressed levels of oxygen levels in the system during no flow conditions; and
- low turbidity levels, indicating the silt benthos was not suspended during no flow conditions.

Table 3.1: Dog Trap Creek Water Quality Results

Site	Site Code	Depth	Time	Replicate	Temp (°C)	EC (µS/cm)	pH	Turbidity (NTU)	DO % saturation
ANZECC Guidelines					na	125-2200	6.5-8.5	6-50	85-110
Dog Trap Creek, 1	DT1	Surface	7:45	1	21.16	3446	6.45	2.6	47.0
				2	21.16	3462	6.41	2.6	44.8
		Bottom	7:45	1	21.16	3459	6.39	2.6	44.2
				2	21.16	3459	6.39	2.6	43.9
Dog Trap Creek, 2	DT2	Surface	7:55	1	21.20	3507	6.43	2.6	51.6
				2	21.20	3505	6.43	2.6	47.8
		Bottom	7:55	1	21.18	3480	6.29	2.5	42.3
				2	21.19	3493	6.06	2.4	38.7

Note: Results presented in red indicate results that fall outside the ANZECC Guideline trigger value ranges.
na = not applicable, °C = degrees Celcius, µS/cm = microsiemens per centimetre, NTU = nephelometric turbidity unit, DO = dissolved oxygen

Flow Regime

No streamflow information is available for Dog Trap Creek. Anecdotal evidence suggests the creek has similar flow patterns to Avondale Creek and may be regarded as ephemeral with less flow persistence, given its catchment comprises a higher proportion of timbered area and less flat, swampy terrain than the lower reaches of Avondale Creek (Hydro Engineering & Consulting, 2016).

Fish

Previous surveys identified the exotic Eastern Gambusia (*Gambusia holbrooki*) comprised 100% of the community sampled at Dog Trap Creek (frc environmental 2012). Eastern Gambusia is declared as noxious under the FM Act, and is considered a pest by Department of Primary Industries (DPI) - Fisheries (DPI Fisheries 2016). The recent surveys undertaken by Cardno (2016) identified Gambusia as being present at the creek crossing in addition to the commonly occurring Striped Gudgeon (*Gobiomorphus australis*) and an introduced Goldfish (*Carassius auratus*) (Plate 1).



Plate 1: Fish collected at Dog Trap Creek crossing: Eastern Gambusia, Striped Gudgeon and Goldfish

3.3 Habitat Types, Condition and Features

3.3.1 Terrestrial

Vegetation surveys undertaken for the Stratford Extension Project (FloraSearch 2012) mapped *River Oak Riparian Woodland of the North Coast and Northern Sydney Basin* as occurring along Dog Trap Creek. The current field survey found a highly disturbed version of this community occurs to the south of the study area. To the north of the study area *Casuarina cunninghamii* (River She Oak) trees occur adjacent to Dog Trap Creek but the understorey is highly degraded and consists mainly of exotic species.

The proposed haul road extension passes through three disturbed vegetation types (Figure 3):

1. Revegetated mine workings;
2. Improved pasture; and
3. Degraded riparian vegetation.

Revegetated Mine Works

This vegetation type is located in ML 1528 and consists of stabilised slopes with seeded cover crop and planted native species (Plate 2). It provides minimal habitat features for fauna with no trees established and few shrubs occurring.



Plate 2: Revegetated slope within ML 1528 (background) and improved pasture (foreground).

Improved Pasture

This vegetation type consists primarily of exotic species such as *Pennisetum clandestinum* (Kikuyu), *Digitaria ciliata*, *Paspalum dilatatum* (Paspalum), *Trifolium repens* (White Clover), *Trifolium fragiferum* (Strawberry Clover), *Hypochaeris radicata* (Dandelion), *Senecio madagascariensis* (Fireweed), *Sida rhombifolia* (Paddys Lucerne), *Verbena bonariensis* (Purple Top), and *Cirsium vulgare* (Thistle) (Plate 3). Only one native species was recorded, the forb *Centella asiatica* (Indian Pennywort).

This vegetation type is not native and contains little or no features that would provide suitable habitat for the majority of the threatened fauna likely to occur in the locality.



Plate 3: Typical improved pasture vegetation that makes up the majority of the study area.

Degraded Riparian Vegetation

Vegetation associated with Dog Trap Creek within the study area consists of a few remnant *Casuarina cunninghamii* (River She Oak) trees with an understorey of exotic and some native species. Exotic species include *Solanum mauritianum* (Wild Tobacco Bush), *Pennisetum clandestinum* (Kikuyu), *Paspalum dilatatum*, *Trifolium repens* (White Clover), *Sida rhombifolia* (Paddys Lucerne), *Verbena bonariensis*, *Cirsium vulgare* (Thistle), *Salix fragilis* (Crack Willow), *Xanthium occidentale* (Noogoora Burr) and *Ligustrum sinense* (Small-leaved Privet). A few natives occur including *Lomandra longifolia*, *Persicaria hydropiper*, *Arthropteris beckleri*, *Commelina cyanea*, *Carex appressus* (Tall Sedge), *Geranium homeanum* and *Ranunculus plebeius* (Plates 4 to 7).

The vegetation is in poor condition. Two *Casuarina cunninghamii* trees fall within the footprint of the proposed haul road extension, including one tree with hollows and one small tree that does not have hollows (Figure 4).



Plate 4: River flat within the study area associated with Dog Trap Creek.



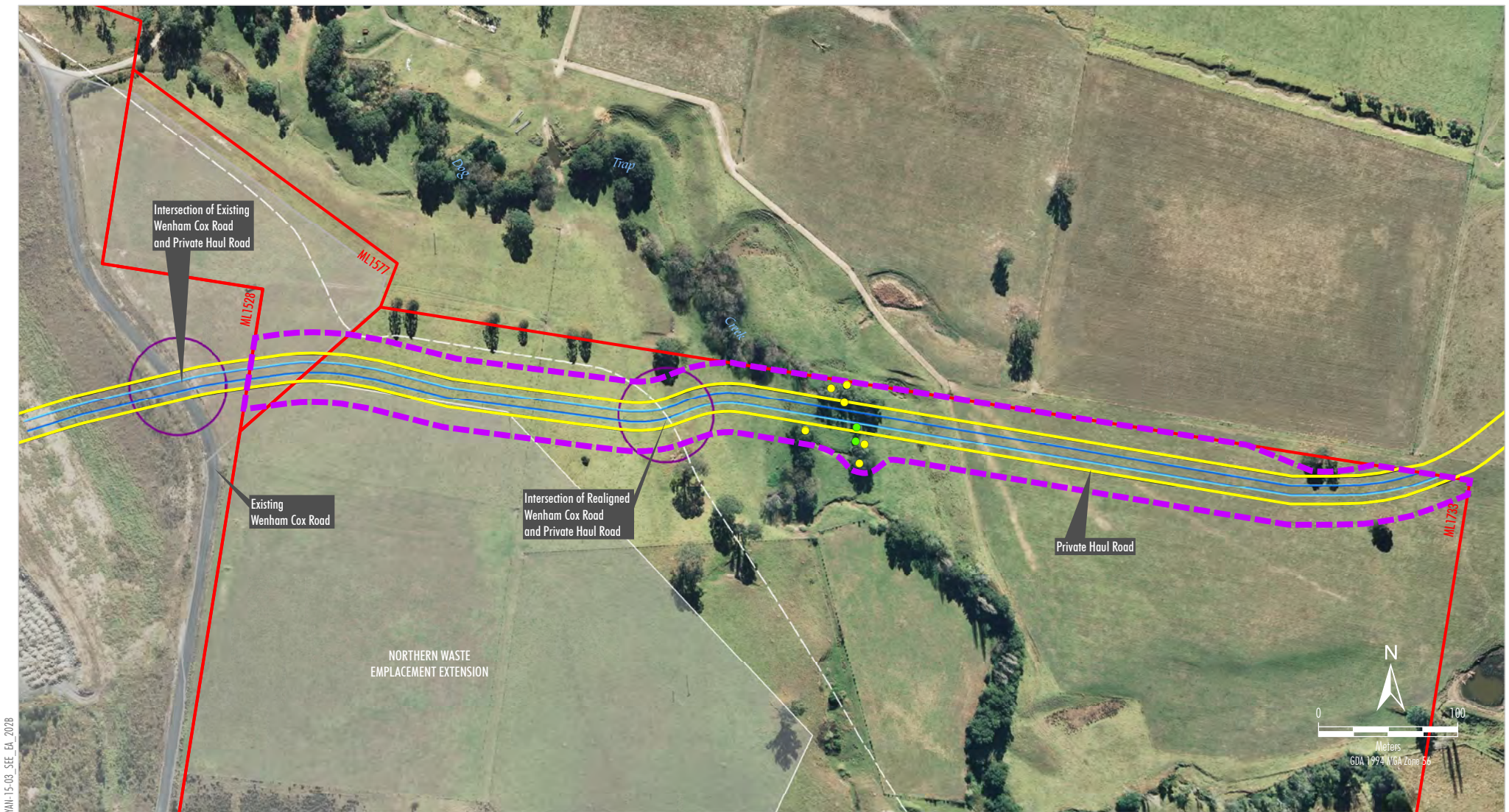
Plate 5: Looking north along Dog Trap Creek, tree in foreground to be removed, trees in background to remain.



