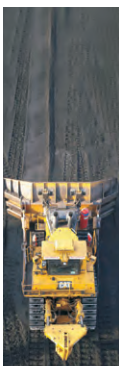
STRATFORDCOAL
Part of the Yancoal Australia Group

Stratford Extension Project
Environmental Impact Statement





APPENDIX F

TERRESTRIAL FAUNA ASSESSMENT

On Thursday 28 June 2012, Yancoal Australia Limited was listed on the Australian Stock Exchange and merged with Gloucester Coal Ltd (GCL) under a scheme of agreement on the same date. Stratford Coal Pty Ltd is now a wholly owned subsidiary of Yancoal Australia Limited. Any reference to GCL in this Appendix should be read as Yancoal Australia Limited.

Terrestrial Fauna Assessment for the Stratford Extension Project

Prepared by Australian Museum Business Services
for Stratford Coal Pty Ltd

Final Report

May 2012

AMBS Reference 110912

AMBS
Australian Museum Business Services - 6 College Street, Sydney NSW 2010, Ph (02) 9320 6311, Fax (02) 9320 6428
australianmuseum.net.au/AMBS ambs@austmus.gov.au

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Recipient:	Tony Dwyer, Stratford Coal Pty Ltd
Authors	Mark Semeniuk, Dr Terry O'Dwyer, Dr Ulrike Kloecker, Melina Budden, Glenn Muir
Reviewed by:	Prof. David Goldney, Jamie Gleeson, Glenn Muir, Mark Semeniuk

Executive Summary

The Stratford Extension Project (the Project) involves an extension of open cut coal mining and processing activities at the Stratford Coal Mine (SCM) and Bowens Road North Open Cut (BRNOC) (both mines are referred to collectively as the Stratford Mining Complex). Stratford Coal Pty Ltd (SCPL) (a wholly owned subsidiary of Gloucester Coal Limited [GCL]) owns and operates the SCM and BRNOC. The Stratford Mining Complex is located in the Gloucester Basin, approximately 100 kilometres (km) north of Newcastle and 11 km south of the town of Gloucester, New South Wales (NSW). The Stratford Mining Complex primarily consists of mine pits, waste emplacements and supporting infrastructure. The surrounding land is predominantly undulating agricultural land to the west, south and north, but with some wooded patches of varying size nearby. The land adjoining to the east contains bushland that extends along a north-south range and further to the east through steeply undulating land.

Under NSW legislation the Project will require the preparation of an Environmental Impact Statement (EIS), and, on 5 December 2011, a delegate of the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities declared the Project to be a 'controlled action' for the purposes of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Australian Museum Business Services (AMBS) was commissioned by SCPL to undertake this terrestrial fauna assessment as part of the information that is required for the EIS. Matters of national environmental significance that are relevant to the fauna assessment (e.g. threatened fauna species) are also assessed in this document.

The primary aim of this assessment is to assess potential impacts on terrestrial fauna (in particular, fauna of conservation significance) based on the Director-General's Environmental Assessment Requirements and accompanying Commonwealth requirements. Fauna of conservation significance are defined in this report as threatened species or populations listed on the Schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act) and/or are listed as matters of national environmental significance by the EPBC Act.

The main components of the Project would include an extension of the existing Roseville West Pit (the Roseville West Pit Extension) and the construction of two additional open cuts, the Avon North Open Cut and Stratford East Open Cut. Extensions of the Stratford Waste Emplacement and Northern Waste Emplacement are also proposed. Additional components of the Project include the construction and use of new waste and coal stockpile areas; progressive backfilling of mine voids with waste rock behind the advancing open cut mining operations; continued use of existing contained water storages/dams and progressive development of additional sediment dams, pumps, pipelines, irrigation infrastructure and other water management equipment and structures; the use of SCM rail loading/unloading facilities and rail transport of coal generated by the Project; realignment of a 132 kilovolt power line; realignments of Wheatleys Lane, Bowens Road and Wenham Cox Road; and other associated minor infrastructure and upgrades to infrastructure that require disturbance to areas additional to those that would be required by the abovementioned activities.

The specific objectives of this assessment are to identify the terrestrial fauna that are known or likely to occur in the area that would be affected by the Project and to assess the potential impacts of the Project on those fauna. Potential impacts on native fauna that may occur as a result of the Project include: loss of particular broad habitat types through clearing; loss of connectivity within the local landscape; loss of foraging, breeding and roosting habitat; loss of hollow-bearing trees; removal of dead wood and dead trees; and loss of individuals and/or local populations.

A number of indirect impacts, such as fragmentation, edge effects, exotic animals, weeds, fire, noise, pollution and changes to surface water hydrology may also occur as a result of the Project. Consideration is also given to a number of impact mitigation measures and detail is provided regarding the proposed Offset areas. This detail includes the method of conserving the Offset areas in perpetuity, how the proposed offsets would be managed and how offsets would be independently audited and monitored.

A desktop review and field surveys were performed in order to identify threatened species that may be affected by the Project. The desktop review included a review of previous fauna survey investigations, a search of the NSW Office of Environment and Heritage (OEH) *Atlas of NSW Wildlife* database for records of threatened fauna within the locality, a search of the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) *Protected Matters* database for matters of national environmental significance within the locality, a search of the Australian Museum collections database, a search of the Birds Australia database for records of threatened birds within the locality, an examination of vegetation maps, an examination of current and historical aerial photographs and an examination of topographic maps.

The majority of field fauna surveys of the Project area were performed between 2007 and 2010 by EcoBiological. Fauna survey work was designed with reference to the relevant guidelines provided by the OEH (NSW Department of Environment and Conservation [DEC], 2004; NSW Department of Environment and Climate Change [DECC], 2009a, 2009b) and SEWPaC (Commonwealth Department of the Environment, Water, Heritage and the Arts [DEWHA], 2010a, 2010b, 2010c). 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; Appendix F). 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.

Additional targeted surveys were performed for the New Holland Mouse, arboreal mammals, and threatened frogs during 2010 and 2011 by AMBS, Anne Kerle, EcoBiological and/or Biosphere Environmental Consultants. Additional diurnal bird surveys and call playbacks for owls and the Bush Stone-curlew were also performed outside of the Project area. In 2011, fauna surveys were performed by AMBS in the proposed Offset areas. Surveys were performed in winter and spring and involved the use of the standard techniques outlined above, with the addition of infra-red cameras. The survey effort was again generally more than the minimum recommended by the OEH guidelines (DEC, 2004).

Fauna habitat assessments were performed across the Project area to assess the broad habitat value of the area. Features considered included landscape connectivity, habitat structure, and abundance of hollow bearing trees and fallen wood. A hollow density map was also prepared and a cave survey was undertaken along the range in the eastern portion of the SCM. A Koala habitat assessment was undertaken using the *State Environmental Planning Policy No. 44* (SEPP 44) criteria, a Spot Assessment Technique (SAT) Assessment, and with reference to the *Recovery Plan for the Koala* (*Phascolarctos cinereus*) (DECC, 2008a).

Where it was considered that potential impacts on threatened species, populations, or their habitats are likely to occur as a result of the Project, an assessment of impacts was made. For threatened species listed on the schedules of the TSC Act, the significance of potential impacts was assessed by application of the assessment of significance (also called Seven Part Tests) in accordance with Section 5A of the NSW *Environmental Planning and Assessment Act 1979*. The significance of potential impacts on relevant matters of national environmental significance was assessed in accordance with the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines* (DEWHA, 2009) and the Commonwealth requirements specific to the Project.

The results of the database searches indicated that 65 animal species that are listed as threatened on the EPBC Act and/or TSC Act have previously been recorded within a 20 km radius of the Project area or were predicted by the EPBC Act *Protected Matters* database to have potential habitat within this area. This included six frog species, two reptile species, 32 bird species and 25 mammal species. Sixteen bird species identified as "listed migratory species" under the EPBC Act have also either been recorded during previous surveys or predicted to occur by the *Protected Matters* database.

In total, 289 animal species have been recorded within the Project area or its surrounds. This list includes 20 species of frog, 31 species of reptile, 183 species of bird and 55 species of mammal. Thirteen exotic species were recorded, including four species of bird and nine species of mammal. The abundance of exotic species was considered to be 'uncommon', with the exception of the Rabbit, which was considered to be 'common'.

A total of ten broad habitat types were identified within the Project area and surrounds. These habitat types include rainforest, riparian forest, wet sclerophyll forest, grassy woodlands, dry sclerophyll forest, aquatic habitats (including artificial wetlands), acacia regeneration, derived grassland/shrub regrowth, plantings and cleared land. Woodland and lowland forest that occurs in the lower elevation areas (the "valley floor") was typically highly fragmented, with larger and more contiguous wooded areas occurring on more steeply undulating slopes and gullies adjacent to the east and further to the west of the Project area.

Two locations of caves were detected to the east of the Project area. The first was found approximately half way up the ridge to the east of the Project area, below a high point on the ridge line. The second was found on a steep sided gully, and had a number of smaller, relatively shallow roosting sites suitable for a range of smaller fauna species such as Antechinus. It was considered unlikely these features would provide habitat for cave-dwelling bats.

Sixty-six hollow-bearing living trees and 36 standing dead trees were detected during surveys across the Project area and surrounds. In total 136 hollows were detected, with 86 having small entrances (<8 centimetre [cm] diameter), 32 medium-sized entrances (8-20 cm diameter) and 18 large hollow entrances (>20 cm diameter). The density of visible hollows was mostly less than 10 per hectare (ha) across the Project area and surrounds, although areas of above average density (15-30 per hectare) occurred along the eastern range and in some lowland woodland patches.

Areas of "potential koala habitat" within the Project area and surrounds (based on the SEPP 44 criteria) were restricted to two vegetation types: Redgum - Box Grassy Woodland and Spotted Gum - Thick-leaved Mahogany Forest. Within these vegetation types, Forest Red Gum (*Eucalyptus tereticornis*) and Tallowwood (*E. microcorys*) constituted greater than 15 percent of the total number of trees. In addition, Cabbage Gum (*Eucalyptus amplifolia*), a primary food tree species for Koalas, occurs within the Project area and surrounds. However, no evidence of Koala activity was found during surveys using the SAT Assessment and no individuals were observed within the Project area. Koalas have, however, been recorded in a Voluntary Conservation Area to the south-west of the Project, in the proposed Offset areas, and in The Glen Nature Reserve.

A total of 28 species of the fauna recorded within the Project area or surrounds are listed as threatened species under either the TSC Act or EPBC Act. This includes 15 species of birds and 13 species of mammals. Eleven species recorded within the Project area or surrounds are listed as migratory under the EPBC Act.

Thirty-three species listed on the TSC Act and six species listed on the EPBC Act were considered likely to be affected to some extent by loss of known or potential habitat and assessments of significance were carried out for these species. Of these, the species considered likely to be most affected by the Project were the Glossy Black-cockatoo, Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Varied Sittella, Brush-tailed Phascogale, Squirrel Glider, Long-nosed Potoroo and New Holland Mouse (all listed as Vulnerable under the TSC Act and/or EPBC Act).

The conclusion of the assessments was that the Project would be unlikely to result in a significant impact on threatened fauna, with the possible exception of the Squirrel Glider, which was considered to have the potential to be significantly impacted in the short-term due to the proposed removal of habitat and a temporary increase in isolation of some known habitat areas. These impacts are not considered likely to result in the loss of the entire local population. The Project incorporates a range of measures targeted specifically at maintaining the Squirrel Glider population, including a nest-box programme and monitoring. Because the Squirrel Glider is currently persisting in a few relatively small patches, the offset strategy has the potential to improve the status of the local Squirrel Glider population in the medium to long-term.

A number of measures to limit adverse impacts of the Project have been incorporated into the Project design. These measures include minimisation of the overall footprint of the Project, continued use of existing infrastructure where possible, avoidance of land clearing where possible, and avoidance of potentially important habitat where possible. Further measures would include timing of land clearing so as not to coincide with fauna breeding and limiting clearing in any given year to the minimum area required for mining operations to proceed in the following year, as practicable.

Measures to mitigate impacts on fauna would be implemented, including pre-clearance surveys for fauna, salvage and relocation of habitat features such as fallen logs, large rocks, tree hollows and stags and a nest box programme. The nest box programme would be designed to specifically target Squirrel Gliders and additional nest boxes of various sizes would be installed for other species of arboreal mammals, birds and bats, taking into consideration the number and size hollows which are removed. A number of species-specific measures would be implemented, such as the installation of glider poles, radio-tracking, and intensive revegetation for the Squirrel Glider; revegetation of Offset areas to include appropriate feed trees for the Glossy Black-cockatoo; and ecological burns for the New Holland Mouse.

The Project would include control measures for weeds, dust, soil erosion, noise, fire and lighting. The disturbance areas associated with the Project would be progressively rehabilitated and revegetated post-mining. This work would incorporate revegetation of some areas with species characteristic of native woodland/open forest and some areas with pasture.

Within 12 months of the Project being approved, a number of proposed Offset areas located in the local area close to the Project area would be conserved and managed in perpetuity. SCPL would seek for long-term security of the offset through a voluntary conservation agreement pursuant to Section 69B of the NSW *National Parks and Wildlife Act 1974*, as described in contemporary Project approval conditions pertaining to offsets.

All broad fauna habitat types that occur within the Project area also occur in the proposed Offset areas, and the amount of each habitat type in the offset is greater than the amount that would be lost due to the Project. The habitat in the Offset areas is considered to be in similar condition to the habitat that would be lost. The Project would include the preparation of a Biodiversity Management Plan for the mining lease area and the Offset areas.

A number of management measures would be implemented to enhance flora and fauna values of the Offset areas. These measures would include: revegetation of cleared land to substantially increase the amount and connectivity of fauna habitat in the area; management of grazing by livestock; control of weeds to enable natural regeneration of native vegetation; exotic animal management to benefit native wildlife; bushfire management; controlling vehicular access; nest box programme; and salvage and relocation of logs, vegetative material and rocks. Monitoring of fauna within the Offset areas would be undertaken to determine the effectiveness of the measures.

It is considered that the Project meets the standard in the requirements of the Director-General of the NSW Department of Planning and Infrastructure in that fauna biodiversity in the region would be maintained or improved in the medium to long-term. The Offset areas contain numerous threatened species and have a number of features that ensure they meet the 'maintain or improve' test. For example, the offsets would represent new protected areas in the region and they would conserve in perpetuity habitat for threatened species in the region. Revegetation within the Offset areas would aim to improve connectivity to help to ensure their long-term viability and facilitate movement of animals between remnant habitat and the large block of forest to the east and south of the Project area, thereby maintaining or re-establishing the potential for genetic exchange across the landscape.

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1 Introduction

1.1 Background

The Stratford Extension Project (the Project) involves an extension of open cut coal mining and processing activities at the Stratford Coal Mine (SCM) and Bowens Road North Open Cut (BRNOC) (both mines are referred to collectively as the Stratford Mining Complex). Stratford Coal Pty Ltd (SCPL) (a wholly owned subsidiary of Gloucester Coal Limited [GCL]) owns and operates the Stratford Mining Complex.

An Environmental Impact Statement (EIS) was prepared for the existing mine in 1994 under New South Wales (NSW) legislation. The current extension of the mine also requires the preparation of an EIS. In addition, on 5 December 2011, a delegate of the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities (Commonwealth Minister) declared the Project to be a "controlled action" for the purposes of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Australian Museum Business Services (AMBS) was commissioned by SCPL to undertake this terrestrial fauna assessment as part of the information that is required for the EIS. Matters of national environmental significance that are relevant to the fauna assessment (e.g. threatened fauna species) are also assessed in this document.

1.2 Scope and objectives

The primary aim of this assessment is to assess potential impacts on terrestrial fauna (in particular, fauna of conservation significance) based on the Director-General's Environmental Assessment Requirements (EARs) and accompanying Commonwealth requirements. Fauna of conservation significance are defined in this report as threatened species or populations listed on the Schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act) and/or are listed as matters of national environmental significance by the EPBC Act. The specific objectives of this study are to consider the:

- terrestrial fauna known or likely to occur in the area that would be affected by the Project, including fauna of conservation significance;
- potential impacts of the Project on those fauna;
- proposed impact avoidance and mitigation measures; and
- proposed offset.

The Director-General's EARs for this Project include the *Guidelines for Threatened Species Assessment* (NSW Department of Environment and Conservation [DEC] and NSW Department of Primary Industries [DPI], 2005) as a relevant guideline for this Project. The guidelines are for Projects assessed under Part 3a of the EP&A Act (now repealed). Never-the-less the guidelines have been considered where applicable.

This assessment is limited to impacts on terrestrial fauna. It does not assess potential impacts to aquatic ecosystems, flora, species listed on the NSW *Fisheries Management Act 1994*, fishes listed on the EPBC Act or matters of national environmental significance listed on the EPBC Act that are not terrestrial fauna.

Data and information used for this study come from a range of sources. Field surveys undertaken by AMBS that are relevant to this assessment include surveys of terrestrial fauna in parts of the area around the Project area and some targeted surveys within the Project area (Appendix G). The majority of the field surveys undertaken within the Project area were carried out by other parties, in particular, terrestrial fauna surveys undertaken by EcoBiological between 2007 and 2010 (Appendix F). Thus, the main components of this assessment include:

- database searches and review of existing survey reports and other literature regarding terrestrial fauna known or likely to occur within the study area and wider locality, particularly species of conservation significance;

- review of possible impacts to fauna (and their habitats) with potential to occur in the study area;
- evaluation of the significance of likely impacts to fauna of conservation significance, through application of Section 5A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) (also called Seven Part Tests) and the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines* (Commonwealth Department of the Environment, Water, Heritage and the Arts [DEWHA], 2009) and other policy statements where relevant;
- presentation of impact avoidance and mitigation measures to reduce the impacts of the Project on terrestrial fauna; and
- description of a proposed Offset area.