Plate 6: Looking south along Dog Trap Creek. Casuarina in mid ground on edge of study area.



Plate 7: Looking west across Dog Trap Creek along proposed haul road corridor.



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- LEGEND**
- Mining Lease Boundary
 - Study Area
 - Type of Tree**
 - *Casuariana* with hollow
 - *Casuariana* without hollow
 - Indicative Proposed Private Haul Road Boundary
 - Indicative Private Haul Road Alignment including Road Shoulders
 - Approved Wenham Cox Road Realignment (Indicative)



STRATFORD MODIFICATION 1

Location of Hollow-bearing Trees

Source: LPI (2016); Geoscience Australia (2006); NSW Department of Industry (2016); SCPL (2016); GTA (2016);

Figure 4

3.3.2 Aquatic

Habitat assessments were undertaken by AMBS at three locations on Dog Trap Creek; upstream of the creek crossing (Plate 8), the creek crossing (Plate 9) and downstream of the creek crossing (Plate 10).

At all locations, Dog Trap Creek is associated with cleared pasture land use with a narrow (<5 m) riparian buffer composed of exotic and native trees and shrubs that shade some sections of the creek. The instream habitat upstream, downstream and at the creek crossing on Dog Trap Creek is composed of a benthic substrate, dominated by silt, with no flow conditions. The creek crossing is bounded by two large deep pools of standing water upstream and downstream (2-3 m depth). At the creek crossing the creek is shallower in depth (up to 1.5 m depth) and the channel of water is up to 2 m wide. The banks are steep and stable and are well vegetated by herbs and grasses, with occasional trees and shrubs. There is little undercutting.

Macrophytes are present within the creek crossing and downstream including: *Ludwigia peploides* (Floating Primrose), *Schoenoplectus pungens* (Sharp Club-rush) *Vallisneria australis* (Ribbonweed), *Paspalum distichum* (Water Couch), and *Potamogeton sulcatus* (Pondweed). Some filamentous algae were present in the upstream and downstream pools. The available aquatic habitat is limited to trailing bank vegetation, some detritus, depth variation, with the upstream and downstream pools, and some macrophytes.

The aquatic ecosystem of Dog Trap Creek has previously been assessed by frc environmental (2012), as having moderate value in regard to aquatic flora and fauna primarily due to the ephemeral and intermittent nature of the waterway, poor streamside cover, limited depth and some bank erosion. The edge habitat of Dog Trap Creek was also assessed in 2012 by frc environmental as having shown improvement since 2010. It supported moderate to high levels of macroinvertebrate communities likely due to the overhanging vegetation and sand/gravel benthic composition at the stream edges (frc environmental 2012).

The RCE score for Dog Trap Creek at the creek crossing was 38 (Cardno 2016) and 29 (this study) indicating relatively limited levels of aquatic habitat quality to support communities (frc environmental 2012).

The fish habitat supported by Dog Trap Creek was determined by Cardno (2016) to be Class 2 – Moderate fish habitat (Table 2.2). Streams that fall into this category are classed as permanent or intermittent stream, creek or waterway with clearly defined bed and banks and with semi-permanent to permanent waters in pools or in connected wetland areas (Cardno 2016). Marine or freshwater aquatic vegetation is present. Fish habitat is known to occur as fish were observed within the creekline (Cardno 2016).

Dog Trap Creek drains the forested escarpment area to the east and flows westward into Avondale Creek. The following description of the creek is provided by frc environmental (2012):

During normal flow conditions, the stream is fast flowing with a coarse sand and gravel substrate on a clay base. The downstream area of Dog Trap Creek is heavily impacted by cattle grazing and has a minimal riparian zone consisting mainly of Eucalyptus and Casuarina species. The stream banks and bed are impacted by cattle activity, with areas of bank erosion.



Plate 8: Upstream of the study area.



Plate 9: The study area.



Plate 10: Downstream of the study area.

3.4 Threatened Species, Populations and Ecological Communities Recorded or Predicted to Occur

3.4.1 Terrestrial

Threatened Flora

The database searches identified eight threatened flora species that have previously been recorded within 10 km of the study area (Appendix B). Of these, three species have been recorded within 5 km of the study area (Table 3.2). All three species occur to the south of the study area in stands of remnant vegetation. None of these species or their potential habitat were recorded in the study area.

No threatened flora populations have been recorded within the study area, or within the locality.

Table 3.2: Threatened Flora Species Recorded within 5 km of the Study Area

Scientific Name	Common Name	Habitat (OEH 2016a)	Distance of Closest Species Record from Study Area
<i>Eucalyptus largeana</i>	Craven Grey Box	Wet forest on sloping sites	3.5 km
<i>Syzygium paniculata</i>	Magenta Lilly Pilly	Mainly found in remnant stands of littoral rainforest	3.5 km
<i>Pomaderris queenslandica</i>	Scant Pomaderris	Moist eucalypt forest with shrubby understorey	1.5 km

Threatened Ecological Communities

River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions is listed as an Endangered Ecological Community (EEC) under the TSC Act and is known to occur on some river flats within the wider region (OEH, 2016b). The vegetation of the study area has been cleared and replaced with improved pasture. This EEC was not found to occur on the flats associated with Dog Trap Creek that fall within or near the study area. These findings are consistent with surveys conducted by FloraSearch (2012) on the study area.

Lowland Rainforest of Subtropical Australia is listed as a Critically Endangered Ecological Community (CEEC) under the EPBC Act and is known to occur in the wider region (DotE, 2016b). The vegetation of the study area has been cleared and replaced with improved pasture. This CEEC was not found to occur within or near the study area.

Threatened Fauna

An assessment of the likelihood of threatened fauna occurring within the study area is considered in Appendix A. No threatened fauna have been recorded within the study area. The study area and surrounds have been either completely, or almost completely, cleared of potential habitat for most of these species. The habitat features that do occur are mainly along Dog Trap Creek and are in poor condition. As such, the study area is not likely to be utilised by most threatened fauna, with the exception of the Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) and possibly the microbat Southern Myotis (*Myotis macropus*) (both listed as Vulnerable under the TSC Act), although individuals of some other threatened species may occur as occasional visitors. The Grey-crowned Babbler (eastern subspecies) is known to occur in the vicinity and could potentially utilise the degraded riparian vegetation along Dog Trap Creek. The Southern Myotis occurs in habitats near water and therefore has potential to occur within the study area, although it usually occurs in areas that are vegetated rather than cleared (Churchill 2008). Examples of other threatened species that could occur on occasion are owls, some diurnal birds and some microbats.

3.4.2 Aquatic

Two listed aquatic species were returned by the database searches conducted for the wider region which incorporates the study area (Section 2.1), namely: the fish species Macquarie Perch (*Macquaria australasica*), which is listed as Endangered under the EPBC Act and FM Act; and the insect species Adam's Emerald Dragonfly (*Archaeophya adamsi*), which is listed as Endangered under the FM Act. Neither species has been recorded within the study area. The habitat present at the creek crossing on Dog Trap Creek and upstream and downstream provides only limited potential habitat for the Macquarie Perch and no habitat for the Adam's Emerald Dragonfly (Table 3.3).

No aquatic species listed under the TSC Act, EPBC Act or FM Act have been recorded during previous surveys of Dog Trap Creek or its surrounds (frc environmental 2012; Cardno 2016).

Table 3.3: Threatened Aquatic Species Habitat within the Study Area

Scientific Name	Common Name	Status			Habitat and Water Quality Requirements	Habitat Present within Study Area
		EPBC Act	TSC Act	FM Act		
<i>Macquaria australasica</i>	Macquarie Perch	Endangered	-	Endangered	The Macquarie Perch is a riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks. Spawning occurs just above riffles (shallow running water). Populations may survive in impoundments if able to access suitable spawning sites.	Limited habitat is present upstream, downstream or within the study area.
<i>Archaeophya adamsi</i>	Adam's Emerald Dragonfly	-	-	Endangered	The Adam's emerald dragonfly inhabits narrow, shaded riffle zones with moss and abundant riparian vegetation (often closed canopy) in small to moderate sized creeks with gravel or sandy bottoms.	No habitat present upstream, downstream or within the study area.

4 Impact Assessment

4.1 Potential Impacts on Terrestrial Ecology

4.1.1 *Threatened Species, Populations and Ecological Communities Recorded or Predicted to Occur*

No threatened plant species or populations were considered likely to occur within the study area (Appendix B) and the study area does not contain any threatened ecological communities. Habitat for threatened fauna within the study area is either absent, or is extremely limited in extent and in poor condition (Appendix A). The vast majority of threatened fauna with potential to occur in the vicinity of the study area are considered unlikely to occur within the study area, except perhaps as occasional visitors (Appendix A). Apart from the Grey-crowned Babbler (eastern subspecies) and Southern Myotis, which are discussed further below, the Modification was considered to have no impact on threatened species, populations or ecological communities.

Two threatened species that may utilise the study area on more than an occasional basis are the Grey-crowned Babbler (eastern subspecies) and Southern Myotis. The Grey-crowned Babbler (eastern subspecies) has previously been recorded in several locations where habitat occurs outside the study area, but it has not been recorded within the study area. Similarly, Babbler nests have been recorded in a number of locations outside the study area, but not within the study area.

The habitat for these species within the study area is extremely limited in extent and in poor condition. In addition, there are extensive areas of potential habitat for these species which would remain outside of the study area and both species are volant. The Modification is not likely to isolate areas of potential habitat for these species.

The potential impacts of the Modification on the Grey-crowned Babbler (eastern subspecies) are extremely limited in extent and are not likely to affect any populations of this species that may occur in the vicinity.

The microbat, Southern Myotis can occur in a wide range of habitats near water, but usually occurs in areas that are vegetated, rather than cleared (Churchill 2008). Most of the study area and surrounds has been cleared. If the species were to occur, the installation of a creek crossing structure would be unlikely to substantially alter its foraging behaviour.

Other threatened fauna that may occur in the study area on occasion include two forest owls that have potential habitat within the study area (Powerful Owl [*Ninox strenua*] and Masked Owl [*Tyto novaehollandiae*]), some diurnal birds (e.g. Varied Sittella [*Daphoenositta chrysoptera*], Little Lorikeet [*Glossopsitta pusilla*], Gang-gang Cockatoo [*Callocephalon fimbriatum*], Glossy Black-cockatoo [*Calyptorhynchus lathami*], Diamond Firetail [*Stagonopleura guttata*]), and some microbats. The potential impacts of the Modification on these species are extremely limited in extent and are not likely to affect any populations of these species that occur in the vicinity (Appendix A).

In consideration of the above, assessments of significance under section 5A of the EP&A Act, or an evaluation of the likelihood of significant impacts under the Commonwealth EPBC Act were not required. The Modification is not considered likely to have a significant impact on threatened flora or fauna. No listed threatened species, populations or ecological communities have been recorded within the study area. Should any threatened species within the locality utilise the very small area of poor quality habitat within the study area, it is unlikely the loss of one or two trees

will significantly impact local populations of these species, as large areas of more suitable habitat would remain in the surrounds.

The Modification is not likely to significantly impact any listed migratory species under the EPBC Act, on the basis of the following:

- no “important habitat” (as defined by the EPBC Significant impact guidelines [Commonwealth of Australia 2013]) exists within the study area for any listed migratory species;
- the Modification would not result in an invasive species that is harmful to any migratory species becoming established in an area of important habitat; and
- the Modification would not disrupt the life cycle of an ecologically significant proportion of any population of any migratory species.

4.1.2 *Loss of Habitat*

The construction of the proposed haul road through ML 1733 and a portion of ML 1528 would result in the removal of approximately 0.7 hectares (ha) of Revegetated Mine Workings, 1.6 ha of Improved Pasture and 0.1 ha of Degraded Riparian Vegetation.

The Revegetated Mine Workings and the Improved Pasture may be used by various fauna species (such as grazers, seed-eating birds and birds of prey) as foraging habitat. The overall quality of these areas as fauna habitat is poor and extremely limited in extent in the study area in comparison to the extensive areas of such habitat in the broader landscape. Any potential impacts on native species which may arise as a result of the removal of this habitat are considered to be negligible.

4.1.3 *Potential Impacts on Dog Trap Creek*

Contour lines indicate that Dog Trap Creek is at the centre of a river flat which is approximately 170 m wide at the site where the proposed haul road extension would cross the creek (Figure 4). The potential impacts of the proposed haul road and crossing on Dog Trap Creek include increases in flood levels upstream of the crossing, increased erosion downstream of the crossing and discharge of sediment-laden water from the surface of the haul road, the road embankment and batters (Hydro Engineering & Consulting 2016). The detailed design of the crossing will aim to minimise these potential impacts. The proposed crossing structure would be constructed of either pre-fabricated culverts or a low bridge to minimise flood impacts, appropriate armouring would be installed downstream of the crossing in accordance with accepted road design practice and the design would include appropriate sediment control measures (Hydro Engineering & Consulting 2016).

The potential impact of the proposed haul road extension on Dog Trap Creek depends on the method used to traverse the creek. A box culvert or a pre-fabricated steel frame bridge are the options proposed.