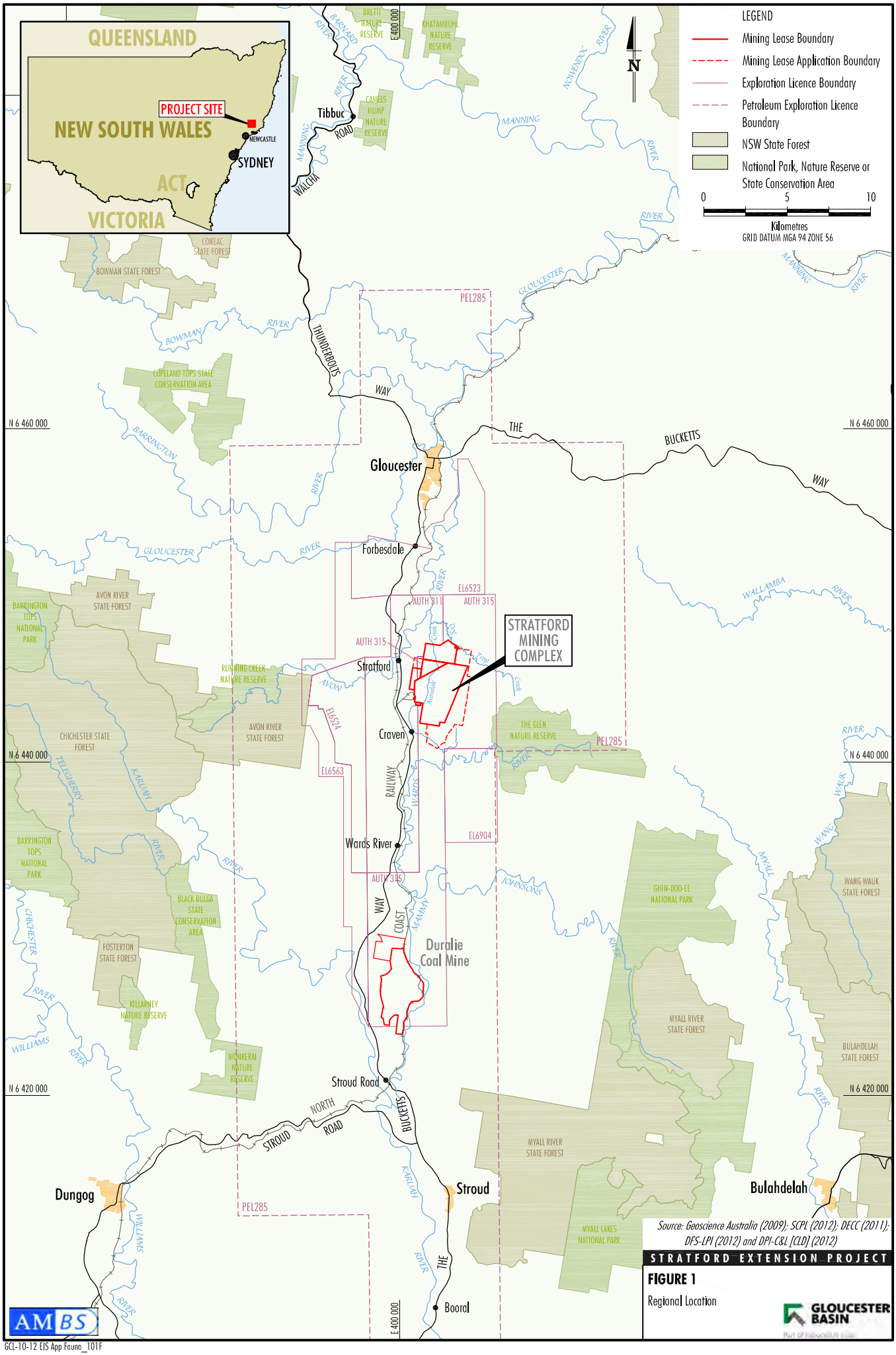
1.3 Location

The Project is located approximately 100 kilometres (km) north of Newcastle and 11 km south of the town of Gloucester, NSW, in the Gloucester Basin (Figure 1). The existing Stratford Mining Complex primarily consists of mine pits, waste emplacements and supporting infrastructure surrounded by undulating agricultural land and wooded areas that extend to the west, south and north. The area to the east and the broader locality also include moderate to steeply sloping terrain between 60 and 300 metres (m) above sea level (Figure 2). Much of the area to the east contains bushland, with the bushland extending to the north and south and further to the east.

1.4 Proposed development

The Project is a proposed extension of open cut mining operations at the Stratford Mining Complex for an additional operational life of approximately 11 years. More detailed information regarding the main components of the Project is provided in Section 2 in the Main Report to the EIS. The main components of the Project are shown on Figure 3. The main activities associated with the development of the Project would include:

- Run-of-mine (ROM) coal production up to 2.6 million tonnes per annum for an additional 11 years (commencing approximately 1 July 2013) or upon the grant of all required approvals, including mining operations associated with:
  - completion of the BRNOC;
  - extension of the existing Roseville West Pit; and
  - development of the new Avon North and Stratford East Open Cuts;
- exploration activities;
- progressive backfilling of mine voids with waste rock behind the advancing open cut mining operations;
- continued and expanded placement of waste rock in the Stratford Waste Emplacement and Northern Waste Emplacement;
- progressive development of new haul roads and internal roads;
- coal processing at the existing Coal Handling and Preparation Plant (CHPP) including Project ROM coal, sized ROM coal received and unloaded from the Duralie Coal Mine (DCM) and material recovered periodically from the western co-disposal area;
- stockpiling and loading of product coal to trains for transport on the North Coast Railway to Newcastle;
- disposal of CHPP rejects via pipeline to the existing co-disposal area in the Stratford Main Pit and, later in the Project life, the Avon North Open Cut void;
- realignments of Wheatleys Lane, Bowens Road, and Wenham Cox/Bowens Road;
- realignment of a 132 kilovolt (kV) power line for the Stratford East Open Cut;



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE 1

Regional Location

AMBS

GLOUCESTER BASIN

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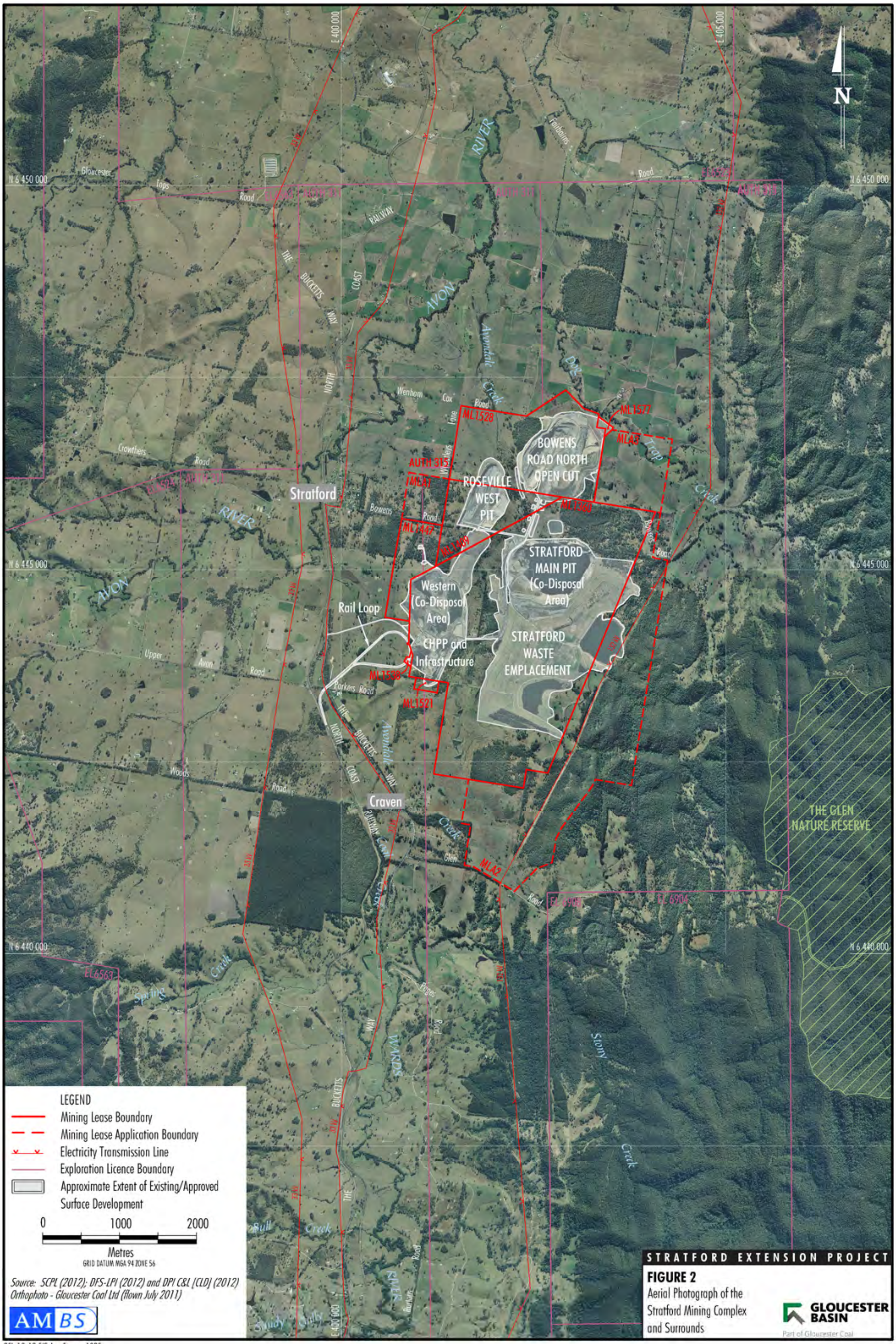

Source: SCPL (2012); DFS-LPI (2012) and DPI C&L [CLD] (2012)
Orthophoto - Gloucester Coal Ltd (flown July 2011)

AMBS

STRATFORD EXTENSION PROJECT

FIGURE 2

Aerial Photograph of the Stratford Mining Complex and Surrounds

GLOUCESTER BASIN
Part of Gloucester Coal

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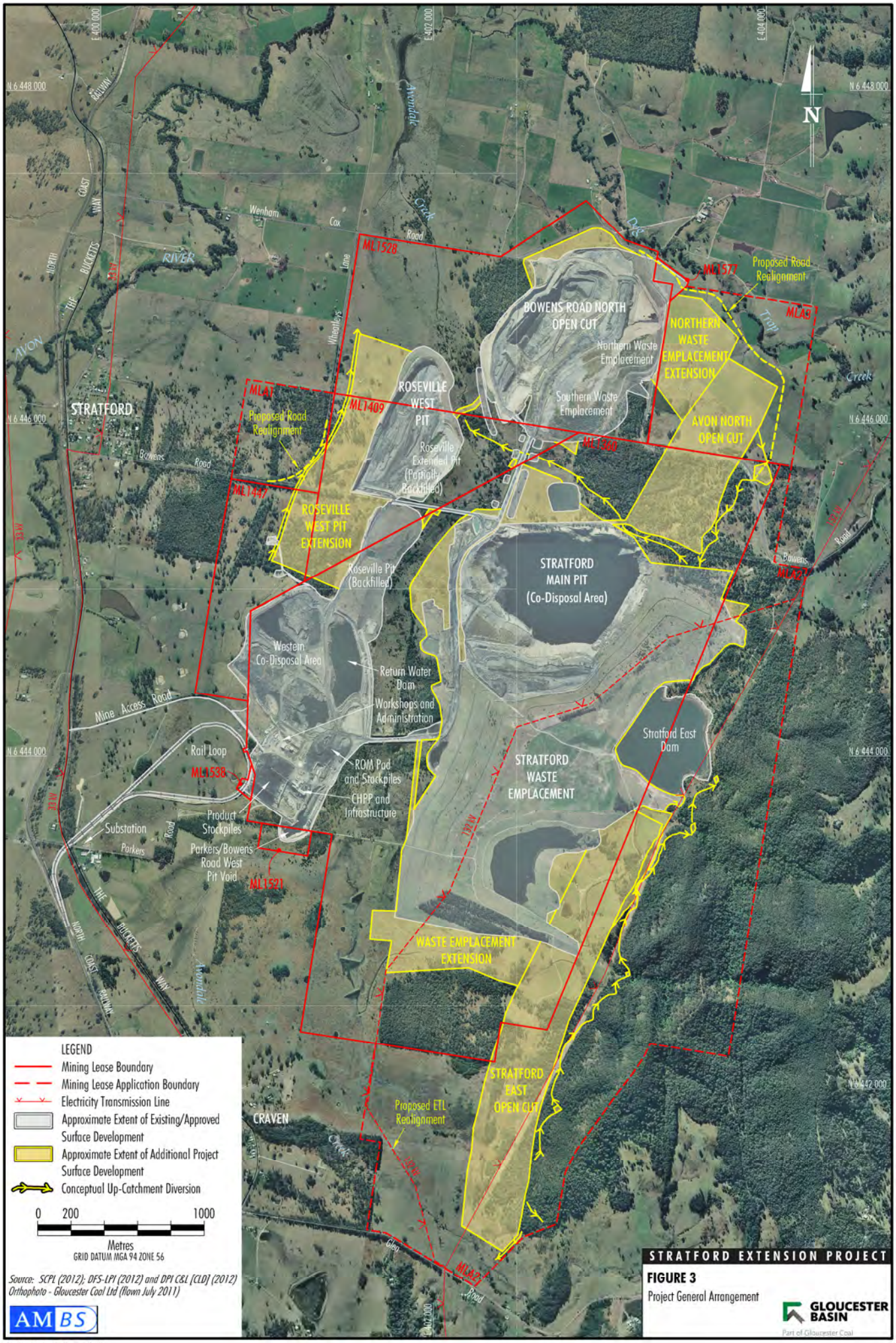

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- continued use of existing contained water storages/dams and progressive development of additional sediment dams, pumps, pipelines, irrigation infrastructure and other water management equipment and structures;
- development of soil stockpiles, laydown areas and gravel/borrow areas, including modifications and alterations to existing infrastructure as required;
- monitoring and rehabilitation;
- all activities approved under DA 23-98/99 and DA 39-02-01; and
- other associated minor infrastructure, plant, equipment and activities, including minor modifications and alterations to existing infrastructure as required.

1.5 Definitions

Definitions of area terms used in this report are related to the direct and indirect impacts likely to occur as a result of the Project. Direct impacts are those that directly affect fauna habitat or individual animals and/or their populations, for example, removal of habitat or mortality of individuals resulting from vegetation clearing. Indirect impacts are those that affect fauna in a manner other than direct loss, for example, weed invasion of the habitat around a development or hydrological changes downstream of a development.

The **Project area** is defined in this report as the area directly affected by the Project, that is, the "footprint" of the Project (Figure 3).

The **study area** is defined in this report as the Project area and nearby areas that were investigated in the fauna assessments performed to date in relation to the Project.

The **locality** is defined in this report as the area within the immediate surrounds of the Stratford Mining Complex.

The **bioregion** is defined according to the Interim Biogeographic Regionalisation for Australia (IBRA), version 6.1.

The **region** is the Catchment Management Authority (CMA) region defined by the NSW Office of Environment and Heritage (OEH).

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

Likely is defined as "a real or not remote chance or possibility".

1.6 Authorship and acknowledgements

This terrestrial fauna assessment was prepared by AMBS ecologists Mark Semeniuk, Dr Terry O'Dwyer, Dr Ulrike Kloecker, Melina Budden and Glenn Muir, with editing and advice provided by AMBS Senior Project Manager Glenn Muir.

Substantial components of the assessment are derived from reports authored by others, in particular, fauna survey reports prepared for the Project by EcoBiological (Appendices F, I and J), Biosphere Environmental Consultants (Appendix H) and Dr Anne Kerle (Appendix I) and flora reports prepared by AMBS (2011) and FloraSearch (2012). AMBS also performed surveys for the New Holland Mouse (Appendix I), as well as fauna surveys surrounding the SMC (Appendix G).

The information and data has been used by AMBS in the preparation of this assessment and it has been assumed by AMBS that the information presented is accurate. However, AMBS takes no responsibility for the comprehensiveness or accuracy of reports prepared by other parties.

2 Existing environment

The following section discusses the environment of the study area, locality and region, including the main features of the bioregion and region (Section 2.1), general landforms of the study area (Section 2.2), geology and soils (Section 2.3), historic land use (Section 2.4), fire history (Section 2.5) and climate (Section 2.6).

2.1 Regional setting

2.1.1 Bioregion

Information regarding the bioregion is summarised from information provided by the OEH. The study area is located within the NSW North Coast Bioregion, which extends up the east coast of NSW from just north of Newcastle to just inside the Queensland border. It covers northern NSW from the shoreline to the Great Escarpment. Typically, there is a sequence of landforms from coastal sand barrier, through low foothills and ranges, to the steep slopes and gorges of the Escarpment itself, with rainfall increasing inland along this transect.

The total area of the bioregion is 5,924,130 hectares (ha) (IBRA 5.1). The NSW portion of North Coast Bioregion occupies 7.11 percent (%) of the state. It has the second highest area of conservation oriented mechanisms of the NSW bioregions. Together, these tenures occupy 1,061,709.63 ha or 18.65% of the bioregion. National parks and nature reserves (under the NSW *National Parks and Wildlife Act 1974* [NPW Act]) make the greatest contribution to the area conserved, occupying 99,386,82 ha, or about 17.42% of the bioregion. Of this area, about 347,425.61 ha is tenured under the NSW *Wilderness Act 1987* and is composed of 11 declared wilderness areas, together occupying about 6.1% of the bioregion.

Other lands managed under the NPW Act includes: land managed as Aboriginal area (125.61 ha or 0.002% of the bioregion); land managed as historic site (482.8 ha or 0.008% of the bioregion); and land managed as state recreation areas (222.1 ha or 0.004% of the bioregion). Within recent years, some landholders have entered into voluntary conservation agreements or property agreements under the NSW *Native Vegetation Conservation Act 1997* and some landholders also hold wildlife refuges.

The Sydney Basin Bioregion bounds the North Coast Bioregion in the south and the Nandewar and New England Tablelands bioregions lie against its western boundary. The Tweed, Richmond, Clarence, Coffs Harbour, Bellinger, Nambucca, Macleay, Hastings and Manning River catchments all fall in the North Coast Bioregion.