A box culvert, in the construction phase, would involve earthworks and disturbance of the creek bed and banks for approximately the width of the proposed haul road. A culvert with bare non-vegetated sides of approximately 7 m in length may represent a barrier to some fauna moving along the sides of the creek. It is understood that the culvert would be designed to convey water past the crossing and minimise flood effects.

The construction of a pre-fabricated steel frame bridge set on concrete footing would still involve some disturbance of the creek banks and bed but to a lesser extent, to install the concrete feet.

The footing for the bridge would not have to be put within or near the creek but could be located some distance from it. As such, the creek and its banks should remain in their current state. There would be little impact on fauna that utilise the creek line.

4.1.4 Tree Removal

The Modification may require the removal of one large and one small *Casuarina cunninghamii* (River She Oak) trees. The one large tree contains hollows potentially suitable for some small hollow-dwelling species such as microbats, if they were to occur. However, the potential for many hollow-dwelling species to occupy this tree is limited due to the lack of suitable habitat in the vicinity.

A fauna ecologist would be present during vegetation clearing when trees with hollows are removed, and any hollows lost would be recorded and appropriate compensatory measures implemented (Section 5.1).

4.1.5 Fauna Strike

Haulage operations on the private haul road between the RHCP and the SMC would be undertaken during daytime only, between the hours of 7:00 am to 6:00 pm. In addition, speed of vehicles on the haul road would be restricted to 60 kilometres per hour. The potential for fauna to be struck by vehicles is therefore limited and expected to be confined to occasional individuals.

4.1.6 Indirect Impacts

The haul road would not be artificially lit and haulage would be limited to daylight hours. Indirect impacts of the proposed haul road extension, such as noise, dust and other pollution may occur along the length of the haul road. However, the haul road is located in areas that are either young, planted vegetation, improved pasture, or heavily weed infested. Therefore, potential indirect impacts are not likely to considerably alter the condition of adjacent flora and fauna habitat.

4.1.7 Conclusion

It is considered that no assessments of significance are required for the construction of the haul road in ML 1733 or ML 1528, as the potential impacts on threatened species, populations and ecological communities or their habitats are extremely limited.

4.2 Potential Impacts on Aquatic Ecology

The proposed creek crossing at Dog Trap Creek is associated with a disturbed creek system experiencing variable flow conditions. The habitat at the creek crossing is disturbed and supports low quality aquatic habitat and water quality to support threatened aquatic species. Previous surveys have identified moderate levels of macroinvertebrate communities on Dog Trap Creek, dominated by exotic, pest fish species. With design consideration given to fish passage, flow velocities and erosion and sediment controls during rainfall events during construction and operation of the creek crossing, the potential impacts to aquatic species which utilise Dog Trap Creek associated with the Modification are considered to be localised.

No fish or macroinvertebrate species listed on the EPBC Act, TSC Act or FM Act have been previously recorded at Dog Trap Creek or its surrounds and only limited potential habitat to support threatened species is present at the creek crossing or upstream and downstream of the site.

Under the FM Act, a number of Key Threatening Processes (KTP) are identified that threaten or may threaten the survival or evolutionary development of threatened species, populations or ecological communities. The KTPs that may be relevant include:

- instream structures and other mechanisms that alter natural flow;
- the removal of large woody debris from NSW rivers and streams; and
- the degradation of native riparian vegetation along NSW water courses.

Other potential impacts include:

- increased turbidity, input of nutrients or contaminants;
- loss of habitat for aquatic fauna as a result of vegetation clearing and earthworks;
- obstruction of fish passage due to construction of creek crossings;
- fuel spills and litter/waste entering aquatic habitats as a result of operation; and
- maintenance of vehicles and other equipment.

The Cardno (2016) data identifies the creek crossing as being suitable for a bridge, arch structure, or culvert. It is recommended that a bridge be used rather than a culvert. The construction of a bridge is likely to result in less disturbance to the creekline in terms of water flow, bank stability and weed invasion than the installation of a culvert.

Design and construction of the Dog Trap Creek crossing would in particular need to consider:

- the NSW Fisheries *Policy and guidelines for fish habitat conservation and management* (NSW DPI 2013 updated);
- regular maintenance of the creek crossing to manage erosion and sediment and sedimentation flowing high flow conditions during operation;
- maintenance of fish passage during construction and operation; and
- management of silt laden benthic substrate during construction.

4.2.1 Conclusion

Where construction is carried out during periods of low flow, the impacts of disturbance to aquatic habitat would be highly localised and are considered acceptable in both a local and regional context, given the ephemeral nature of the creek and the existing disturbed nature of creek crossing location. The impact to fish passage would be low where the crossing is designed and installed following the NSW Fisheries *Policy and guidelines for fish habitat conservation and management* (NSW DPI 2013 updated) and where the crossing is regularly maintained.

Implementation of best practice fuel and waste management systems will effectively address the risk to aquatic ecology from litter and spills. It is considered unlikely that the Modification would result in a significant increase in cumulative adverse impacts on aquatic ecosystems.

5 Mitigation Measures

The existing biodiversity mitigation measures which are currently in place for the existing and approved SMC (AMBS 2012) would continue to be implemented for the Modification.

5.1 Terrestrial

The existing Vegetation Clearance Protocol developed for the approved activities at the SMC (AMBS 2012) would be implemented during clearance activities undertaken for the Modification. The Vegetation Clearance Protocol would include: pre-clearance surveys for fauna; presence of a suitably trained and qualified person(s) to manage animals that may be encountered during land clearing; and management of fauna post-vegetation clearing (AMBS 2012).

Native trees in the degraded riparian vegetation along Dog Trap Creek which occur within the study area and would be removed by the Modification may be replaced by planting new trees as close to the proposed haul road as possible.

5.2 Aquatic

The primary potential impacts associated with construction and operation of the Dog Trap Creek crossing relate to impediments to fish passage, introducing sediment runoff downstream of the works and vehicle and equipment runoff during construction and operation.

5.2.1 Construction and Design of Creek Crossing

The design and operation of the creek crossing can influence fish passage and would consider the NSW Fisheries *Policy and guidelines for fish habitat conservation and management* (NSW DPI 2013 updated). The creek crossing would be a bridge or culvert. Dog Trap Creek has been classed by Cardno (2016) as a Class 2 Waterway (Fairfull and Witheridge 2003), which would require consideration in the design. During construction consideration would be made to maintain fish passage.

The risk of impacts to instream habitat and aquatic fauna and flora would be minimised where the creek crossing is:

- installed during dry periods where possible (preferably in the dry creek bed);
- installed using methods to isolate aquatic fauna from impacts during construction; and
- maintained to ensure there is regular removal of debris or plant growth that may impede fish passage.

Should a culvert be used instead of a bridge, given the similarity of the Modification to the creek crossings proposed for the Stratford Extension Project, the following design principles would be followed, consistent with those outlined by frc environmental (2012):

- Culvert would be open-bottomed, if possible, to retain the natural morphological features of the stream. If this is not possible and if practicable, culverts would be countersunk below the stream bed and natural materials such as rocks secured to the base of the culvert to increase roughness and reduce water velocity.
- Culvert would be constructed without a drop-off at the passage outlet, as this impedes fish migration upstream.
- Culvert would be constructed with minimum disturbance to the outer banks on stream bends, as these are usually the most unstable and are prone to erosion.

- Culvert would be surrounded by riparian vegetation (planted after construction, if necessary) to stabilise banks, provide food and habitat for fauna and prevent predation of aquatic fauna by birds.

5.2.2 Erosion and Sediment Control Measures

Controls to manage the potential impacts caused by erosion and sediments for works undertaken throughout the construction and operation of the creek crossing would be undertaken. In addition, the benthic sediment at the creek crossing is silt laden and poses a risk of sediment-laden runoff to nearby waterways which would impact on already low levels of dissolved oxygen in Dog Trap Creek. This potential to increase sedimentation downstream of the creek crossing would be reduced where:

- timing of clearing and earthworks for the construction of the creek crossing is undertaken during low flow conditions; and
- silt curtains or similar are installed downstream of the creek crossing (integrating fish passage requirements).

5.2.3 Operation and Maintenance of Vehicles and Equipment

Consistent with the existing management measures undertaken at the SMC, risks associated with the spillage of fuels and other contaminants would be substantially reduced, if not eliminated, where:

- vehicle maintenance areas, portable refuelling stations and storage of fuels, oils and batteries are located within bunded areas, designed and constructed in accordance with Australian Standard (AS) 1940:2004 – *The storage and handling of flammable and combustible liquids* and are located above the 100 Average Recurrence Interval (ARI) flood level;
- all spills of contaminants are reported in accordance with mines spill incident procedures; and
- appropriate spill containment kits are available, and used for the clean-up of spills in the field. The kits would contain equipment for clean-up of both spill on land or in dry creek beds, and spills to water (e.g. floating booms).

5.2.4 Offsets

A substantial biodiversity offset was included as part of the Stratford Extension Project to maintain or improve biodiversity values in the region in the medium to long-term (AMBS, 2012). Following implementation of the above listed mitigation measures, it is considered that impacts on terrestrial and aquatic ecology are substantially the same as those associated with the existing approved SMC and no further biodiversity offsets are considered warranted.

6 Conclusion

The following conclusions have been made regarding the potential impacts of the proposed haul road construction within the study area (i.e. within ML 1733 and ML 1528):

- The vegetation which would be disturbed by the Modification consists of improved pasture, revegetated mining landscapes and a strip of degraded riparian vegetation.
- No threatened flora, fauna or aquatic species of significance listed under the TSC Act, EPBC Act or FM Act have been recorded within the study area and most are unlikely to occur, or likely to occur only as occasional visitors.
- Potential impacts on threatened fauna that may occur within the study area on more than just an occasional basis (such as the Grey-crowned Babbler [eastern subspecies] and Southern Myotis) are limited to the removal of one or two trees and a small area of poor quality habitat.
- There is no potential habitat for threatened flora, and limited potential habitat for threatened fauna and aquatic species listed under the TSC Act, EPBC Act or FM Act within the study area.
- Potential impacts on threatened species, populations or ecological communities are considered to be negligible.
- Two *Casuarina cunninghamii* (River She Oak) trees occur within the footprint of the proposed haul road extension and would be removed by the Modification.
- To minimise impacts to the aquatic environment of Dog Trap Creek, design concepts for the crossing should minimise potential for exacerbating flooding and minimise impacts on the creek bed and banks.
- Best practice erosion and sediment control measures should be used during the construction of the haul road and the creek crossing.

The proposed Modification is unlikely to have a significant impact on any threatened species, populations, ecological communities or their habitats, considering aspects such as the extent of potential habitat for the species in the wider landscape and the small scale and poor quality of potential habitat to be cleared for the proposed Modification. Accordingly, it is considered that impacts on terrestrial and aquatic ecology are substantially the same as those associated with the existing approved SMC and no further biodiversity offsets are considered warranted.

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Appendix A: Likelihood of occurrence of threatened and migratory fauna

Threatened fauna

Key: V = vulnerable, E = endangered, CE = Critically Endangered

Class	Scientific Name	Common Name	TSC Act	EPBC Act	Recorded within 10 km	Potential Occurrence within Study Area	Likelihood of Impact/s
Amphibia	<i>Litoria booroolongensis</i>	Booroolong Frog	E	E	NO	Not recorded in study area. No habitat in the study area or nearby surrounds. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
	<i>Mixophyes balbus</i>	Stuttering Frog	E	V	YES	Not recorded in study area. Closest record 6.5 km to south-east of the study area in the ranges. No habitat in the study area or nearby surrounds. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
	<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	YES	Not recorded in study area. Closest record 6.5 km to south-east of the study area in the ranges. No habitat in the study area or nearby surrounds. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
Aves	<i>Anseranas semipalmata</i>	Magpie Goose	V	-	YES	Not recorded in study area. Closest record approximately 3.9 km to south-east of the study area. No habitat in study area apart from (possibly) small poor quality area at Dog Trap Creek that is unlikely to be used by the species. Considered unlikely to occur in study area.	Unlikely – the creek habitat in this location is unlikely to be used by the species.

Class	Scientific Name	Common Name	TSC Act	EPBC Act	Recorded within 10 km	Potential Occurrence within Study Area	Likelihood of Impact/s
	<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	NO	Not recorded in study area or locality. No suitable habitat within the study area. There are no flowering eucalypts on which this species may forage, and the study area is not within one of the four Regent Honeyeater breeding areas in NSW (OEH, 2016b). Considered unlikely to occur in the study area, except (possibly) as rare visitor.	Unlikely – the study area is not suitable habitat for this species.
	<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	NO	Not recorded in study area or locality. No habitat in study area apart from (possibly) small poor quality area at Dog Trap Creek that is unlikely to be used by the species. Considered unlikely to occur in the study area.	Unlikely – the creek habitat in this location is unlikely to be used by the species.
	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-	YES	Not recorded in study area. One record in locality, 7.2 km to south of the study area. No habitat in study area apart from a line of trees along Dog Trap Creek, surrounded by cleared paddocks. Could occasionally occur in study area, but unlikely to be a resident as no breeding habitat present and there are no records in the immediate surrounds.	Unlikely – impacts limited to loss of one or two trees. Species not recorded in study area or immediate surrounds and no breeding habitat present.
	<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V	-	YES	Not recorded in study area. Has been recorded in locality, including evidence of feeding, with the closest record being 1.5 km from the study area. No feed trees (<i>Allocasuarina</i> sp.) or breeding habitat in the study area. Could occur in study area as occasional visitor.	Unlikely – not recorded in study area and no feed trees or breeding habitat present.

Class	Scientific Name	Common Name	TSC Act	EPBC Act	Recorded within 10 km	Potential Occurrence within Study Area	Likelihood of Impact/s
	<i>Chthonicola sagittata</i>	Speckled Warbler	V	-	YES	Not recorded in the study area. Has been recorded in locality, with closest record 1.7 km to south-west of the study area. No suitable habitat within the study area. Considered unlikely to occur in the study area, except as occasional visitor.	Unlikely – the study area is not suitable habitat for this species.
	<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-	YES	Not recorded in study area. One record from 1994 in the locality, but no recent records. No habitat in the study area or surrounds. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
	<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	YES	Not recorded in the study area. Has been recorded in the locality, with closest record 1.4 km to south-east of the study area. No habitat in study area apart from a line of trees along Dog Trap Creek, surrounded by cleared paddocks. Could occasionally occur in the study area.	Unlikely – impacts limited to loss of one or two trees in an area that would be used by this species only occasionally, if at all.
	<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	NO	Not recorded in study area or locality. No habitat observed in the study area or surrounds. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	YES	Not recorded in study area. Has been recorded in the locality, with closest record 4 km to north-west of the study area. No habitat in study area apart from (possibly) small poor quality area at Dog Trap Creek that is unlikely to be used by the species. Considered unlikely to occur in the study area.	Unlikely – the creek habitat in this location is unlikely to be used by the species.