2.1.2 Catchment Management Authority Region

The study area is located within the Hunter-Central Rivers CMA Region and the Karuah Manning sub-region (OEH, 2012). This area is within the hinterland of the southern part of the NSW North Coast bioregion, close to the catchment divide between the Karuah and Manning River Valleys. It is in the catchment of the Avon River, which flows north into the Gloucester River and then to the Manning River, before entering the Pacific Ocean near Taree. The Avon River rises to the west of the Project area in Avon River State Forest and Running Creek Nature Reserve, reaching an altitude of 950 m Australian Height Datum (AHD) at Terrible Billy. Avon River State Forest and the adjoining Chichester State Forest form the eastern foothills of the Barrington Plateau, much of which comprises Barrington Tops National Park. Here altitudes reach more than 1,500 m AHD.

A wooded range occurs to the east of the Project area, but with lower altitudes (to 470 m AHD) than to the west. The Glen Nature Reserve is situated approximately 3 km south-east of the Project area (Figure 2). The areas to the north and south of the Project area are predominantly cleared farming land in broad river valleys formed by the confluence of the Avon, Gloucester and Barrington Rivers near the town of Gloucester.

Less than 1 km south of the Project area is a low catchment divide to the valley of the southward flowing Wards River, which joins the Karuah River before emptying into Port Stephens. The Wards River Valley is relatively narrow between steep forested hills.

2.2 Landform

The majority of the Project area is situated on gently undulating terrain at elevations between approximately 120 m AHD in the north and 150 m AHD in the south. The exception is the eastern margin of the site which comprises the steeper eastern slopes on the edge of the wooded range to the east with elevations in excess of 200 m AHD.

2.3 Geology and soils

2.3.1 Bioregion

The geology and geomorphology of the North Coast Bioregion is one of the most diverse in NSW. It has Devonian and Permian bedrocks that are part of the New England Fold Belt and have been closely faulted as they were thrust over the northern margin of the Sydney Basin. Small bodies of granite and granodiorite have intruded the sedimentary rocks and there are three centres of Tertiary basalt eruption.

At the time of the opening of the Tasman Sea by plate movements 80 to 100 million years ago during the break up of Gondwana, the coast of the Australian continent was uplifted and warped. As the ocean widened the uplifted block subsided at the coast and river systems developed that eroded back toward the inland flexure along the warp. Rapid headward erosion of these streams formed the Great Escarpment and cut deep gorges back into the plateau areas of the adjacent New England Tablelands Bioregion. The Great Escarpment is very prominent in this bioregion.

The soil and vegetation patterns in the bioregion are complex because of the different substrates, the topographic variation and the climatic differences encountered across and along the bioregion.

2.3.2 Study area

The dominant soils within the Project area are derived from the Permian sediments of the Gloucester Coal Measures that underlie much of the study area and surrounds (Henderson, 2000). However, the eastern margin of the study area has colluvial soils on steep terrain derived from the Alum Mountain Volcanics and, further east, from Carboniferous sediments (Henderson, 2000).

Floodplains occur only outside the northern extremities of the Project area on the Avon River and Dog Trap Creek. These floodplains are in poor condition and are not considered active due to declines in water volumes over geological time, and are designated as part of the Gloucester Stagnant Alluvial Soil Landscape (Henderson, 2000). The soils of the watercourses within the main parts of the study area, Avondale Creek and tributaries, are characterised as part of the Craven Transferral Soil Landscape and receive sediments from the adjacent low slopes (Henderson, 2000). They are not alluvial soils derived from water borne sediments carried over relatively long distances, such as occurs on permanent incised watercourses like the Avon River and Dog Trap Creek. Owing to the low relief of the Avondale Creek catchment, drainage is slow, resulting in seasonally waterlogged, swampy conditions in the drainage lines.

The soils of the valley floor and the footslopes of the wooded range to the east are similar, being derived from the Gloucester Coal Measures. The soils are of low fertility, acidic, highly erodible, mostly well-drained and hardsetting. The steeper slopes of the wooded range to the east have shallow to moderately deep soils derived from Permian Alum Mountain Volcanics with high stone and gravel contents, low fertility, low water holding capacity, moderate to high erodibility and may be strongly acidic (Henderson, 2000).

2.4 Land use

The flat terrain of the valley floor has experienced extensive vegetation clearing, primarily for the purposes of agriculture. Throughout the district dairying and beef production were the primary industries (Gloucester Shire Council, 2011). There is also evidence of previous pasture improvement associated with milk production, particularly Kikuyu (*Pennisetum clandestinum*) dominated pastures in many paddocks (FloraSearch, 2012). Logging of native forests for timber has also been an important industry in the region historically (Gloucester Shire Council, 2011).

2.5 Fire history

The vegetation within the Stratford Mining Complex is subject to ongoing fire management, with occasional hazard reduction burns. The lower slopes towards the southern extent of the Stratford Mining Complex are burned approximately every 1-3 years, while the vegetation on the valley floor is burned every 5 years (GCL, pers. comm.).

2.6 Climate

The study area is located approximately 50 km inland from the coastline. Long-term meteorological data for the region is available from Commonwealth Bureau of Meteorology (BoM) meteorological stations and is summarised in Table 1.

The long-term average annual rainfall recorded at the Gloucester Post Office (60015), located approximately 14 km north of the Project, is 983 millimetres (mm) (Table 1). Closer to the Project, rainfall records at Craven (Longview) (60042) since 1961 and Gloucester (Hiawatha) (60112) since 1976 indicate the average annual rainfall is 1,057 mm and 1,021 mm, respectively (Table 1). The months with the highest monthly-average rainfalls at the Gloucester Post Office, Craven (Longview) and Gloucester (Hiawatha) meteorological stations are February and March (121.7 mm and 127.9 mm, 136.8 mm and 133.9 mm, and 131.7 and 124.1 mm, respectively) (Table 1). In comparison, the lowest monthly-average rainfalls are July and August (51.4 mm and 46.6 mm, 40.3 mm and 44.3 mm, and 39.9 mm and 36.1 mm) (Table 1).

Evaporation records are available from the Chichester Dam (61151), Taree Airport Automated Weather Station (AWS) (60141) and Paterson (Tocal) AWS (61250) meteorological stations, which have recorded average annual evaporation of approximately 1,059 mm, 1,607 mm and 1,571 mm, respectively (Table 1). The highest monthly average evaporation for Chichester Dam, Taree Airport AWS and Paterson (Tocal) AWS is in December (151.9 mm, 201.5 mm and 210.8 mm, respectively) and the lowest monthly average evaporation is in June (33 mm, 66 mm and 63 mm, respectively) (Table 1).

The closest BoM meteorological stations to the Stratford Mining Complex recording temperature data are located at Chichester Dam and Dungog Post Office (BoM, 2011). Long-term, monthly-average daily maximum and minimum temperatures from Chichester Dam and Dungog Post Office meteorological stations show that temperatures are warmest from November to February and coolest in the winter months of June, July and August (Table 1). Monthly-average daily maximum temperatures at the Dungog Post Office are highest in January (34.0 degrees Celsius [ºC]) and monthly-average daily minimum temperatures are lowest in July (0.3ºC) (Table 1).

Table 1: Meteorological summary – average temperature, rainfall and evaporation.

Period of Record	Average Daily Temperature (°C) [1] [Minimum–Maximum]		Average Monthly Rainfall (mm) [2]					Average Monthly Evaporation (mm) [3]		
	Chichester Dam (61151)	Dungog Post Office (61017)	Data Drill Sequence [4]	Gloucester Post Office (60015) [1]	Craven (Longview) (60042) [1]	Gloucester (Hiawatha) (60112) [1]	Stratford Mining Complex AWS[2,5]	Chichester Dam (61151) [1]	Taree Airport AWS (60141) [1]	Paterson (Tocal) AWS (61250) [1]
	1938 to 1956	1966 to 1975	1889 to 2011	1888 to 2011	1961 to 2011	1976 to 2011	1996 to 2011	1942 to 2011	1999 to 2011	1967 to 2011
January	13.7–30.1	15.7–34.0	121.6	114.8	125.3	113.3	99.6	139.5	201.5	192.2
February	13.8–29.8	15.5–31.1	129.3	121.7	136.8	131.7	111.1	110.2	155.4	149.7
March	13.1–26.2	13.1–29.3	134.6	127.9	133.9	124.1	107.9	93.0	148.8	130.2
April	2.8–23.3	7.6–27.4	88.3	77.3	85.2	83.8	71.1	69.0	105.0	99.0
May	0.8–21.0	6.1–23.6	78.1	68.6	88.3	81.4	72.1	46.5	83.7	74.4
June	4.4–17.4	2.6–19.8	79.9	68.4	79.2	60.4	79.2	33.0	66.0	63.0
July	4.4–15.9	0.3–20.2	58.9	51.4	40.3	39.9	51.0	40.3	74.4	74.4
August	4.9–20.5	3.7–20.8	53.1	46.6	44.3	36.1	36.6	58.9	99.2	105.4
September	6.8–21.8	5.9–25.2	55.9	51.2	47.4	44.5	42.8	87.0	138.0	132.0
October	7.8–23.9	7.5–28.0	73.9	69.2	79.3	68.5	70.6	108.5	158.1	161.2
November	12.3–28.7	10.8–31.4	85.6	83.9	91.8	102.4	106.1	123.0	162.0	174.0
December	14.4–30.7	11.2–31.3	108.1	104.4	98.5	101.7	78.7	151.9	201.5	210.8
Annual Average	*11.0–21.9*	*10.3–24.8*	*1067 [1067.3]*	*983 [985.4]*	*1,057 [1,050.3]*	*1,021 [987.8]*	*924 [926.8]*	*1,059 [1,060.8]*	*1,607 [1,593.6]*	*1,571 [1,566.3]*

[1] Source: BoM (2011).

[2] Source: After Gilbert & Associates (2012).

[3] As measured by Class A Evaporation Pan.

[4] Data Drill located at 32.15°S, 151.95°E – located to the south-west of Mining Lease (ML) 1360 at the Stratford Mining Complex. The Data Drill sequence is a continuous, synthetic record based on interpolation of data from nearby sites.

[5] Records missing for periods: 12 March 2001 to 31 December 2001; 10 February 2005 to 25 March 2005; 7 November 2005 to 30 November 2005; and 17 January 2008 to 13 February 2008.

[ ] Sum of average monthly records.

3 Methods

3.1 Desktop review

A desktop investigation was carried out to identify terrestrial fauna and terrestrial fauna habitat that may be affected by the Project. This included:

- a review of recent fauna survey investigations undertaken within the Project area and surrounds:
  - fauna survey report of surveys within the existing mine lease and some adjacent areas by EcoBiological (Appendix F);
  - fauna survey report of surveys in parts of the area around the Stratford Mining Complex by AMBS (Appendix G);
  - frog survey report for Dog Trap Creek by Biosphere Environmental Consultants (Appendix H);
  - targeted New Holland Mouse survey reports by Kerle, AMBS and EcoBiological (Appendix I); and
  - targeted arboreal mammal survey report by EcoBiological (Appendix J);
- a search of the OEH *Atlas of NSW Wildlife* database for records of threatened fauna within the locality (sourced 19 May 2011) (Appendix B);
- a search of the Commonwealth Department of Sustainability, Environment, Populations and Communities (SEWPaC) *Protected Matters* database for matters of national environmental significance within the locality (sourced 29 April 2011) (Appendix B);
- a search of the Australian Museum collections database (sourced 1 June 2011) (Appendix B);
- a search of the Birds Australia database for records threatened birds within the locality (sourced 20 May 2011) (Appendix B);
- an examination of vegetation maps and reports regarding the vegetation of the Project area and surrounds (FloraSearch, 2012; AMBS, 2011);
- an examination of current and historical aerial photographs of the Project area and surrounds; and
- an examination of topographic maps of the Project area and surrounds.

In addition to the above, a number of reports of earlier survey work (performed prior to the current mining operations) were reviewed:

- Murray (1994);
- Hoye and Finney (1994);
- AGC Woodward-Clyde (1994);
- SCPL (1994);
- Hoye (1998);
- Mount King Ecological Surveys (2001); and
- Richards (2001).

3.2 Field surveys

3.2.1 EcoBiological 2007-2010

This assessment is based to a large extent on the results of fauna surveys undertaken by EcoBiological (Appendix F) between 2007 and 2010. The survey techniques and effort reported by EcoBiological are described in this section and a map indicating the locations of fauna sampling sites is included in Appendix F. Fauna surveys were undertaken between April and November 2007, August 2008, January to February 2009, and February to March 2010. Weather conditions during the surveys were considered appropriate for the target groups, with the exception of heavy rainfall during the 2010 survey, which was sub-optimal for some reptile species. However, reptile surveys were also performed on other occasions.

EcoBiological (Appendix F) report that fauna surveys were designed with reference to the following sources:

- DEC Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities, Working Draft November (DEC, 2004);
- OEH Field Survey Methods – Introduction (NSW Department of Environment and Climate Change [DECC], 2009a);
- OEH Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians (DECC, 2009b);
- Survey Guideline for Australia's Threatened Bats (DEWHA, 2010a);
- Survey Guideline for Australia's Threatened Birds(DEWHA, 2010b); and
- Survey Guideline for Australia's Threatened Frogs (DEWHA 2010c).

EcoBiological (Appendix F) also considered the Flora and Fauna Guidelines: *Lower Hunter and Central Coast Regional Environmental Management Strategy* (Murray *et al*., 2002a, 2002b). Survey guidelines for nationally threatened mammals and reptiles (SEWPaC, 2011a, 2011b) were not available until after the completion of the field surveys.

Stratification of the survey area was based on broad habitat types, with fauna survey sites then distributed accordingly (Appendix F). Fauna habitat assessments were performed across the Project area and surrounds to assess the broad habitat value, considering features such as landscape connectivity, habitat structure, abundance of hollow bearing trees and fallen wood. In addition, a cave habitat survey was undertaken along the range in the eastern portion of the study area. Potential habitat for the Koala was assessed on the basis of the *State Environmental Planning Policy No. 44* (SEPP 44) criteria and the Spot Assessment Technique (SAT) Assessment was used to survey for evidence of Koala activity. The presence of additional feed tree species listed by the *Recovery Plan for the Koala* (*Phascolarctos cinereus*) (DECC, 2008a) was also considered when undertaking the Koala habitat assessment.

Targeted fauna surveys were undertaken using a range of techniques. Species detected were assigned a broad abundance class, based on the frequency with which they were observed. Survey effort for most fauna groups was usually more than the minimum recommendations of the OEH (DEC, 2004) (Tables 2 to 9). Exceptions to this include:

- Elliott B ground traps – EcoBiological (Appendix F) commented that no medium-sized threatened terrestrial mammals were likely to occur, and trapping effort was therefore reduced;
- cage traps – EcoBiological (Appendix F) baited cage traps with raw chicken to target Spotted-tailed Quolls. Other medium-sized mammals that would be attracted to universal bait would not have been targeted by this technique;
- harp traps and ultrasonic call recording – wet sclerophyll forest areas were not sampled due to the high level of disturbance and difficulty of access;
- pitfall traps – this technique was not used due to the difficulty of the terrain, so were considered to not be an efficient trapping method; and
- some of the survey for microbats were carried out during April, July and August, which, whilst sub-optimal months of the year for surveying this fauna group, nevertheless can yield worthwhile data.

Table 2: Field schedule and weather conditions (from EcoBiological [Appendix F]).

Activity	Date	T (°C) min–max	Rainfall (mm)	Cloud 8th	Wind (km/hr)
Fauna trapping	16–20/04/2007	12.2–29.6	1.6	2–8	Calm–2
	20–23/01/2009	15.5–34.7	nil	0–2	Calm–2
	04–07/02/2010	20.7–27.0	3.6	6–8	2–4
	27/09–1/10/2010	7.4–19.0	4.2	0–2	2–4
Spotlighting	23/04/2007	11.5–30.2	nil	2–8	Calm–2
	20–21/08/2008	3.5–20.3	nil	0–4	Calm–6
	04–07/02/2010	20.7–27.0	3.6	6–8	2–4
Anabat call recording	18/4/2007	16.8	nil	Clear	Calm
	19/4/2007	17.2	nil	Clear	Calm–2
	16/7/2007	7.5	nil	0–1	Calm
	17/7/2007	7.2	nil	0–1	Calm
	27/11/2007	20.4	nil	2–3	Calm–2
	20/8/2008	14.8	nil	Clear	Calm
	21/8/2008	15.1	nil	0–2	Calm–2
	20/1/2009	25.8	nil	Clear	2–4
	21/1/2009	27	nil	0–2	Calm
	18/3/2010	15.1	nil	0–2	2–4
Nocturnal call playback	23/04/2007	11.5–30.2	nil	2–8	Calm–2
	20–21/08/2008	3.5–20.3	nil	0–4	Calm–6
	04–07/02/2010	20.7–27.0	3.6	6–8	2–4
	27/09–1/10/2010	7.4–19.0	4.2	0–2	2–4
Bird survey	16–17/04/2007	12.2–29.6	1.6	2–8	Calm–2
	27–28/11/2007	13.5–33.7	nil	2–4	Calm–2
	11–13/08/2008	5.2–18.0	nil	0–4	Calm–6
	20–22/01/2009	15.5–34.7	nil	0–2	Calm–2
	2–3/02/2010	19.0–27.3	7.8	6	2–4
	18–19/03/2010	11.7–28.0	nil	0–8	Calm– 4
Nocturnal herpetological survey	26–28/11/2007	14.7–31.4	nil	2–4	Calm–2
	20–21/01/2009	18.0–33.1	nil	0–2	Calm–2
	1–3/02/2010	16.4–29.3	20.4	2–6	2–4
	27/09–1/10/2010	7.4–19.0	4.2	0–2	2–4
	23/11/2010	12.5–26.5	0	4	2
Diurnal herpetological survey	16–21/04/2007	12.2–29.6	1.6	2–8	Calm–2
	20–21/01/2009	15.5–34.7	nil	0–2	Calm–2
	1–3/02/2010	16.4–29.3	20.4	2–6	2–4
	1–5/11/2010	10.2–25.0	65.6	0–8	2–6

km/hr = kilometres per hour.

Table 3: Weather conditions during the period two weeks prior to surveys (from EcoBiological [Appendix F]).

Dates	T (°C) min–max	Rainfall (mm)	Cloud 8th	Wind (km/hr)
1–15/04/2007	13.0–24.5	13.8	0–8	Calm–2
15–29/11/2007	14.9–30.4	100.4	2–8	Calm–2
5–19/08/2008	6.4–17.2	20.6	2–8	2–10
5–19/01/2009	16.4–31.8	24.2	0–8	Calm–2
20/1–3/2/2010	15.5–38.6	30.8	0–8	Calm–4
13–26/09/2010	1.0–26.0	18.6	0–8	Calm–7
14–31/10/2010	9.0–28.6	60.2	0–8	Calm–9
9–22/11/2010	11.2–31.0	54.7	2–8	Calm–4

Table 4: Survey effort for mammals (from EcoBiological [Appendix F]).

Method	Survey effort required/ delivered	Dry Sclerophyll Forests	Grassy Woodlands	Wetland/Creek	Comments
Area (ha)		**400.82**	**121.88**	**26.04**	
Elliott A (trap nights)	DEC	500	200	NA	
	EcoBiological	720	400		
Elliott B ground (trap nights)	DEC	500	200	NA	
	EcoBiological	160	72		No medium-sized threatened terrestrial mammals were likely to occur, therefore trapping effort was reduced.
Cage (trap nights)	DEC	120	48	NA	
	EcoBiological	152	64		
Arboreal Elliott (trap nights)	DEC	120	48	NA	
	EcoBiological	248	112		
Hair tube ground (trap nights)	DEC	400	160	NA	
	EcoBiological	400	160		
Hair tube tree (trap nights)	DEC	120	60	NA	
	EcoBiological	276	144		
Nocturnal spotlight	DEC	5 hours	2 hours	NA	
	EcoBiological	7 hours	4 hours		

DEC = DEC 2004 survey effort requirements/EcoBiological = survey effort by EcoBiological

Table 5: Survey effort for bats (from EcoBiological [Appendix F]).

Method	Survey effort required/ delivered	Wet Sclerophyll Forests	Dry Sclerophyll Forests	Grassy Woodlands	Wetland/Creek
Area (ha)		**28.24**	**400.82**	**121.88**	**26.04**
Harp trap (trap nights)	DEC		16 nights	8 nights	NA
	EcoBiological	Not sampled*	32 nights	16 nights	
Anabat	DEC		64 hours	32 hours	NA
	EcoBiological	Not sampled*	10 nights/120 hours	10 nights/60 hours	

* Wet Sclerophyll Forest areas were not sampled due to the high level of disturbance; *Lantana camara* dominated these areas creating low quality habitat and difficult access.

Table 6: Survey effort for birds (from EcoBiological [Appendix F]).

Method	Survey effort required/ delivered	Wet Sclerophyll Forests	Dry Sclerophyll Forests	Grassy Woodlands	Wetland/Creek
Area (ha)		**28.24**	**400.82**	**121.88**	**26.04**
Diurnal bird surveys (includes replication)	DEC	There is no minimum recommended survey effort per stratification unit. A suggested commonly used method is 20 minutes per ha. EcoBiological conducted 20-30 minute surveys for the same area.			
	EcoBiological	2 surveys	25 surveys	14 surveys	7 surveys

Table 7: Survey effort for call playback (from EcoBiological [Appendix F]).

Owl call playbacks	DEC (2004) Survey Requirement	EcoBiological Effort
Powerful Owl	5 visits per site on different nights	6 sites 5 visits
Barking Owl	5 visits per site on different nights	6 sites 5 visits
Grass Owl	5 visits per site on different nights	6 sites 5 visits
Sooty Owl	6 visits per site on different nights	2 sites 6 visits*
Masked Owl	8 visits per site on different nights	5 sites 8 visits, 1 site 2 visits

* Only two sites were found to be potentially suitable for the Sooty Owl.

Table 8: Survey effort for frogs (from EcoBiological [Appendix F]).

Species	Habitat	Timing	EcoBiological Effort
Mixophyes balbus (three suitable streams, one accessible)	Mountain streams	September–April	One 200 m nocturnal transect on two occasions, tadpole survey, call playback
Mixophyes iteratus (suitable habitat not present for this species)	Large streams near forest	September–March	Not required
Litoria aurea (large areas of marginal habitat)	Wetlands, dams	August–February	Three four hourly searches at large waterbodies, one hour on three separate occasions at small waterbodies, call playbacks, tadpole surveys
Litoria booroolongensis (three suitable streams, one accessible)	Mountain streams	December–February	One 200 m nocturnal transect on two occasions, tadpole survey, call playback
Litoria daviesae (three suitable streams, one accessible)	Mountain streams	September–March	One 200 m nocturnal transect on two occasions, tadpole survey, call playback

Table 9: Survey effort for reptiles (from EcoBiological [Appendix F]).

Method	Survey effort required/ delivered	Wet Sclerophyll Forests	Dry Sclerophyll Forests	Grassy Woodlands	Wetland/ Creek
Area (ha)		**28.24**	**400.82**	**121.88**	**26.04**
Reptile run (trap nights)	DEC		120	48	NA
	EcoBiological		180	48	
Diurnal reptile survey (30 min surveys on separate days)	DEC	1 hour	4 hours	2 hours	NA
	EcoBiological	1 hour	7 hours	3 hours	
Nocturnal reptile survey (30 min surveys on separate days)	DEC	1 hour	4 hours	2 hours	NA
	EcoBiological	1 hour	4 hours	4 hours	

3.2.2 Targeted surveys for the New Holland Mouse

Surveys targeting the New Holland Mouse (*Pseudomys novaehollandiae*) were undertaken in three separate studies during 2010 and 2011 and the survey reports are provided in Appendix I. The surveys were designed to record the presence of this species and the habitat types that were being utilised. The surveys did not distinguish between areas that would be used for foraging and breeding. Summaries of the methods used are provided in this section.

EcoBiological (Appendix I) performed surveys at six locations using Elliot traps between 27 September and 1 October 2010. Three of these sites were within the Project area and surrounds, two were within the Offset areas, and one site was within the Offset area for the DCM, which is located to the south of Stratford. At each site 25 Elliot traps were deployed. Habitat assessments were conducted within a 20 x 20 m plot at each sampling site, midway along each trapping line.

Kerle (Appendix I) performed surveys at five locations using Elliot traps between 31 January and 4 February 2011. One of these sites was within the Project area and immediate surrounds (STA4), and three were within the Offset areas (STA2, STA3, STA5). A total of 25 Elliot traps were deployed at each of three sites (STA1, STA2 and STA3), 13 were placed at STA4 and 12 at STA5. Habitat assessments were undertaken along each trapping transect.

AMBS (Appendix I) performed surveys at 18 locations using Elliot traps during March to May 2011. Four of these sites were within the Offset areas and the remainder in other locations within the Gloucester Valley outside of the Project area. At each site 25 Elliot traps were deployed. Habitat assessments were conducted within a 20 x 20 m plot at each sampling site, midway along each trapping line.

The habitat assessments undertaken during each of the aforementioned surveys used similar methodologies. In general, each habitat assessment survey used a 20 x 20 m plot midway along each trapping line and the following attributes were recorded:

- native plant diversity;
- percent overstorey and midstorey projected foliage cover;
- precent cover of grasses and shrubs;
- projected exotic foliage cover;
- number of hollow trees;
- presence/absence of overstorey regeneration;
- total length of hollow logs;
- leaf litter cover;
- soil type; and
- disturbance history (evidence of fire, vegetation clearing, grazing, etc.).

In addition, AMBS (Appendix I) estimated the density of the ground layer, using a density measure in each survey plot. The density of the vegetation at a height of 0.5 m or less was estimated and expressed as a percentage. The density score was determined by observing the distribution of the vegetation density from all strata below 0.5 m across the plot vertically and estimating the thickness of the layer horizontally.

3.2.3 Arboreal mammal survey

EcoBiological (Appendix J) performed targeted arboreal mammal surveys in areas outside the Project area between 1 and 5 November 2010. A total of five sampling sites were used. At each site the following techniques were used:

- spotlighting on foot – 2 hours on two nights at each site;
- spotlighting from a vehicle – travelling at about 5 km per hour, transects were driven over two nights along existing roads or tracks;
- Elliot B traps (arboreal) – six traps at each site for four consecutive nights, with universal bait;
- arboreal pipe traps – two PVC pipe traps in trees at each site over four consecutive nights;
- infra-red cameras – 20 camera nights, with universal bait;
- call playback – used to target the Squirrel Glider - two call playback locations were chosen at each site, and each location was surveyed twice over different nights;
- secondary evidence – searches for faecal pellets and evidence of sap feeding were undertaken at each site; and
- habitat assessment – a rapid habitat assessment was undertaken at each site.

3.2.4 Threatened frog survey

Biosphere Environmental Consultants (Appendix H) performed targeted surveys for threatened frog species at Dog Trap Creek during February 2011. Nocturnal frog surveys were conducted at six sites. At each site call playback was undertaken for the Giant Barred Frog (*Mixophyes iteratus*) and the Green and Golden Bell Frog (*Litoria aurea*), followed by a 2-hour streamside search along a 200 m transect. Tadpoles were surveyed at each site for 1 hour using a dip net. Habitat assessments were also undertaken at each site, recording vegetation, topography and water quality characteristics.

3.2.5 Additional bird surveys and habitat assessment

AMBS (Appendix I) performed bird surveys and nocturnal call playback in areas outside the Project area during April and May 2011. Diurnal bird surveys involved 20-minute surveys, performed at 18 sites within 3 hours of dawn and at six sites during the late afternoon. Nocturnal call playback was undertaken at four sites, one of which was within the proposed Offset areas (CP3). Survey effort undertaken for threatened nocturnal bird species is shown in Table 10.

Table 10: Survey effort for call playback targeting threatened nocturnal birds outside the Project area (from Appendix I).

Common Name	Scientific Name	Number of nights call playback undertaken			
		Site			
		CP1	CP2	CP3	CP4
Bush Stone-curlew	*Burhinus grallarius*	1	5	5	-
Powerful Owl	*Ninox strenua*	1	5	5	-
Masked Owl	*Tyto novaehollandiae*	1	7	7	-
Barking Owl	*Ninox connivens*	1	5	5	-
Sooty Owl	*Tyto tenebricosa*	-	5	5	-
Grass Owl	*Tyto capensis*	-	-	-	4

AMBS (Appendix G) also carried out diurnal bird surveys within the Project area and surrounds during June and July 2011 to target the Swift Parrot and Regent Honeyeater. A total of 12 sites were surveyed, with each being surveyed on four separate occasions, for 20 minutes each survey.

Fauna habitat assessments were performed at 57 sites throughout the study area. Vegetation mapping of the study area was used as a guide for stratification and sites were distributed accordingly within each vegetation type. At each standard site, the following features were recorded within an area of 50 x 100 m:

- broad habitat type;
- age structure;
- predominant topography;
- altitude;
- disturbance history (e.g. fire, grazing);
- dominant shrub growth;
- dominant ground layer;
- litter/humus depth;
- abundance of key plant species (e.g. *Acacia* spp., *Allocasuarina* spp.);
- abundance of weeds;
- ground layer features (percent cover vegetation, rock, soil, litter, logs);
- number of large dead trees;
- number of trees with hollows;
- number of hollows (small <10 centimetres (cm), medium 10-30 cm, large >30 cm, or basal hollows);
- abundance of decorticating bark;
- number of logged stumps, fallen branches and rock crevices;
- length of large (>30 cm) logs; and
- stream or waterbody characteristics.

At locations throughout the study area where standard habitat assessments were not undertaken, brief habitat descriptions and photographs were recorded. It was also noted whether the habitat was similar to an area in which a standard habitat assessment was undertaken.

3.2.6 Fauna surveys in a wider area around the project

A range of fauna surveys were performed by AMBS outside of the Project area and immediate surrounds. These included surveys in the Offset areas and also in other locations where access was made available. Surveys were performed in winter (June, July and August 2011) and spring (September and October 2011). Summaries of the fauna survey techniques and effort undertaken are provided in Tables 11 and 12.

Table 11: Winter fauna survey techniques and effort (from Appendix G).

Technique	No. of sites	No. deployed per site	Survey effort/Description
Diurnal bird census	23	n/a	Survey dates: 28/06/2011 – 2/07/2011; 19–26/07/2011. Twenty-minute survey within 3 hours of dawn, with 18 sites surveyed four times and five sites surveyed once. All birds observed or heard were recorded. Surveys targeted flowering trees where possible.
Hair funnels (ground)	10	20	Left for a minimum of 14 days at each site between 28/06/2011 and 12/08/2011. All hair funnels were baited with chicken necks in order to target the Spotted-tailed Quoll. Spacing between funnels at each site was 100 m.
Hair tubes (arboreal)	10	30	Left for a minimum of 14 days at each site between 28/06/2011 and 12/08/2011. Each tube contained universal bait or universal bait with sardines in order to target the Brush-tailed Phascogale. Tubes were placed between 0.5–2 m above the ground and spacing was approximately 20 m.
Infra-red cameras	12	1	Each camera was left for a minimum of 14 days between 28/06/2011 and 12/08/2011. Each camera was attached to a tree approximately 0.5 m above the ground. A bait chamber with chicken necks was positioned between 1–3 m from the camera, in order to target the Spotted-tailed Quoll.

Table 12: Spring fauna survey techniques and effort (from Appendix G).

Technique	No. of sites	No. deployed per site	Survey effort/Description
Elliot A traps (ground)	16	25	Traps were checked every morning for 4 days (100 trap nights at each site). Each trap contained universal bait, cotton wool or leaf litter, and was placed in a plastic bag. Spacing between traps was 10 m.
Cage traps	16	6	Traps were checked every morning for 4 days (24 trap nights at each site). Each trap contained universal bait with truffle oil in order to target the Long-nosed Potoroo. Spacing between traps was about 50 m.
Elliot B traps (on tree platforms)	16	6	Traps were checked every morning for 3–4 days (24 trap nights at each site). Elliot B traps were placed on tree mounts approximately 3–5 m above the ground. Each trap contained universal bait, cotton wool or leaf litter, and was placed in a plastic bag. A honey-water solution was sprayed up and down the tree trunk as an additional attractant. Spacing between traps was at least 20 m.
Funnel traps	20	4	Two funnel traps were paired at 1 m in from each end of a 10 m polyethylene drift fence. Traps were checked every morning for

Technique	No. of sites	No. deployed per site	Survey effort/Description
			4 days (16 trap nights at each site).
Hair funnels (ground)	19	20	Hair funnels at most sites were left for a minimum of 14 days between 19/09/2011 and 15/10/2011. Four sites in the north-east were left for 7 days due to site access limitations. Hair funnels were baited alternating with universal bait or universal bait with truffle oil. Spacing between funnels was 20 m.
Diurnal bird census	28	n/a	Twenty-minute standard search within 3 hours of dawn. All birds observed or heard were recorded.
Diurnal reptile search	16	n/a	Active search of potential reptile habitats performed for 60 person minutes at each site.
Nocturnal call playback (targeting forest owls)	4	n/a	Each session included an initial listening period (10 minutes) followed by call broadcast of Bush Stone-curlew (5 nights per site), Powerful Owl (5 nights per site), Masked Owl (8 nights per site), Barking Owl (5 nights per site) and Sooty Owl (5 nights per site). Each broadcast was for 5 minutes followed by 5 minutes of listening. A 10 minute spotlighting session was performed following the final listening period. All species observed or heard were recorded.
Nocturnal call playback (other)	18	n/a	Call playback was undertaken for the Yellow-bellied Glider (11 sites), Squirrel Glider (10 sites) and Koala (10 sites) on one occasion at each site. Each session included an initial listening period (10 minutes) followed by call broadcast (5 minutes each species). Each broadcast was followed by 5 minutes of listening. Spotlighting followed each call playback session (see below). Call playback was also undertaken opportunistically for the Masked Owl (1 site) and Sooty Owl (2 sites) at locations where potential habitat was considered to occur.
Nocturnal spotlighting	12	n/a	Active searches for nocturnal species, including amphibians, reptiles and mammals were performed for 60 person minutes at each site. All species observed or heard were identified. Spotlighting from a vehicle also occurred at two sites, on two occasions at each site.
Nocturnal frog search	6	n/a	Searches were performed for 30-60 person minutes at each site and all species observed or heard were identified. Each site was surveyed on 2 separate nights.
Harp trapping	25	1	Harp traps were checked each morning for 2 days (2 trap nights at each site).
Anabat	44	1	Anabats were left overnight for 2 nights at each site and retrieved each morning.
Opportunistic records	n/a	n/a	Opportunistic observations of fauna were recorded.
Infra-red cameras	22	1	All cameras left in-situ for a minimum of 14 days between 19/09/2011 and 15/10/2011. Four sites were left in-situ for 7 days due to site access limitations.

3.2.7 Earlier survey reports

Frog surveys were undertaken by SCPL (1994), Murray (1994) and Mount King Ecological Surveys (2001) prior to the current Stratford Mining Complex developments. SCPL (1994) performed frog surveys in early October 1981 and March 1982 as part of a larger fauna survey that utilised techniques such as trapping, spotlighting and active diurnal searches. Murray (1994) performed frog surveys over two days in July 1994, which included diurnal investigations, spotlighting and listening for calls. Mount King Ecological Surveys (2001) performed fauna surveys at the BRNOC in October and November 2000 for six days utilising spotlighting techniques around dams and other waterbodies and recorded frog calls that were subsequently identified.

Reptile surveys were undertaken by SCPL (1994) and Mount King Ecological Surveys (2001) prior to the current Stratford Mining Complex developments. SCPL (1994) incorporated reptile surveys with frog surveys (described above) and used techniques such as trapping, spotlighting and active diurnal searches. Mount King Ecological Surveys (2001) searched for reptiles using a range of active techniques (such as searching under rocks, logs and tin and prising the bark from dead trees). Between 1 and 2 hours was spent at each site searching for reptile species (Mount King Ecological Surveys, 2001).

Bird surveys were performed by AGC Woodward-Clyde (1994) and Mount King Ecological Surveys (2001) prior to the current Stratford Mining Complex developments. AGC Woodward-Clyde (1994) performed surveys in late September 1981 and March 1982 over a total of six days. Methods to detect birds employed by AGC Woodward-Clyde (1994) consisted of direct observations along transects. Mount King Ecological Surveys (2001) also performed surveys in which they recorded all birds that were seen and heard, as well as call playback (targeting the Barking Owl, Masked Owl, Powerful Owl, Tawny Frogmouth and Owlet Nightjar).