Class	Scientific Name	Common Name	TSC Act	EPBC Act	Recorded within 10 km	Potential Occurrence within Study Area	Likelihood of Impact/s
	<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	YES	Not recorded in study area. Has been recorded in the locality, with closest record 4.9 km to south-east of the study area. No habitat in study area apart from a line of trees along Dog Trap Creek, surrounded by cleared paddocks. Could occur in the study area occasionally.	Unlikely – impacts limited to loss of one or two trees in an area that would be used by this species only occasionally, if at all.
	<i>Grantiella picta</i>	Painted Honeyeater	V	V	NO	Not recorded in study area or locality. No habitat in study area apart from a line of trees along Dog Trap Creek, surrounded by cleared paddocks. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
	<i>Lathamus discolor</i>	Swift Parrot	E	CE	NO	Not recorded in study area or locality. No habitat in the study area. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
	<i>Irediparra gallinacea</i>	Comb-crested Jacana	V	-	YES	Not recorded in the study area. Recorded in locality near a dam 6.5 km south of the study area. No habitat in study area apart from (possibly) small poor quality area at Dog Trap Creek that is unlikely to be used by the species. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
	<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-	YES	Not recorded in study area. One record from 1994 in the locality, but no recent records. No habitat in the study area apart from a line of trees along Dog Trap Creek, surrounded by cleared paddocks. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.

Class	Scientific Name	Common Name	TSC Act	EPBC Act	Recorded within 10 km	Potential Occurrence within Study Area	Likelihood of Impact/s
	<i>Ninox strenua</i>	Powerful Owl	V	-	YES	Not recorded in study area. Has been recorded in the locality, with closest record 7.7 km to north of the study area along creek line. Small area of potential foraging habitat occurs within the study area. No breeding habitat present. Could occasionally occur within the study area.	Unlikely – impacts limited to loss of one or two trees that may form part of a much broader foraging area (assuming that the study area forms part of the home range of individuals of this species), which would have little or no effect on the survival of individuals of this species in the locality.
	<i>Petroica phoenicea</i>	Flame Robin	V	-	YES	Not recorded in study area. One record from locality, approximately 3.5 km to the south-west of the study area. No habitat in study area. Considered unlikely to occur in the study area except as occasional visitor.	Unlikely – not likely to occur except as occasional visitor.
	<i>Petroica boodang</i>	Scarlet Robin	V	-	YES	Not recorded in study area. One record from locality, approximately 4.6 km to south of the study area. No habitat in study area or surrounds. Considered unlikely to occur in the study area except as occasional visitor.	Unlikely – not likely to occur except as occasional visitor .
	<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V	-	YES	Not recorded in study area. Recorded nearby along Dog Trap Creek (EcoBiological 2011a). Potential habitat occurs in study area along Dog Trap Creek. A number of nests of this species have been recorded in the locality (EcoBiological 2011a), but no nests observed in the study area. Could occur within the study area along Dog Trap Creek.	Unlikely - loss of one or two trees in the creek would have little impact on this species, which is known from several locations outside the study area and has a number of nesting sites recorded in other locations, but not within the study area.
	<i>Rostratula australis</i>	Australian Painted Snipe	E	E	NO	Not recorded in study area or locality. No habitat in study area apart from (possibly) small poor quality area at Dog Trap Creek. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.

Class	Scientific Name	Common Name	TSC Act	EPBC Act	Recorded within 10 km	Potential Occurrence within Study Area	Likelihood of Impact/s
	<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	YES	Not recorded in the study area. There have been no records of the species in the locality since 1994. No habitat in study area apart from small area of poor quality. Considered unlikely to occur in the study area.	Unlikely - impacts limited to loss of a very small area of poor quality habitat that would have little or no impact on the survival of the species in the vicinity or locality if it does still occur. Species has not been recorded in the study area and there are no records in the locality since 1994.
	<i>Tyto novaehollandiae</i>	Masked Owl	V	-	YES	Not recorded in study area. Has been recorded in the locality, with closest record 4.8 km to south-west of study area. Small area of potential foraging habitat occurs within the study area. No breeding habitat present. Could occasionally occur within the study area.	Unlikely – impacts limited to loss of one or two trees that may form part of a much broader foraging area (assuming that the study area forms part of the home range of individuals of this species), which would have little or no effect on the survival of individuals of this species in the locality.
	<i>Tyto tenebricosa</i>	Sooty Owl	V	-	YES	Not recorded in study area. Has been recorded in the locality, with closest record 2 km to east of study area in ranges. Small area of potential foraging habitat occurs within the study area. No breeding habitat present. Considered unlikely to occur within the study area.	Unlikely – impacts limited to loss of one or two trees that may form part of a much broader foraging area (assuming that the study area forms part of the home range of individuals of this species), which would have little or no effect on the survival of individuals of this species in the locality.

Class	Scientific Name	Common Name	TSC Act	EPBC Act	Recorded within 10 km	Potential Occurrence within Study Area	Likelihood of Impact/s
Mammalia	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	YES	Not recorded in study area. Has been recorded in the locality, with closest record 9.8 km to north-west of the study area. No habitat within study area apart from a line of trees along Dog Trap Creek, surrounded by cleared paddocks. Unlikely to occur in study area except as occasional foraging visitor.	Unlikely – no breeding habitat in study area and species unlikely to occur except (possibly) as occasional foraging visitor. Loss of one or two trees would have little or no impact on foraging behaviour.
	<i>Dasyurus maculatus</i> (SE mainland population)	Spotted-tailed Quoll	V	E	YES	Not recorded in study area. Scattered records in locality, closest record approximately 3.5 km to north of the study area. No habitat within study area. Considered unlikely to occur within study area.	Unlikely – not likely to occur.
	<i>Kerivoula papuensis</i>	Golden-tipped Bat	V	-	YES	Not recorded in study area. Two records in the locality, approximately 6 km south-west of the study area. No habitat within study area. Considered unlikely to occur within study area.	Unlikely – not likely to occur.
	<i>Miniopterus australis</i>	Little Bentwing-bat	V	-	YES	Not recorded in study area. Has been recorded in the locality, with closest record 1.7 km to south-west of the study area. No habitat in the study area except a line of trees along Dog Trap Creek, surrounded by cleared paddocks. Considered unlikely to occur in the study area except as occasional foraging visitor.	Unlikely – not likely to occur except as occasional foraging visitor. Loss of one or two trees would have little or no impact on foraging behaviour.
	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-	YES	Not recorded in study area. Has been recorded in the locality, with closest record 2 km to west of the study area. No breeding habitat in the study area. Could occasionally forage in the study area.	Unlikely – the loss of a very small area of possible foraging habitat would have little or no effect on foraging behaviour or on the survival of this species in the locality.