Hoye and Finney (1994) performed surveys from 25 to 29 July 1994 which used mist nests and harp traps, Anabat call recording and spotlighting. Hoye (1998) surveyed the Project area using the following methods: mist nests and harp traps; Anabat call recording; spotlighting; and radio-tracking of bats to locate day roost sites. Richards (2001) completed targeted surveys for threatened bat species at the BRNOC on 3 May 2000 using Anabat call recording.

Methods used to detect mammal species during Mount King Ecological Surveys (2001) surveys consisted of: Elliot trapping (both on-ground and in trees); cage trapping; spotlighting; the use of hair tubes; call playback of nocturnal mammals; pitfall trapping; and habitat characterisation.

3.3 Assessment of impacts

The potential impacts of the Project on fauna of conservation significance were considered in three phases. The first phase considered the likely potential impacts of the Project on fauna and fauna habitat. This consideration included direct and indirect impacts. A discussion of these potential impacts is presented in Section 5.

The second phase used the results of the database searches, fauna surveys and habitat assessments to determine whether a particular species was likely to occur within the Project area, utilise habitats within the Project area on occasion, or be influenced by off-site impacts of the Project. The results of this assessment are presented in Appendix B.

Where threatened fauna were considered likely to occur within the Project area, utilise habitats within the Project area on occasion or be influenced by off-site impacts of the Project, the significance of the potential impacts of the Project on those fauna was assessed. The significance of potential impacts on relevant threatened species and populations listed on the schedules of the TSC Act were assessed by application of the Seven Part Test in accordance with Section 5A of the EP&A Act and the *Threatened Species Assessment Guideline – the Assessment of Significance* (DPI, 2008). The significance of potential impacts on relevant matters of national environmental significance was assessed in accordance with the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines* (DEWHA, 2009).

3.4 Mitigation measures and offset areas

The Project will include a range of measures to reduce or mitigate potential impacts and also includes Offset areas. Mitigation measures were considered in Section 6 and the Offset areas in Section 7.

4 Results

4.1 Database searches for threatened species

The search of database records for threatened fauna within a 20 km radius of the Project area provided a list of 65 animal species that are listed as threatened on the EPBC Act and/or TSC Act, including six species of frog, two species of reptile, 32 species of bird and 25 species of mammal. The list includes species that have previously been reported within this area as well as species that were predicted by the EPBC Act *Protected Matters* database to have potential habitat within this area. The list of these threatened species presented in Appendix B, together with information about each species regarding whether there are previous records from the area, whether the species was detected during fauna surveys, an assessment of the likelihood that the species would occur within the Project area and an assessment of the likelihood that the species would be affected by the Project.

Thirty-three of the species listed in Appendix B are known or considered likely to occur in the Project area or immediate surrounds, including 17 species of bird and 16 species of mammal listed on the TSC Act (five of which are also listed on the EPBC Act) and one species of mammal (the New Holland Mouse) that is listed on the EPBC Act, but not the TSC Act. These species are considered further in Section 5.3.

4.2 Fauna recorded in the project area and/or surrounds

A total of 289 animal species have been recorded within the Project area or surrounds since 1994. This includes 20 species of frog, 31 species of reptile, 183 species of bird and 55 species of mammal. A complete list is provided in Appendix A. The results of the fauna survey demonstrate that there is good representation of species diversity across all faunal types within the area.

4.2.1 Exotic fauna

Thirteen of the animal species known to occur in the area are exotic fauna, including four species of bird and nine species of mammal (Appendix A). Exotic species that have been recorded in the study area include the Rock Dove, Spotted Turtle-Dove, Common Starling, Common Myna, House Mouse, Black Rat, Domestic Dog, Red Fox, Cat, Brown Hare, European Hare, Rabbit, and European Cattle. EcoBiological (Appendix F) considered exotic species to be uncommon, with the exception of the Rabbit, which was considered common.

4.2.2 Threatened fauna species

Threatened fauna that have been recorded within the Project area or surrounds are listed in Table 13, together with the source of the records. The locations of these threatened species records are shown on Figures 4a to 4d.

Table 13: Threatened fauna species recorded in the Project area or surrounds.

Scientific Name	Common Name	Conservation Status[1]		Comment
		TSC Act	EPBC Act	
Birds				
Irediparra gallinacea	Comb-crested Jacana	V	-	Two individual Comb-crested Jacanas were recorded once to the south of the Project area within a farm dam during recent surveys by AMBS (Appendix G) (Figure 4a).
Anseranas semipalmata	Magpie Goose	V	-	One individual Magpie Goose was opportunistically recorded flying from a wetland area in 2010 by EcoBiological (Appendix F) (Figure 4a).
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-	The Glossy Black-cockatoo was recorded by AGC Woodward-Clyde (1994) within the study area (the exact location was not reported). This species was regarded as uncommon and was recorded within dry sclerophyll forest habitat (AGC Woodward-Clyde, 1994). More recently, the Glossy Black-cockatoo has been recorded in the eastern portion of the Project area (Figure 4a) within Dry and Wet Sclerophyll Forest (Appendix F), and to the east of the Project area, on the footslopes (Appendix G). Evidence of feeding has been reported from a number of locations in the study area by a range of sources.
Glossopsitta pusilla	Little Lorikeet	V	-	The Little Lorikeet was recorded by AGC Woodward-Clyde (1994) within the study area (the exact location was not reported). This species was regarded as uncommon and was recorded within savannah woodland habitat (AGC Woodward-Clyde, 1994). Two individuals were also recorded in the southern part of the Project area in Dry Sclerophyll Forest during recent surveys by AMBS (Appendix G) (Figure 4a).
Tyto novaehollandiae	Masked Owl	V	-	Two Masked Owls were recorded within the Project area by EcoBiological in 2010 within the Spotted Gum/ Thick-leaved Mahogany forest habitat (Appendix F). An individual of this species was also recorded south, outside of the Project area during recent surveys by AMBS (Appendix G) (Figure 4a).
Tyto tenebricosa	Sooty Owl	V	-	One Sooty Owl was recorded in the ranges to the north-east of the Project area during recent surveys by AMBS (Appendix G).
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	One individual Gang-gang Cockatoo was recorded at one location (Figure 4a) south of the Project area, within dense vegetation close to the proposed Offset areas (EcoBiological, 2009).
Pyrrholaemus saggitatus	Speckled Warbler	V	-	The Speckled Warbler was recorded by AGC Woodward-Clyde (1994) within the study area (the exact location was not reported). This species was regarded as uncommon and was recorded within dry sclerophyll forest habitat (AGC Woodward-Clyde, 1994). Two individuals of this species were also recorded once in a small patch of Dry Sclerophyll Forest located to the west of the BRNOC during recent surveys by AMBS (Appendix G) (Figure 4a).

Scientific Name	Common Name	Conservation Status[1]		Comment
		TSC Act	EPBC Act	
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	The Hooded Robin (south-eastern form) was recorded by AGC Woodward-Clyde (1994) within the study area (the exact location was not reported). The species was regarded as uncommon and has not been recorded recently in the study area.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	The Brown Treecreeper (eastern subspecies) was recorded by AGC Woodward-Clyde (1994) within the study area (the exact location was not reported). The species was regarded as uncommon and has not been recorded recently in the study area.
Petroica phoenicea	Flame Robin	V	-	One individual Flame Robin was recorded to the south of the Project area in Wet Sclerophyll Forest, near the proposed Offset areas during recent surveys by AMBS (Appendix G) (Figure 4a).
Petroica boodang	Scarlet Robin	V	-	One individual Scarlet Robin was recorded once within the Project area in Dry Sclerophyll Forest, during recent surveys by AMBS (Appendix G) (Figure 4a).
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	AGC Woodward-Clyde (1994) recorded the Grey-crowned Babbler (eastern subspecies) within the study area (the exact location was not reported). More recently, seven Grey-crowned Babblers (eastern subspecies) were recorded opportunistically during bird surveys within the Project area in 2007 (Appendix F). In addition, several Grey-crowned Babbler (eastern subspecies) nests were located within the northern, south-western and southern portions of the study area (Figure 4a) (Appendix F). This species was also recorded to the north and south of the Project area on 16 occasions during recent surveys by AMBS (Appendix G) (Figure 4a). The number of individuals observed during each sighting ranged from two to seven.
Daphoenositta chrysoptera	Varied Sittella	V	-	The Varied Sittella was recorded by AGC Woodward-Clyde (1994) within the study area (the exact location was not reported). EcoBiological (Appendix F) (Figure 4a) also recorded this species during bird surveys in 2007 and 2010. Two individuals were located in 2007, while six and three individuals were recorded within 2010 during two separated sightings (Appendix F). During 2011, AMBS recorded the species in more than 10 locations, in Grassy Woodlands, Dry and Wet Sclerophyll Forest (Appendices G and I), with numbers of individuals observed during each sighting ranging from two to ten.
Stagonopleura guttata	Diamond Firetail	V	-	The Diamond Firetail was recorded by AGC Woodward-Clyde (1994) within the study area (the exact location was not reported). The species was regarded as uncommon and has not been recorded recently in the study area.

Scientific Name	Common Name	Conservation Status[1]		Comment
		TSC Act	EPBC Act	
Mammals				
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	The Brush-tailed Phascogale was recorded at various locations within and around the Project area (Figure 4b). EcoBiological (Appendix F) recorded the Brush-tailed Phascogale in 2008 and 2010 through the use of Elliot traps. Both individuals were recorded within the Cabbage Gum grassy woodland habitat within the north-eastern and south-eastern portions of the Project area (Figure 4b) (Appendix F). This species was also recorded by AMBS to the west, south and north of the Project area including three locations within the Voluntary Conservation Area to the south-west (Appendix G). The Australian Museum (2011) recorded one individual close to the Glen Nature Reserve (Figure 4b). Kerle (Appendix I) also recorded this species to the south of the Project area, while EcoBiological (Appendix I) recorded it to the north of the Project area (Figure 4b).
Phascolarctos cinereus	Koala	V	-	The Koala was recorded at a number of locations outside the Project area (Figure 4b). Two individuals of the species were recorded within the Voluntary Conservation Area and also one within the Glen Nature Reserve by EcoBiological (Appendix J) (Figure 4b). The species was also recorded twice within Grassy Woodland habitat and once within Wet Sclerophyll Forest to the south of the Project area during recent surveys by AMBS (Appendix G) (Figure 4b).
Petaurus norfolcensis	Squirrel Glider	V	-	The Squirrel Glider was recorded opportunistically during bat surveys by Hoye and Finney (1994). It was observed during spotlighting in remnant vegetation along a track off Parker's Road between areas that are now part of the SCM (Figure 4b) (Hoye and Finney, 1994). EcoBiological (Appendix F) also recorded an individual Squirrel Glider during a trapping survey in 2007. This individual was recorded within the eastern portion of the Project area within the Cabbage Gum grassy woodland habitat (Figure 4b) (Appendix F). Two individuals were subsequently recorded to the north of the Project area (Appendix J) (Figure 4b). A further three Squirrel Gliders were recorded in Dry Sclerophyll Forest south of Bowens Road and two in a patch of vegetation west of the Project area during recent surveys by AMBS (Figure 4b) (Appendix G).
Petaurus australis	Yellow-bellied Glider	V		The Yellow-bellied Glider was recorded in three locations outside of the Project area (Figure 4b). AMBS (Appendix G) recorded two individuals; one to the far south and one to the north-east within Wet Sclerophyll Forest (Figure 4b). An individual was also recorded to the east by EcoBiological, within the Glen Nature Reserve (Figure 4b) (Appendix I).

Scientific Name	Common Name	Conservation Status[1]		Comment
		TSC Act	EPBC Act	
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	The Long-nosed Potoroo was recorded in three locations; one adjacent and to the east of the Project area and two to the south of the Project area within Wet Sclerophyll Forest, during recent surveys by AMBS (Figure 4b) (Appendix G).
Pseudomys novaehollandiae	New Holland Mouse	-	V	An individual New Holland Mouse was recorded in 2010 within the eastern portion of the Project area and surrounds (Figure 4b) by EcoBiological (Appendix F). This individual was detected during trapping surveys within the White-Stringybark/Grey Ironbark forest habitat. A further four individuals were recorded in February 2010 in the Project area and an individual was recorded within the DCM Offset by EcoBiological (Appendix I) (Figure 4b). An additional targeted survey for the New Holland Mouse was performed in January 2011 by Kerle (Appendix I). Kerle (Appendix I) recorded two New Holland Mice in the eastern portion of the Project area and surrounds (Figure 4b). Further surveys performed by AMBS (Appendices G and I) recorded a number of New Holland Mice to the south of the Project area (Figure 4b).
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Three individuals of this species were recorded to the south of the Project area by AMBS (Appendix G) (Figure 4b).
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Richards (2001) recorded the Yellow-bellied Sheathtail-bat in the northern portion of the study area; however, the exact location was not reported.
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	The Eastern Freetail-bat was recorded by EcoBiological (Appendix F) (Figure 4c) at one location in 2007 and 2008 and three locations in 2010 (Appendix F). This species was recorded within the south-eastern and north-eastern portions of the Project area (Figure 4c) within the Cabbage Gum grassy woodland, White-Stringybark/Grey Ironbark forest and Spotted Gum/Thick-leaved Mahogany forest habitats (Appendix F). This species was also detected by AMBS in a number of locations outside the Project area (Figure 4c) (Appendix G).
Miniopterus australis	Little Bentwing-bat	V	-	EcoBiological (Appendix I) recorded the Little Bentwing-bat from three locations during 2010 (Figure 4c). This species was recorded within the south-eastern portion of the Project area (Figure 4c) within the Cabbage Gum grassy woodland habitat and also within the north-eastern portion of the Project area (Appendix F) (Figure 4c). Further surveys by AMBS (Appendix G) recorded this species at a number of locations outside of the Project area, including the Voluntary Conservation Area to the south-west (Figure 4c).

Scientific Name	Common Name	Conservation Status[1]		Comment
		TSC Act	EPBC Act	
Myotis macropus	Southern Myotis	V	-	Hoye (1998) recorded the Southern Myotis within the study area; however, the exact location was not reported. EcoBiological (2009) recorded an individual to the south of the Project area within wooded vegetation and a further thirteen individuals were recorded to the east and south by AMBS (Appendix G) (Figure 4c).
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	The Eastern Bentwing-bat has been recorded during multiple surveys within the study area. Early records were made by Hoye and Finney (1994) and Hoye (1998); however, the exact locations were not reported. More recently, the Eastern Bentwing-bat was recorded at five locations in 2008 and two locations in 2010 in and around the Project area (Appendix F) (Figure 4c). An individual was also recorded far south of the Project area (EcoBiological, 2009) and the species was detected at a number of other locations outside the Project area by AMBS (Appendix G) (Figure 4c).
Scoteanax ruepellii	Greater Broad-nosed Bat	V	-	Hoye (1998) recorded the Greater Broad-nosed Bat within the study area; however, the exact location was not reported. "Possible" ultrasound recording of this species were made outside of the Project area by AMBS surveys (Appendix G) (Figure 4d).

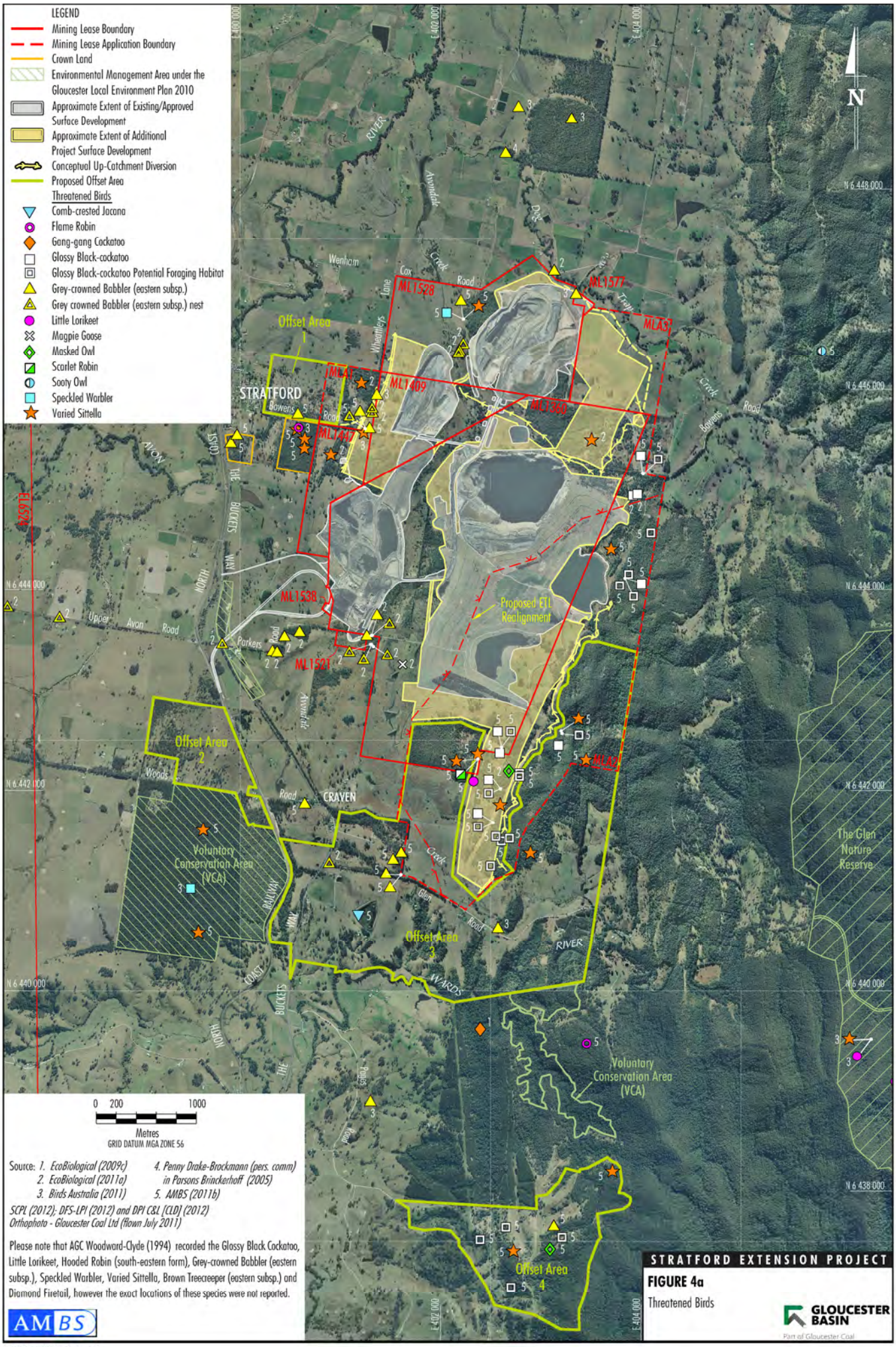
[1] Threatened species status under the TSC Act and EPBC Act (current as at 16 February 2012).
V Vulnerable E Endangered

Three species of threatened microchiropteran bats were potentially recorded by AMBS during surveys outside of the Project area (Appendix G). These records were obtained by ultrasound recording and were considered to be 'possible' or 'probable' records because a definite identification could not be made. The reason for uncertain identification was due to:

- poor quality of some of the recordings; and/or
- recordings of partial calls only; and/or
- similarity of calls between some species.