Class	Scientific Name	Common Name	TSC Act	EPBC Act	Recorded within 10 km	Potential Occurrence within Study Area	Likelihood of Impact/s
	<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-	YES	Not recorded in study area. Has been recorded in the locality. No habitat in study area except line of trees along Dog Trap Creek, surrounded by cleared paddocks. Considered unlikely to occur in the study area except as occasional visitor.	Unlikely – not likely to occur except as occasional visitor and loss of one or two trees would have little or no impact on the survival of the species in the locality.
	<i>Myotis macropus</i>	Southern Myotis	V	-	YES	Not recorded in study area. Records exist for locality, the closest approximately 3.2 km to south-east of the study area. Potential habitat occurs in the study area along Dog Trap Creek. Could occur in the study area.	Unlikely – impacts limited to loss of a very small area of degraded riparian vegetation that would have little or no impact on the survival of the species in the locality.
	<i>Petaurus australis</i>	Yellow-bellied Glider	V	-	YES	Not recorded in study area. Has been recorded in the locality, with closest record 6.6 km to south-east of study area on ranges. No habitat in the study area or surrounds. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
	<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	YES	Not recorded in study area. Has been recorded in the locality, with closest record 1.7 km to south-west of study area. No habitat in the study area. Considered unlikely to occur in the study area except as occasional visitor.	Unlikely – not likely to occur except as occasional visitor.
	<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	NO	Not recorded in study area or locality. No habitat in the study area or surrounds. Considered unlikely to occur in the study area.	Unlikely– not likely to occur.

Class	Scientific Name	Common Name	TSC Act	EPBC Act	Recorded within 10 km	Potential Occurrence within Study Area	Likelihood of Impact/s
	<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	YES	Not recorded in study area. Several records throughout the locality. Closest record 1.1 km to south-east of study area. No habitat in the study area or surrounds. Considered unlikely to occur in the study area except as occasional visitor.	Unlikely – not likely to occur except as occasional visitor.
	<i>Phascolarctos cinereus</i> (combined populations of Qld, NSW and the ACT)	Koala	V	V	YES	Not recorded in study area. Several records from locality, closest 5 km to south-east of study area. No habitat in study area. Considered unlikely to occur in study area.	Unlikely – not likely to occur.
	<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo	-	V	YES	Not recorded in study area. Has been recorded in the locality, closest record approximately 8 km to south of study area on ranges. No habitat in the study area. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
	<i>Pseudomys novaehollandiae</i>	New Holland Mouse, Pookila	-	V	YES	Not recorded in study area. Has been recorded in the locality, with closest record 1.5 km to south-east of study area. No habitat in the study area. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
	<i>Pseudomys oralis</i>	Hastings River Mouse, Koontoo	E	E	NO	Not recorded in study area or in the locality. No habitat in the study area or surrounds. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	YES	Not recorded in the study area. Few records exist for the locality, closest record 4.9 km to south of study area. No habitat observed in the study area apart from a line of trees along Dog Trap Creek which are unlikely to be used by the species. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.

Class	Scientific Name	Common Name	TSC Act	EPBC Act	Recorded within 10 km	Potential Occurrence within Study Area	Likelihood of Impact/s
	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	YES	Not recorded in study area. Recorded in the locality in 2001, no report of the exact location provided. Could potentially forage almost anywhere in locality if present and could therefore potentially occur on occasion in the study area.	Unlikely – the loss of one or two trees and a very small area of possible foraging habitat that may be used occasionally would have little or no effect on the survival of this species in the locality.
	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	YES	Not recorded in the study area. Recorded in locality in 1998. More recently 'possible' ultrasound recordings were made in locality. No habitat in the study area. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.
Reptilia	<i>Hoplocephalus stephensii</i>	Stephens' Banded Snake	V	-	YES	Not recorded in the study area. Has been recorded in the locality, with closest record approximately 6.3 km to south-west of the study area in the ranges. No habitat in study area. Considered unlikely to occur in the study area.	Unlikely – not likely to occur.

Migratory fauna

Common Name	Scientific Name	Types of presence	Important habitat* within study area?
Fork-tailed Swift	<i>Apus pacificus</i>	Species or species habitat likely to occur within area	No
Oriental Cuckoo	<i>Cuculus optatus</i>	Species or species habitat may occur within area	No
White-throated Needletail	<i>Hirundapus caudacutus</i>	Species or species habitat known to occur within area	No
Rainbow Bee-eater	<i>Merops ornatus</i>	Species or species habitat may occur within area	No
Black-faced Monarch	<i>Monarcha melanopsis</i>	Species or species habitat known to occur within area	No
Spectacled Monarch	<i>Monarcha trivirgatus</i>	Species or species habitat known to occur within area	No
Yellow Wagtail	<i>Motacilla flava</i>	Species or species habitat may occur within area	No
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	Species or species habitat known to occur within area	No
Rufous Fantail	<i>Rhipidura rufifrons</i>	Species or species habitat known to occur within area	No
Great Egret	<i>Ardea alba</i>	Species or species habitat known to occur within area	No
Cattle Egret	<i>Ardea ibis</i>	Breeding likely to occur within area	No
Latham's Snipe	<i>Gallinago hardwickii</i>	Species or species habitat may occur within area	No
Osprey	<i>Pandion haliaetus</i>	Species or species habitat likely to occur within area	No
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Species or species habitat known to occur within area	No

Note: * An area of 'important habitat' for a migratory species is defined in the *Significant impact guidelines 1.1* (Commonwealth of Australia 2013) as:

- a. habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- b. habitat that is of critical importance to the species at particular life-cycle stages, and/or
- c. habitat utilised by a migratory species which is at the limit of the species range, and/or
- d. habitat within an area where the species is declining.

Appendix B: Likelihood of occurrence of threatened flora

Key: V = vulnerable, E = endangered, CE = Critically Endangered

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Distribution	Recommended survey period (OEH 2016b)	Recorded within the study area	Potential occurrence within study area
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E	V	On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities (OEH 2016b).	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest (OEH 2016b).	All year	No - but has been recorded approximately 3.5 km to the south	Unlikely – potential habitat does not occur.
<i>Eucalyptus largeana</i>	Craven Grey Box	E	-	Restricted and local, in wet forest on sloping sites in subcoastal ranges.	Confined to Gloucester-Craven district and near Pokolbin, although a number of unsubstantiated records exist from outside the currently accepted range. Populations are known from Copeland Tops State Conservation Area and Berrico Nature Reserve, with unconfirmed records from Talawahl and Glen Nature Reserves and Willi Willi National Park.	All year	No - but has been recorded approximately 3.5 km to the south	Unlikely – potential habitat does not occur.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Distribution	Recommended survey period (OEH 2016b)	Recorded within the study area	Potential occurrence within study area
<i>Pomaderris queenslandica</i>	Scant Pomaderris	E	-	Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.	Widely scattered but not common in north-east NSW and in Queensland. It is known from several locations on the NSW north coast and a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolata.	All year	No - but has been recorded approximately 1.5 km to the south.	Unlikely – potential habitat does not occur.
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	V	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland (OEH 2016b).	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost (OEH 2016b).	November - February	No	Unlikely – potential habitat does not occur.
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	Usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree <i>Leptospermum laevigatum</i> – Coastal Banksia, Banksia integrifolia subsp. integrifolia coastal scrub; Forest Red Gum <i>Eucalyptus tereticornis</i> aligned open forest and woodland; Spotted Gum <i>Corymbia maculata</i> aligned open forest and woodland; and Bracelet Honeymyrtle <i>Melaleuca armillaris</i> scrub to open scrub.	Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley.	All year	No	Unlikely – potential habitat does not occur.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Distribution	Recommended survey period (OEH 2016b)	Recorded within the study area	Potential occurrence within study area
<i>Haloragis exalata subsp. velutina</i>	Tall Velvet Sea-berry	V	V	Grows in damp places near watercourses. This subspecies also occurs in woodland on the steep rocky slopes of gorges.	This subspecies of Tall Sea-berry occurs on the north coast of NSW and south eastern Queensland. It is plentiful in inaccessible areas of the upper Macleay River, Its known or predicted habitat is north of Tamworth, Barrington Tops National Park and Taree.	All year	No	Unlikely – the species has not been recorded in the locality. The study area is outside of the species known or predicted area of occurrence.
<i>Thesium australe</i>	Austral Toadflax	V	V	Grassland on coastal heathlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (<i>Themeda australis</i>) (OEH 2016b).	Austral Toad-flax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Although originally described from material collected in the SW Sydney area, populations have not been seen in a long time. It may persist in some areas in the broader region (OEH 2016b).	September - April	No	Unlikely – potential habitat does not occur.