These 'possible' records consisted of the following species: Large-eared pied Bat (*Chalinolobus dwyeri*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and Eastern Cave Bat (*Vespadelus troughtoni*) (Appendix G; Figure 4d). All three species are listed as vulnerable under the TSC Act, and the Large-eared pied Bat is also listed as vulnerable under the EPBC Act. These records have been included in the results, based on the precautionary principle.

The accuracy of data for threatened species that have been provided by external sources cannot be guaranteed. For example, the level of accuracy of OEH records can range from 10 to 1,000 m, depending on the sensitivity of species and the where the records have been taken from. However, where dates and accuracy levels for records were available (e.g. when looking at OEH records), these factors were taken into consideration when undertaking 'assessments of significance' under both the EPBC Act and TSC Act for species considered likely to be impacted by the Project.



Source: 1. EcoBiological (2009c) 2. EcoBiological (2011a) 3. Birds Australia (2011) 4. Penny Drake-Brockmann (pers. comm) in Parsons Brinckerhoff (2005) 5. AMBS (2011b)

SCPL (2012); DFS-LPI (2012) and DPI C&L (CLD) (2012)
Orthophoto - Gloucester Coal Ltd (flown July 2011)

Please note that AGC Woodward-Clyde (1994) recorded the Glossy Black Cockatoo, Little Lorikeet, Hooded Robin (south-eastern form), Grey-crowned Babbler (eastern subsp.), Speckled Warbler, Varied Sittella, Brown Treecreeper (eastern subsp.) and Diamond Firetail, however the exact locations of these species were not reported.

AMBS

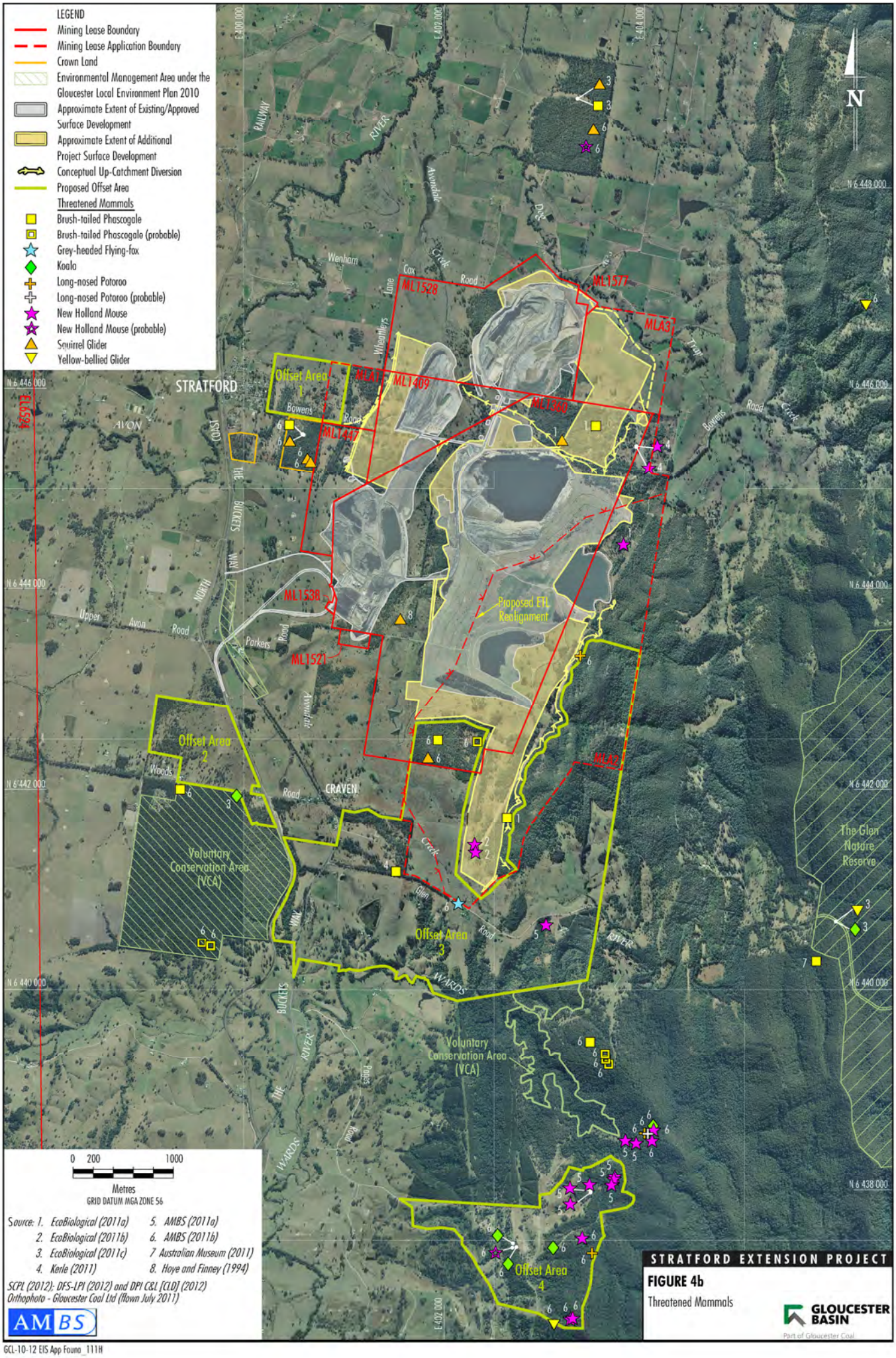
STRATFORD EXTENSION PROJECT

FIGURE 4a

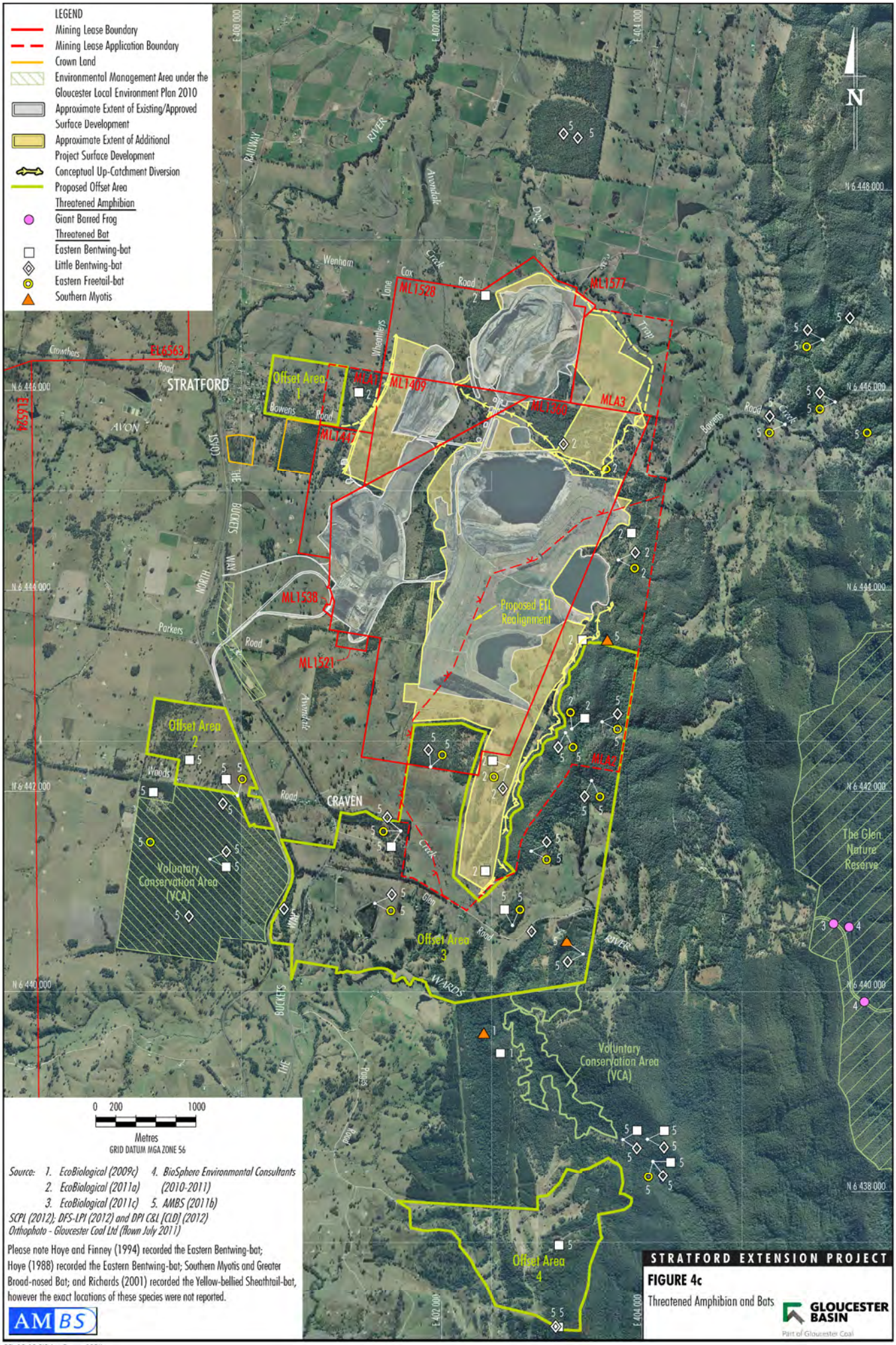
Threatened Birds

GLOUCESTER BASIN
Part of Gloucester Coal

GCL-10-12 EIS App Fauna_110J



GCL-10-12 EIS App Fauna_111H



Source: 1. *EcoBiological (2009c)* 2. *EcoBiological (2011a)* 3. *EcoBiological (2011c)* 4. *BioSphere Environmental Consultants (2010-2011)* 5. *AMBS (2011b)*

SCPL (2012); DFS-LPI (2012) and DPI C&L (CLD) (2012)
Orthophoto - Gloucester Coal Ltd (flown July 2011)

Please note Hoye and Finney (1994) recorded the Eastern Bentwing-bat; Hoye (1988) recorded the Eastern Bentwing-bat; Southern Myotis and Greater Broad-nosed Bat; and Richards (2001) recorded the Yellow-bellied Sheathtail-bat, however the exact locations of these species were not reported.

AMBS

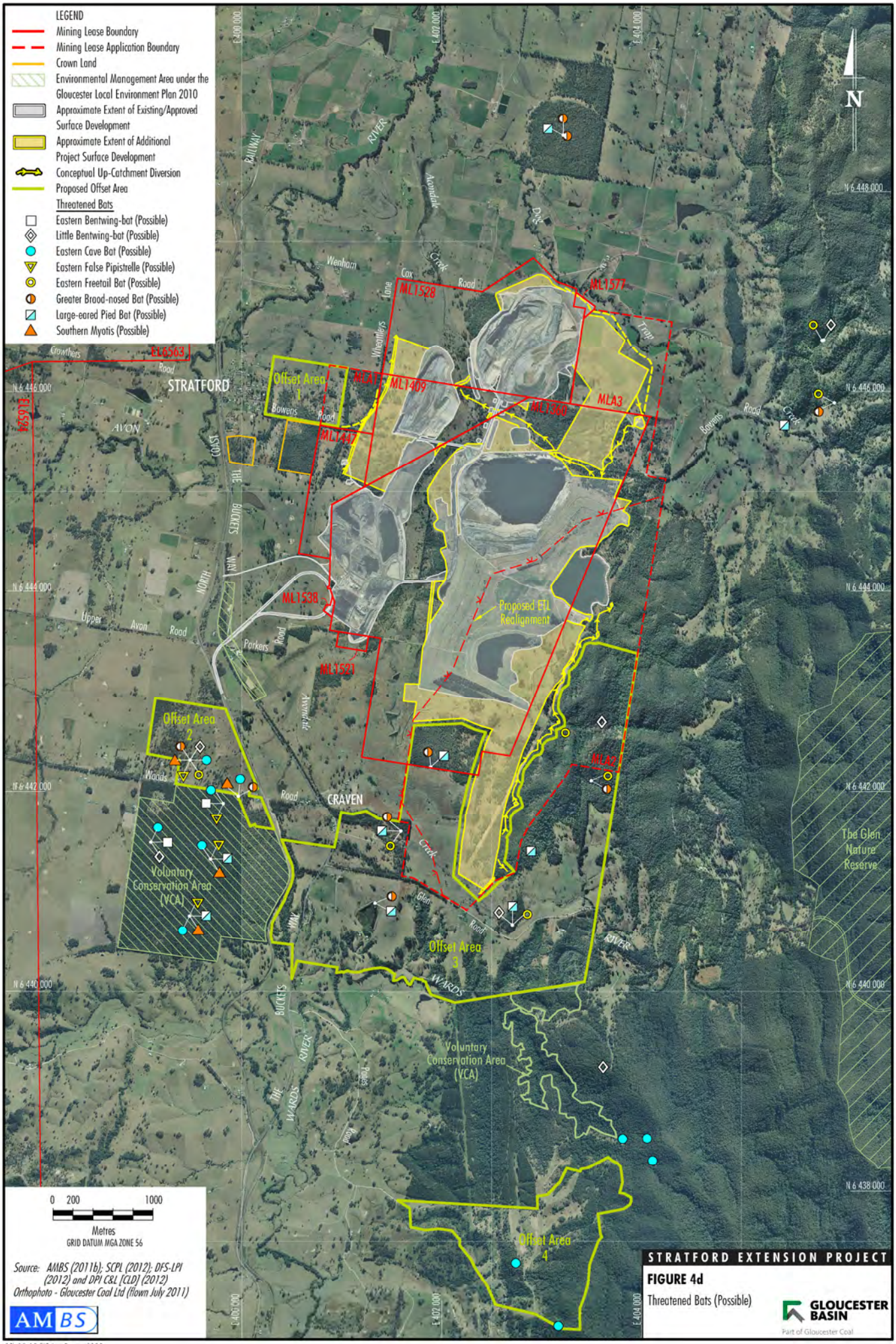
STRATFORD EXTENSION PROJECT

FIGURE 4c

Threatened Amphibian and Bats

GLOUCESTER BASIN
Part of Gloucester Coal

GCL-10-12 EIS App Fauna_112H



GCL-10-12 EIS App Fauna_1136

4.2.3 Threatened populations

Two threatened fauna populations have been predicted as having potential to occur within the Karuah Manning sub-region based on the OEH (2012) threatened species database (information sourced 12 December 2011):

- Emu Population in the New South Wales North Coast Bioregion and Port Stephens Local Government Area (NSW Scientific Committee, 2002a); and
- Koala Population, Hawks Nest and Tea Gardens population (NSW Scientific Committee, 1999).

The Emu Population primarily occurs within the Port Stephens Local Government Area, with the majority of recent records occurring between Coffs Harbour and Ballina (NSW Scientific Committee, 2002a). The Koala Population is largely concentrated in the vicinity of Hawks Nest and Tea Gardens (NSW Scientific Committee, 1999). The geographical locations of these endangered populations are well outside the locality of the Project area and they are considered extremely unlikely to be impacted by the Project.

4.2.4 Listed migratory species

Searches of the EPBC Act *Protected Matters Database* returned 16 species of bird that are listed as migratory under the EPBC Act and are predicted as having potential to occur within a 20 km radius of the Project area (Appendix E). Eleven of these species have been recorded within the Project area or surrounds during fauna surveys (Appendix A).

4.3 Fauna habitat

A number of habitat assessments have been undertaken across the Project, study and Offset areas by EcoBiological, Biosphere Environmental, Kerle and AMBS (Appendices F to J). This section consolidates the reported results.

4.3.1 Fauna habitat types

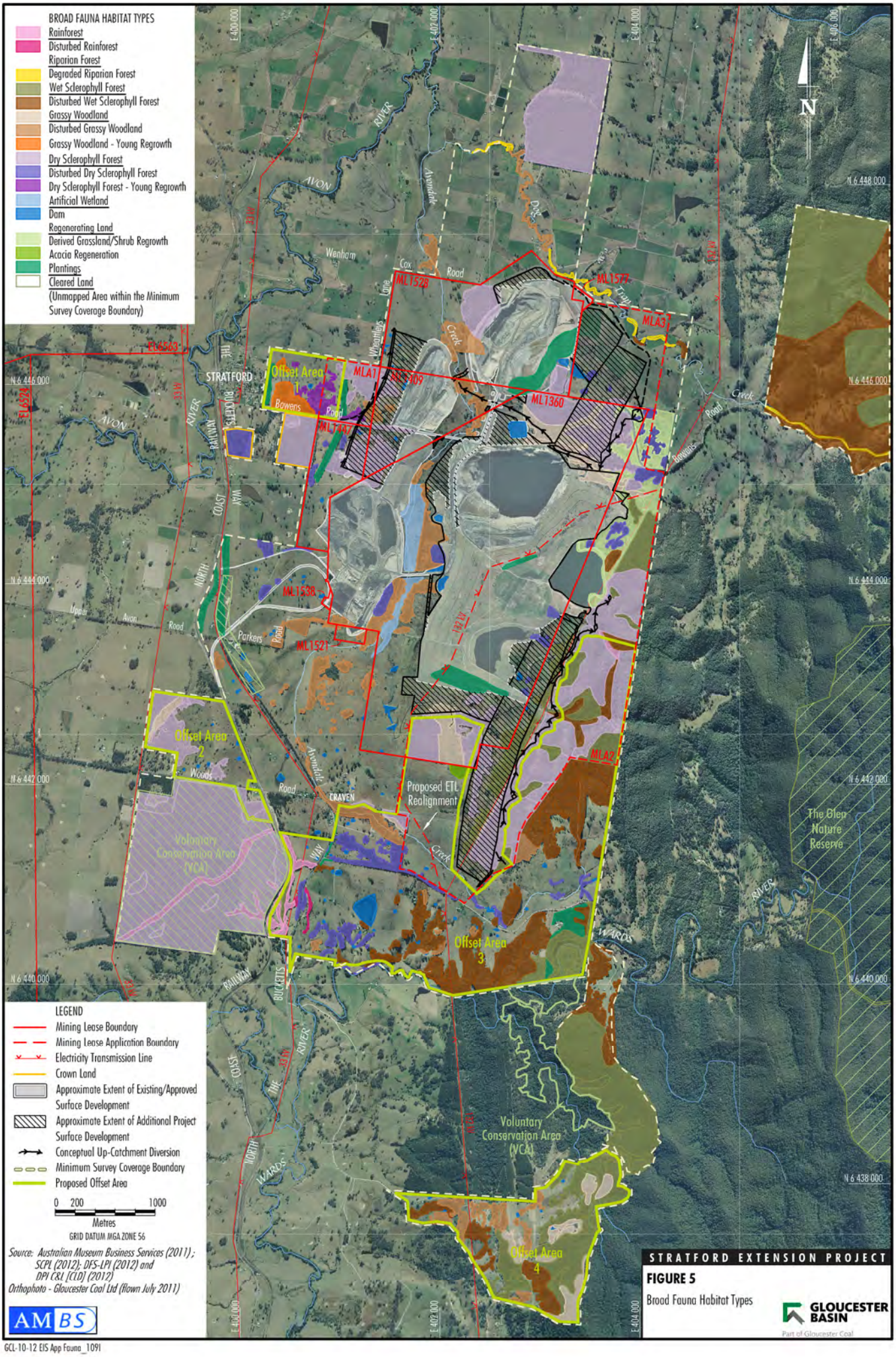
Ten broad habitat types have been identified in the Project area and surrounds (Figure 5):

- Rainforest;
- Riparian Forest;
- Wet Sclerophyll Forest;
- Grassy Woodland;
- Dry Sclerophyll Forest;
- Aquatic Habitats (including Artificial Wetlands);
- Acacia Regeneration;
- Derived Grasslands/Shrub Regrowth;
- Plantings; and
- Cleared Land.

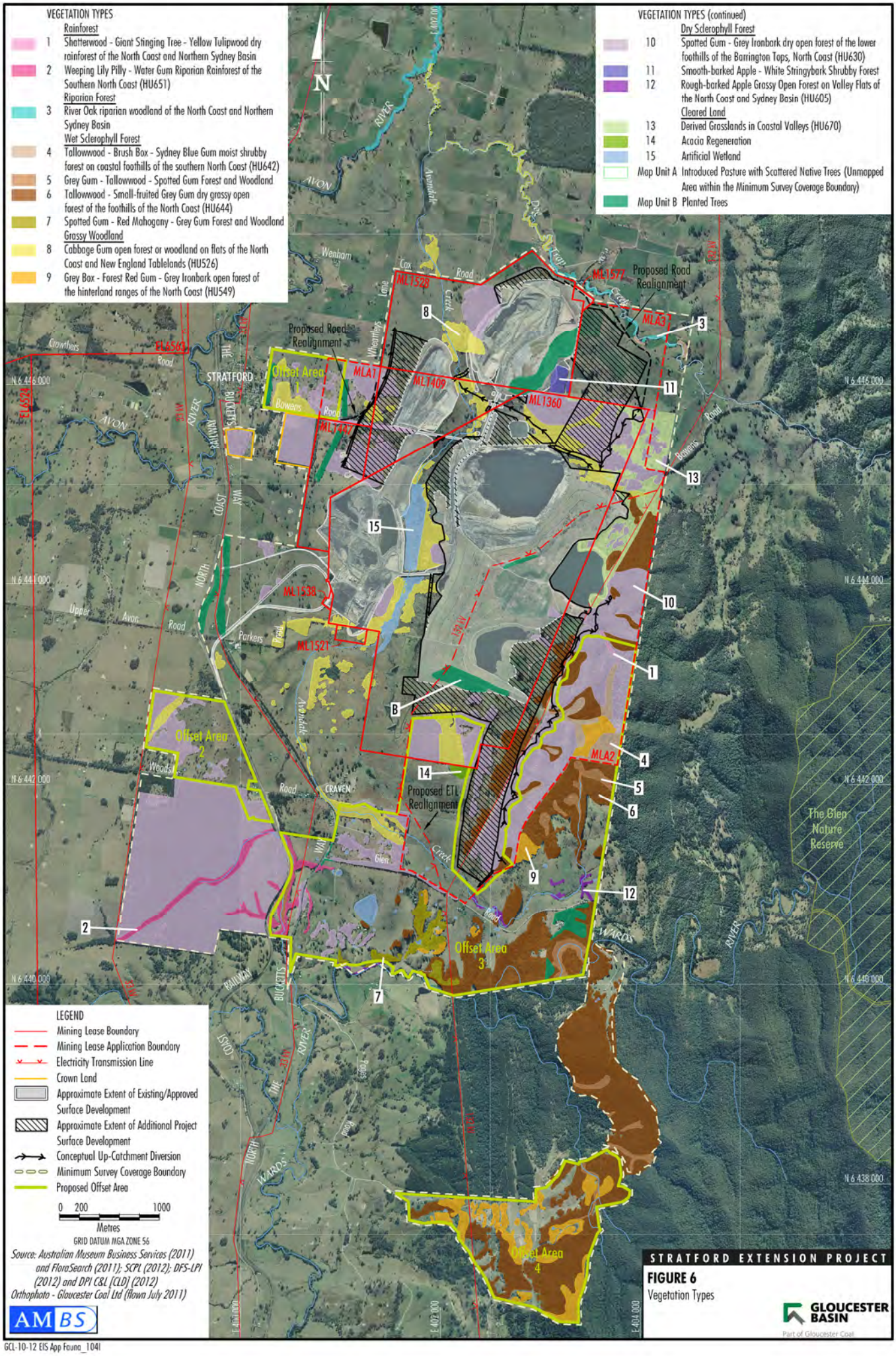
A description of these broad habitat types is presented in this section.

The broad habitat types generally correspond to vegetation associations. Vegetation types that have been mapped within and around the Project area are mapped on Figure 6.

In general, the fauna habitat values within the Project area and surrounds were reported by EcoBiological to be ‘moderate’ (Appendix F). However, habitats ranged in quality, with some parts of the Project area and surrounds in very good condition and others in comparatively poor condition (typically due to current land use and/or weed invasion). The variability in the current condition of fauna habitat within the Project area and surrounds is likely also to be due to previous land use and clearing (which can be seen on air photos of the area taken from 1964 to 2011, reproduced here as Figures 7a to 7e).



GCL-10-12 EIS App Fauna_1091



GCL-10-12 EIS App Fauna_1041

* The location of the Project on the photo is indicative only due to the historic nature of the air photo.

LEGEND

Approximate Extent of Existing/Approved Surface Development

Approximate Extent of Additional Project Surface Development (Open Cut Mining Operations)

Source: NSW Lands Department (2011); SCPL (2012)

STRATFORD EXTENSION PROJECT

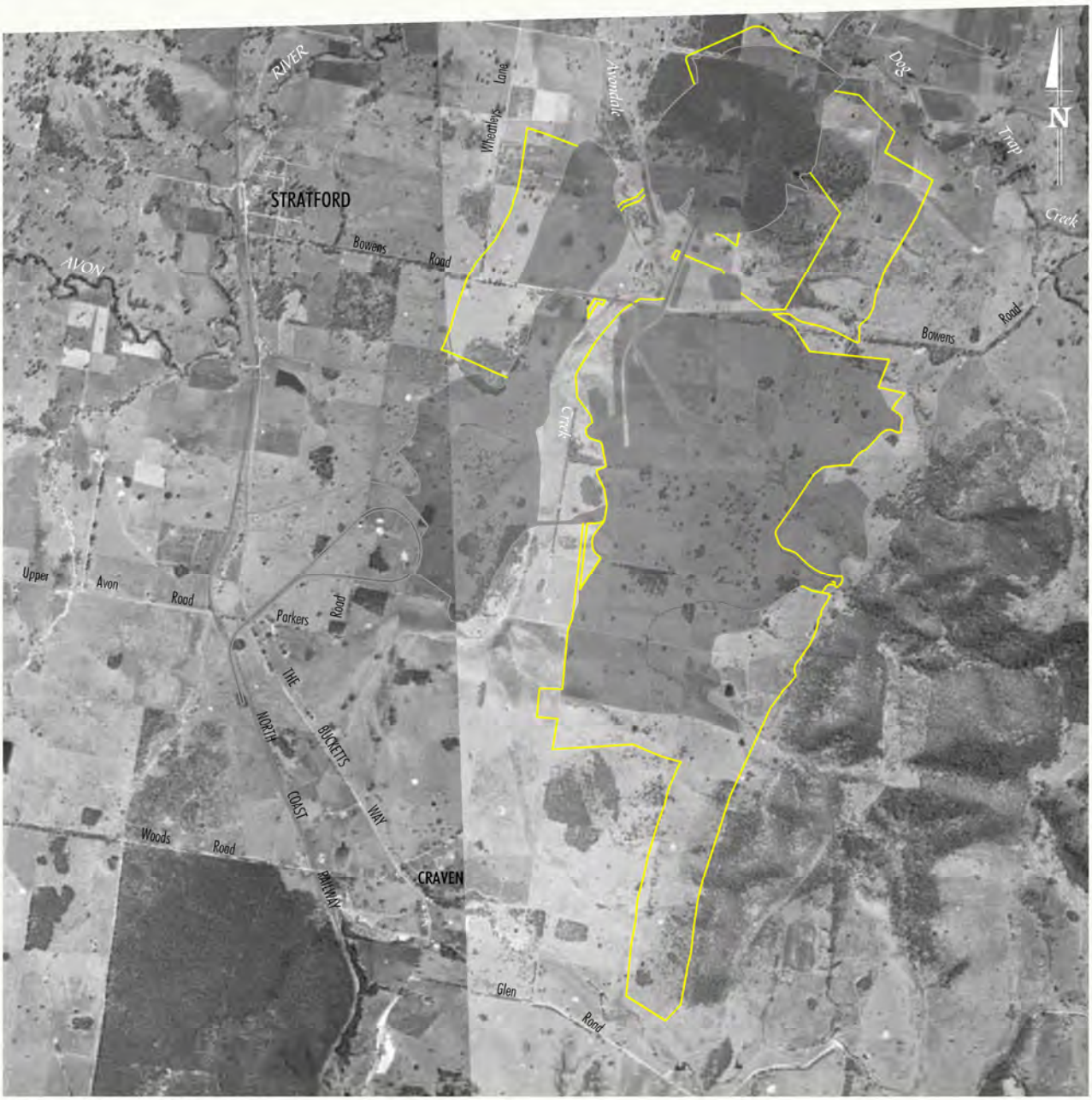
FIGURE 7a

Historic Air Photo of Stratford - 1964

AMBS

GLOUCESTER BASIN

GCL-10-12 EIS App Fcuinc_1220



* The location of the Project on the photo is indicative only due to the historic nature of the air photo.

LEGEND

Approximate Extent of Existing/Approved Surface Development

Approximate Extent of Additional Project Surface Development (Open Cut Mining Operations)

Source: NSW Lands Department (2011); SCPL (2012)

STRATFORD EXTENSION PROJECT

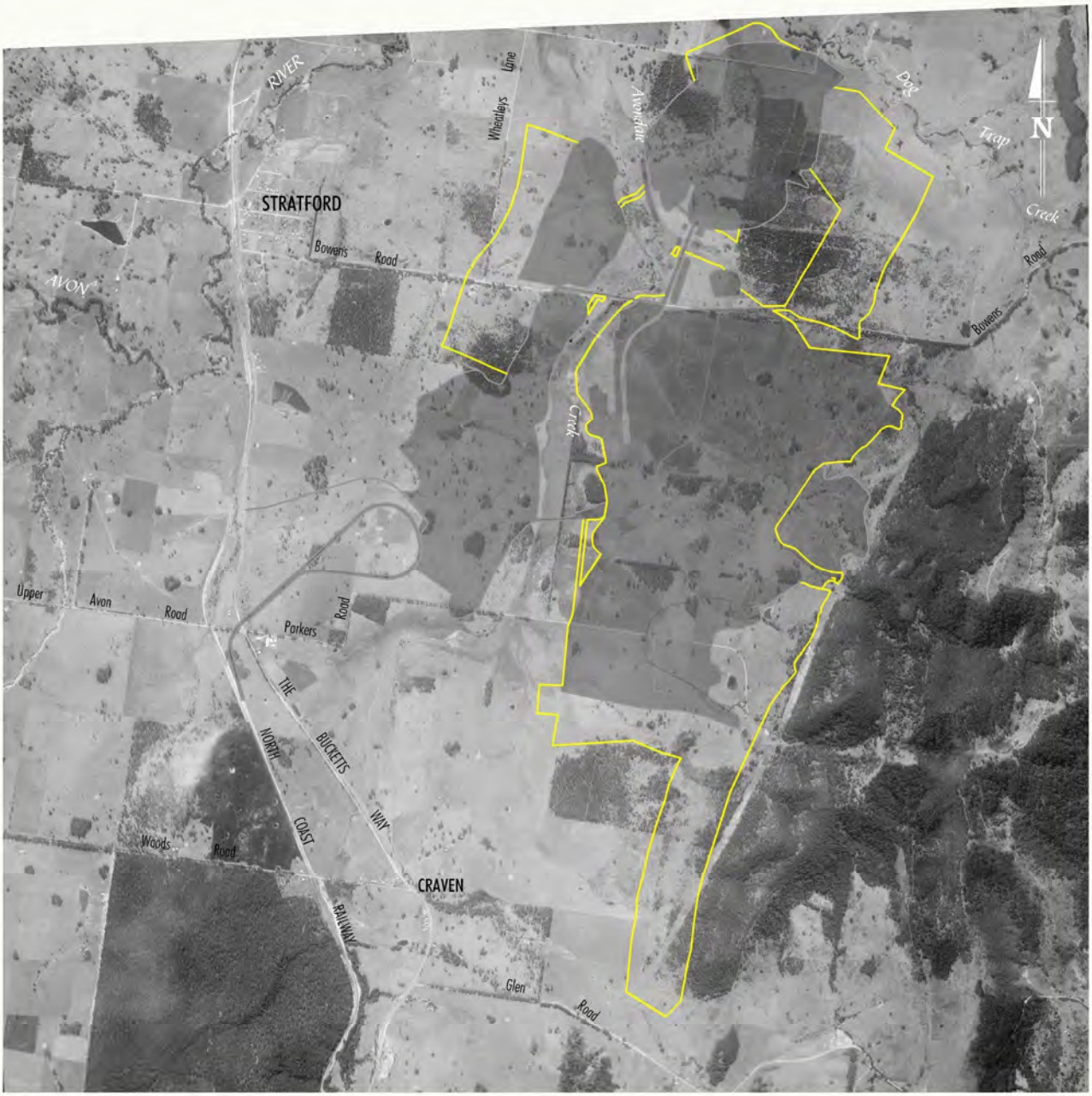
FIGURE 7b

Historic Air Photo of Stratford - 1971

AMBS

GLOUCESTER BASIN

GCL-10-12 EIS App Figure_123E



* The location of the Project on the photo is indicative only due to the historic nature of the air photo.

LEGEND

Approximate Extent of Existing/Approved Surface Development

Approximate Extent of Additional Project Surface Development (Open Cut Mining Operations)

Source: NSW Lands Department (2011); SCPL (2012)

STRATFORD EXTENSION PROJECT

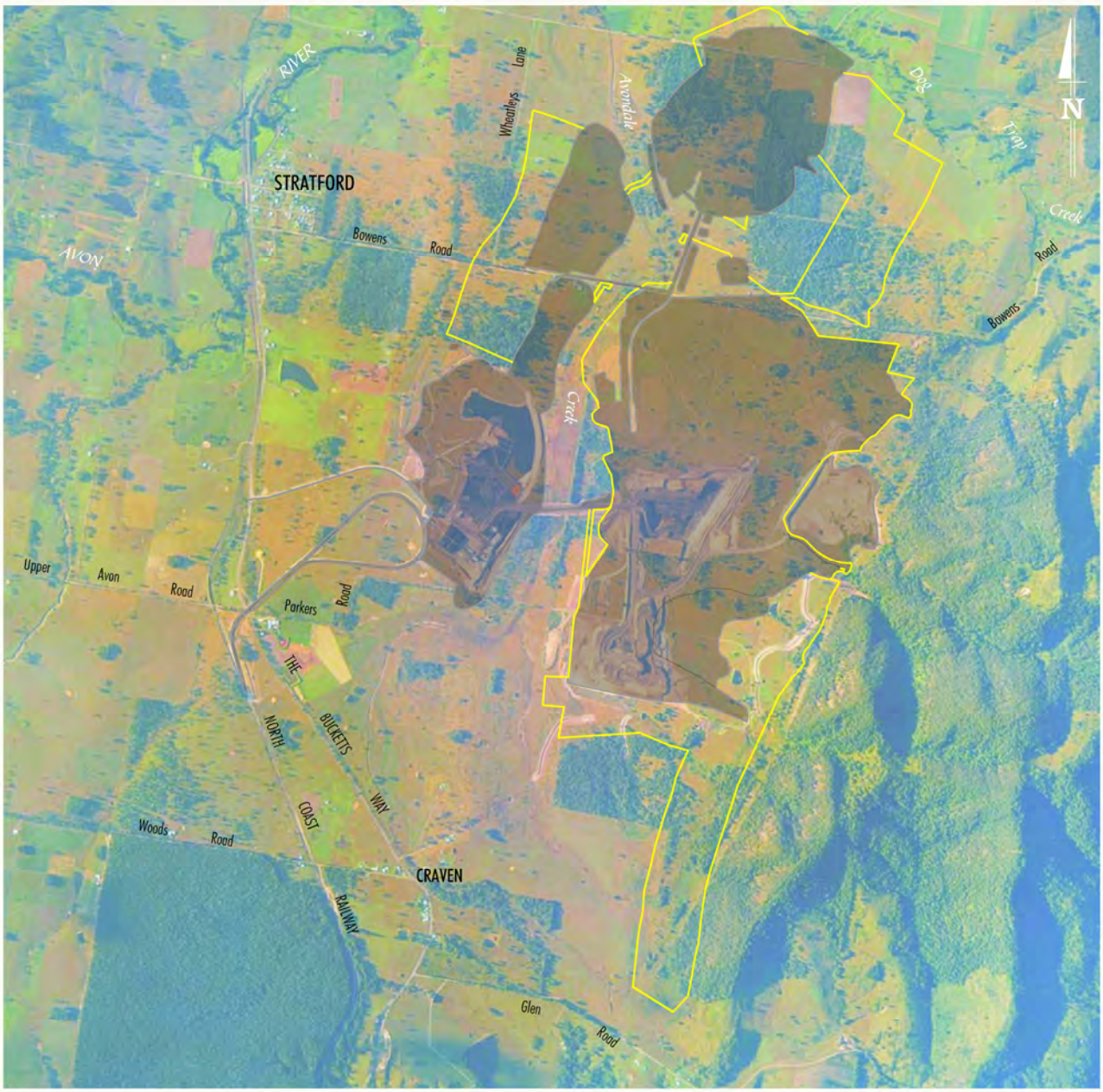
FIGURE 7c

Historic Air Photo of Stratford - 1989

AMBS

GLOUCESTER BASIN

GCL-10-12 EIS App Figure_124E



* The location of the Project on the photo is indicative only due to the historic nature of the air photo.