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat	Distribution	Recommended survey period (OEH 2016b)	Recorded within the study area	Potential occurrence within study area
<i>Euphrasia arguta</i>	-	E	CE	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 densest in an open disturbed area and along the roadside, indicating the species had regenerated following disturbance.	Was rediscovered in the Nundle area of the NSW north western slopes and tablelands in 2008. Prior to this, it had not been collected for 100 years. Historically, <i>Euphrasia arguta</i> has only been recorded from relatively few places within an area extending from Sydney to Bathurst and north to Walcha. The Royal Botanic Gardens Specimen Register records an additional location reported and vouchered in 2002 from near the Hastings River; and <i>Euphrasia arguta</i> was also recorded from the Barrington Tops in 2012.	January - April	No	Unlikely – potential habitat does not occur.

Appendix C: Flora recorded

Family	Scientific Name	Common Name	Noxious Weed Class*
Native Species			
Davalliaceae	<i>Arthropteris beckleri</i>		
Cyperaceae	<i>Carex appressa</i>	Tall Sedge	
Casuarinaceae	<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>	River She Oak	
Apiaceae	<i>Centella asiatica</i>	Indian Pennywort	
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew	
Geraniaceae	<i>Geranium homeanum</i>	-	
Juncaceae	<i>Juncus</i> spp.	A Rush	
Lomandraceae	<i>Lomandra longifolia</i> var. <i>longifolia</i>	-	
Onagraceae	<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>	Water Primrose	
Poaceae	<i>Paspalum distichum</i>	Water Couch	
Polygonaceae	<i>Persicaria hydropiper</i>	Water Pepper	
Polygonaceae	<i>Persicaria subsessilis</i>	Hairy Knotweed	
Potamogetonaceae	<i>Potamogeton sulcatus</i>	Pondweed	
Ranunculaceae	<i>Ranunculus plebeius</i>	Forest Buttercup	
Cyperaceae	<i>Schoenoplectus pungens</i>	-	
Urticaceae	<i>Urtica incisa</i>	Stinging Nettle	
Hydrocharitaceae	<i>Vallisneria australis</i>	Ribbonweed	
Exotic Species			
Asteraceae	<i>Aster subulatus</i>	Wild Aster	
Poaceae	<i>Bromus cartharticus</i>	Prairie Grass	
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	
Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	
Cyperaceae	<i>Cyperus eragrostis</i>	Umbrella Sedge	
Cyperaceae	<i>Cyperus sesquiflorus</i>	-	
Poaceae	<i>Digitaria ciliaris</i>	Summer Grass	
Asteraceae	<i>Hypochaeris radicata</i>	Catsear	
Oleaceae	<i>Ligustrum sinense</i>	Small-leaved Privet	4
Poaceae	<i>Paspalum dilatatum</i>	Paspalum	
Poaceae	<i>Pennisetum clandestinum</i>	Kikuyu Grass	
Polygonaceae	<i>Polygonum aviculare</i>	Wireweed	
Polygonaceae	<i>Rumex</i> spp.	Dock	
Salicaceae	<i>Salix fragilis</i>	Crack Willow	4
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	4
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	
Solanaceae	<i>Solanum mauritianum</i>	Wild Tobacco Bush	
Poaceae	<i>Sporobolus</i> spp.	Rat's Tail Couch	
Fabaceae	<i>Trifolium fragiferum</i> var. <i>fragiferum</i>	Strawberry Clover	
Fabaceae	<i>Trifolium repens</i>	White Clover	
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	

Family	Scientific Name	Common Name	Noxious Weed Class*
Asteraceae	<i>Xanthium occidentale</i>	Noogoora Burr	4

*NSW Noxious Weeds Act 1993

Appendix D: Modified Riparian, Channel and Environmental Inventory (Chessman et al. 1997)

Descriptor and category	Score	Dog Trap Creek (Cardno 2016)	Dog Trap Creek (AMBS 2016)
1. Land use pattern beyond the immediate riparian zone			
Undisturbed native vegetation	4		
Mixed native vegetation and pasture/exotics	3		
Mainly pasture, crops or pine plantation	2	2	2
Urban	1		
2. Width of riparian strip of woody vegetation			
More than 30 m	4		
Between 5 and 30 m	3		
Less than 5 m	2	2	2
No woody vegetation	1		
3. Completeness of riparian strip of woody vegetation			
Riparian strip without breaks in vegetation	4		
Breaks at intervals of more than 50 m	3		
Breaks at intervals of 10 - 50 m	2	2	
Breaks at intervals of less than 10 m	1		1
4. Vegetation of riparian zone within 10 m of channel			
Native tree and shrub species	4		
Mixed native and exotic trees and shrubs	3	3	3
Exotic trees and shrubs	2		
Exotic grasses / weeds only	1		
5. Stream bank structure			
Banks fully stabilised by trees, shrubs etc.	4		
Banks firm but held mainly by grass and herbs	3	3	3
Banks loose, partly held by sparse grass etc.	2		
Banks unstable, mainly loose sand or soil	1		
6. Bank undercutting			
None, or restricted by tree roots	4	4	4
Only on curves and at constrictions	3		
Frequent along all parts of stream	2		
Severe, bank collapses common	1		
7. Channel form			
Deep: width / depth ratio < 7:1	4		4
Medium: width / depth ratio 8:1 to 15:1	3	3	
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1		
8. Riffle / pool sequence			
Frequent alternation of riffles and pools	4		
Long pools with infrequent short riffles	3	3	
Natural channel without riffle / pool sequence	2		2
Artificial channel; no riffle / pool sequence	1		
9. Retention devices in stream			
Many large boulders and/or debris dams	4		

Descriptor and category	Score	Dog Trap Creek (Cardno 2016)	Dog Trap Creek (AMBS 2016)
Rocks / logs present; limited damming effect	3	3	
Rocks / logs present, but unstable, no damming	2		
Stream with few or no rocks / logs	1		1
10. Channel sediment accumulations			
Little or no accumulation of loose sediments	4		
Some gravel bars but little sand or silt	3	3	
Bars of sand and silt common	2		2
Braiding by loose sediment	1		
11. Stream bottom			
Mainly clean stones with obvious interstices	4		
Mainly stones with some cover of algae / silt	3	3	
Bottom heavily silted but stable	2		2
Bottom mainly loose and mobile sediment	1		
12. Stream detritus			
Mainly unsilted wood, bark, leaves	4	4	
Some wood, leaves etc. with much fine detritus	3		
Mainly fine detritus mixed with sediment	2		2
Little or no organic detritus	1		
13. Aquatic vegetation			
Little or no macrophyte or algal growth	4		
Substantial algal growth; few macrophytes	3	3	
Substantial macrophyte growth; little algae	2		
Substantial macrophyte and algal growth	1		1
Total Score - 2016		38	29

Source: Modified from Chessman, B.C., Kotlash, A., and Growns, I. (1997) Objective derivation of macroinvertebrate family sensitivity grade numbers for the SIGNAL-HU97 biotic index: application to the Hunter River System, New South Wales. Australian Journal of Marine and Freshwater Research, 48, 159-172