LEGEND

Approximate Extent of Existing/Approved Surface Development

Approximate Extent of Additional Project Surface Development (Open Cut Mining Operations)

Source: NSW Lands Department (2011); SCPL (2012)

STRATFORD EXTENSION PROJECT

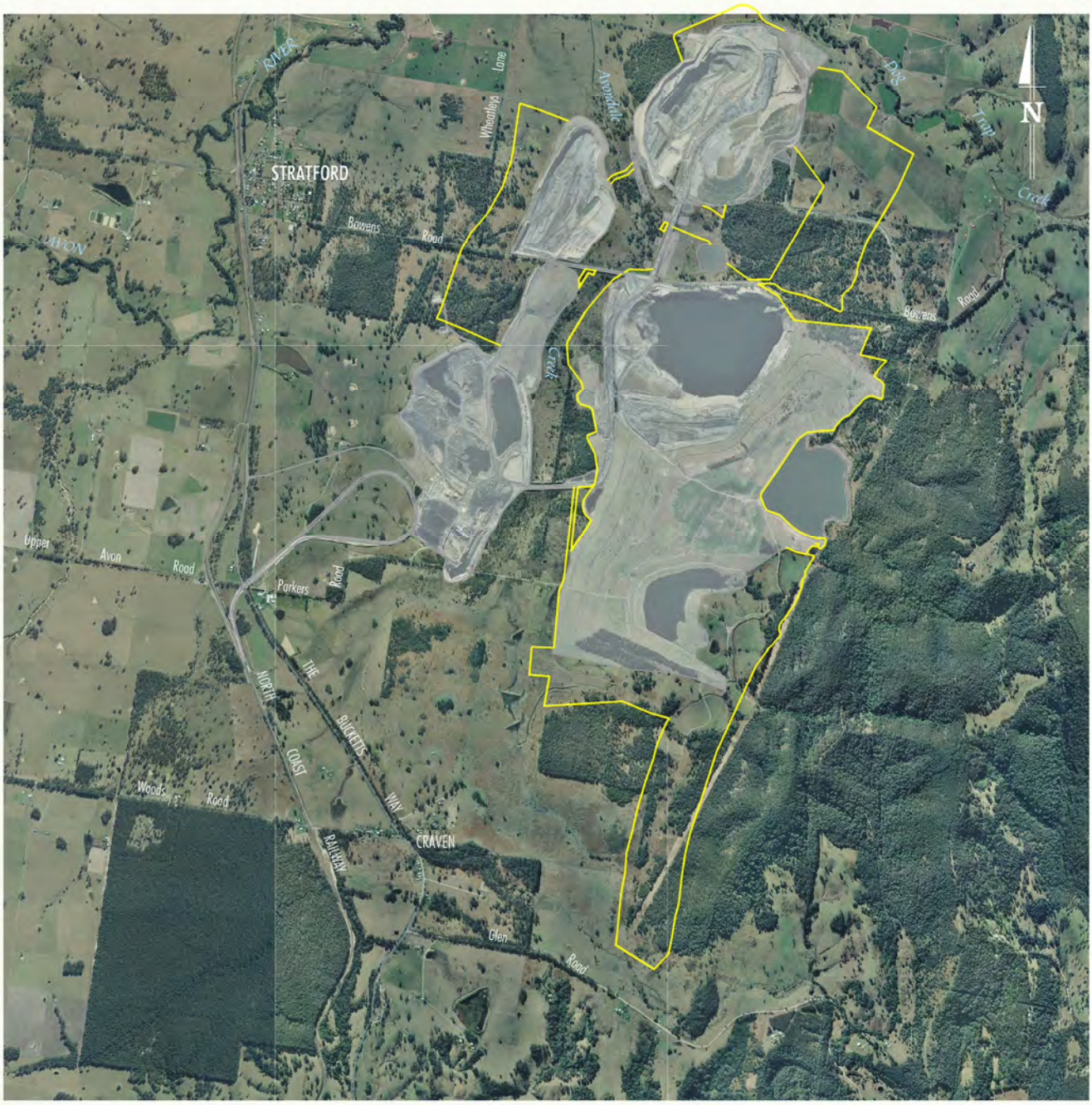
FIGURE 7d

Historic Air Photo of Stratford - 1996

AMBS

GLOUCESTER BASIN

GCL-10-12 EIS App Figure_125E



LEGEND

Approximate Extent of Existing/Approved Surface Development

Approximate Extent of Additional Project Surface Development (Open Cut Mining Operations)

Source: SCPL (2012); Gloucester Coal Ltd (flown July 2011)

STRATFORD EXTENSION PROJECT

FIGURE 7e

Air Photo of Stratford - 2011

AMBS

GLOUCESTER BASIN

Prior to 1964 large areas of bushland were cleared, particularly the dry sclerophyll forest and/or woodland, on the valley floor and from locations in the eastern portion of the current Stratford Mining Complex. The 1964 aerial photograph shows that much of the vegetation at that time was highly fragmented (Figure 7a).

Remaining areas of remnant vegetation are often adversely impacted by livestock grazing and weeds. Consequently, there are only a few areas remaining with large remnant dry sclerophyll forest and/or woodland habitat in good condition.

This previous clearing has resulted in a low abundance of old growth features throughout much of the study area. Nonetheless, there are locations within the study area resulting from regeneration that has occurred since 1964 that are in very good condition, with low numbers of weeds, good structural diversity and containing some old growth features.

EcoBiological (Appendix F) found that the areas containing low fauna habitat values within the Dry Sclerophyll Forests largely corresponded to the distribution of sites with a low vegetation condition within the valley and lower slopes. It was assumed that the same anthropogenic factors that have caused the decline in the native vegetation condition in these areas have also resulted in a reduced habitat value for fauna. This has led to many of the lowland areas having a reduced habitat complexity and reduced log and hollow availability.

Rainforest

Rainforest habitats had a very limited distribution in the study area, occurring only in one small patch to the east of the Project area (Figure 5). This habitat type was consistent with Vegetation Type 1 (Figure 6).

The rainforest in the study area was a moist closed forest with a dense canopy, midstorey and understorey composed of rainforest flora. The canopy was approximately 20 m high. Vines and small ferns were common throughout and leaf litter was abundant. A rocky creek extended through the centre, but had little potential to retain water for long periods after rain. Leaf litter was present but thinly distributed. Overall the condition of the Rainforest habitat was good.

This area would provide suitable habitat for a range of native fauna and was considered important due to the lack of other areas of similar habitat. Connectivity with other areas of vegetation was good. Much of this habitat area was vegetated during the 1960s (Figure 7a) and is considered to be mid-mature to late-mature.

Rainforest habitat to the east of the Project area is shown on Plate 1.

Plate 1: Rainforest Habitat

Rainforest habitat was also recorded to the south-west of the Project Area within the Voluntary Conservation Area (Vegetation Type 2) (Figure 6).

Riparian Forest

Riparian Forest habitat occurred north of the Project area, along Avon River and Dog Trap Creek (Figure 5) and was consistent with Vegetation Type 3 (Figure 6).

Both areas of this habitat were disturbed and were surrounded by farmland. Most of the tree and shrub cover was removed from the edges of the banks, leaving a narrow strip of vegetation. Previous vegetation clearing combined with the impact of cattle accessing the creeks has led to the further degradation of the creek bank, with erosion evident throughout. Overall the condition of fauna habitat in these areas was poor. The area was not considered to provide any potential habitat for threatened frogs that could occur in the locality (Appendix H). Connectivity with other areas of native vegetation was poor.

Riparian Forest was also recorded within the Voluntary Conservation Area to the south-west and in Offset area 3 (Figure 5). Descriptions of these habitats are provided in Section 7.2.6.

Riparian Forest habitat north of the Project area is shown on Plate 2.

Plate 2: Riparian Forest Habitat

Wet Sclerophyll Forest

Within the study area, Wet Sclerophyll Forest habitats (Figure 5) were characterised by Vegetation Types 4, 5 and 6 (Figure 6). This habitat was not widespread within the Project area, occurring only in the eastern section, where it adjoined much larger areas of similar habitat.

The habitat was generally composed of open forest between 20 to 35 m high (average approximately 30 m), with most areas classified as early mature to mid-mature. Some areas contained emergent mature or late mature trees but these were not dominant across the landscape. Much of the Wet Sclerophyll Forest habitat within the Project area was cleared or disturbed prior to the 1960s, with the exception of a few small patches east of the Stratford East Dam (Figure 7a).

Canopy trees were a mixture of *Eucalyptus* spp. Common species included Tallowwoods, Ironbarks, Stringybarks, Mahoganies, Spotted Gums and *Angophora* spp. A small tree layer was a dominant feature of the habitat and was composed mostly of regrowth *Eucalyptus* spp., *Allocasuarina* spp. and Turpentines, although *Allocasuarina* spp. were mostly only present on the lower slopes, not in the gullies. The shrub layer was generally sparse, but diverse (e.g. *Acacia* spp., *Leucopogon* spp., *Persoonia* spp. and *Podolobium* spp.). The ground cover was highly variable; in some locations thick native grasses dominated, in others there was a dense ferny understorey. In some locations the ground cover was sparse, with a mixture of rock, thin litter and grasses. Hollow bearing trees were mostly uncommon, but were present in varying sizes. Fallen logs were abundant. Rock crevices were not observed. Weeds were generally rare on the west facing slopes, becoming more common on the eastern side of the ridge and within gullies. There was little evidence of cattle grazing.

Overall the condition of the habitat was considered to be moderate to good, with the best areas occurring on the lower slopes. This habitat would provide resources for a range of native fauna, including some threatened species. Connectivity with other areas of native vegetation was generally good, but became increasingly fragmented on the lower slopes where this habitat met the lowland valley Grassy Woodlands and Dry Sclerophyll Forests.

Disturbed wet sclerophyll forest also occurred in the eastern section of the Project area, in a number of locations within gullies. In these locations the gullies had become dominated by weeds, creating a dense largely impenetrable understorey. Wet Sclerophyll Forest (Vegetation Type 7) was also recorded in extensive stands east and south of the Project area.

Wet Sclerophyll Forest habitat is shown on Plate 3.

Plate 3: Wet Sclerophyll Forest Habitat

Grassy Woodland

Grassy Woodland habitats were scattered throughout the lowland valley areas (Figure 5) and were consistent with Vegetation Type 8 (Figure 6). The habitat had a relatively limited and fragmented distribution within the Project area and surrounds.

The habitat was relatively simple but quality was variable. The majority of the Grassy Woodland areas were classified as early mature, with most areas apparently cleared prior to the 1960s (Figure 7a). In these areas the vegetation structure was more closely associated with a dense regrowth formation, rather than the typical woodland formation. The canopy averaged approximately 20 m high, but was very sparse, composed of young Cabbage Gums or *Angophora* spp., and other scattered *Eucalyptus* spp. The midstorey was often dense, dominated by *Melaleuca* spp. averaging approximately 15 m high. Shrubs were mostly absent and the ground cover was heavily dominated by grasses. No hollow bearing trees were observed but could occur in small numbers. Ground cover features such as rock crevices, fallen logs and branches, were mostly absent. Some locations had been badly impacted by cattle grazing.

Overall the condition of the habitat was considered to be poor to moderate; the best areas were in locations that were the least fragmented. Connectivity with other areas of vegetation was variable, but generally poor.

Disturbed areas of Grassy Woodland occurred in patches throughout the southern and central sections of the Project area and surrounds. In these locations the primary reason for the disturbance was previous land clearing (Figure 7a). The habitat in these locations had minimal understorey and was severely fragmented, in some areas reduced to scattered paddock trees. Grassy Woodland also occurred in young vigorous regrowth formation, apparently recovering from clearing approximately 10 years ago. In these areas, ground cover features were mostly absent (e.g. fallen logs, fallen branches) and no tree hollows or rock crevices were observed. Nonetheless, these areas still provide habitat for native fauna species and could provide opportunities for dispersal for some fauna.

Grassy Woodland (Vegetation Type 9) was also recorded to the south of the Project area (Figure 6).

Grassy Woodland habitat is shown on Plate 4.

Plate 4: Grassy Woodland Habitat (right: Young Regrowth Grassy Woodland)

Dry Sclerophyll Forest

Within the Project area, Dry Sclerophyll Forest habitat was widely distributed (Figure 5) and was consistent with Vegetation Types 10 and 11 (Figure 6).

Vegetation Type 10 occurred throughout the lowland valley areas, as well as upslope within the eastern portion of the Project area and surrounds (Figure 6). The majority of these areas were classified as early to mid-mature, with many areas apparently cleared prior to the 1960s (Figure 7a). However, there are also patches which appear to have been present during this time.

Habitats within the lowland valley areas were generally composed of open forest between 20 to 35 m high (average approximately 30 m) and most areas were classified as early mature to mid-mature. Some areas contained emergent mature or late mature trees, but these were not dominant across the landscape. Similarly, there were areas dominated by young trees 12 to 20 m high, which were apparently recovering from a disturbance event.

The canopy trees were a mixture of *Eucalyptus* spp., with common species including Ironbarks, Stringybarks, *Angophora* spp., Spotted Gum and Mahoganies. In the lowland areas, the midstorey was sparse, dominated by regrowth *Eucalyptus* spp. or *Melaleuca* spp. Where *Melaleuca* spp. were present the midstorey increased in density. In the areas upslope, the midstorey was dominated by regrowth *Eucalyptus* spp. Small shrubs (e.g. *Acacia* spp., *Bursaria* sp., *Persoonia* spp. and *Ozothamnus* sp.) were scattered throughout the sparse and patchy understorey in the lowlands, with *Exocarpus* sp and *Podolobium* sp. becoming more common upslope. Influence from understorey and midstorey rainforest species was more common further upslope. *Allocasuarina* spp. were mostly absent in the lowland areas, but occurred occasionally. They were most common on the lower slopes in the eastern portion of the Project area and surrounds. The ground cover was sparse, mostly composed of native grasses and leaf litter, with weeds being rare. Locations upslope contained areas of exposed bare rock and weeds were more common (e.g. patches of dense Lantana).

Hollow bearing trees were mostly uncommon; however in some locations (e.g. woodland south of the Project area [in the Offset areas] and in the remnant patch to the north of the Project area) more were recorded than anywhere else in the area surveyed by AMBS (Section 7.2). Similarly, the abundance of fallen logs throughout the Project area and surrounds was variable, with some locations containing less than 30 m per 0.5 ha, and others containing greater than 100 m. Rock crevices were mostly absent. There was little evidence of cattle grazing.

Areas of disturbed dry sclerophyll forest occurred in patches. These areas were mostly impacted by previous clearing and are now fragmented. In some areas, cattle grazing has severely reduced the understorey. One area of young regrowth vegetation occurs to the west of the Project area. It appears to have been cleared within the previous 10 to 15 years and now consists of a largely monotopic stand of trees approximately 5 m high.

Overall, the condition of the habitats was considered to be moderate to good. Connectivity of the vegetation upslope was generally good, but became increasingly fragmented on the lower slopes and valley floor.

Vegetation Type 11 occurred in one small area (Figure 6). It was characterised as an early to mid-mature woodland with canopy height of 20 to 35 m (average approximately 20 m). Stringybarks dominated the canopy, and *Melaleuca* spp. were present in the very sparse midstorey. The shrub layer was dense providing good structure and was dominated by *Banksia* spp. and *Leptospermum* spp. with other shrubs being less common (e.g. *Acacia* spp. and *Persoonia* spp.). The ground cover was heavily dominated by native grasses, with grass trees scattered throughout. *Allocasuarina* spp. was absent, leaf litter was sparse and weeds were rare. There was no evidence of grazing by cattle. Hollow bearing trees, fallen logs and rock crevices were very uncommon. Overall the condition within this habitat type was good, but the connectivity with other vegetation was considered low.

Dry Sclerophyll Forest also occurred to the south of the Project area (Figures 5 and 6).

Dry Sclerophyll Forest habitat is shown on Plate 5.

Plate 5: Dry Sclerophyll Forest Habitat

Aquatic habitats

The quality of aquatic habitats was generally low. The most widespread version of this habitat type was artificial dams (Figure 5). These occurred throughout most of the lowland areas. They varied from containing dense aquatic vegetation (e.g. *Typha* sp.) to being completely devoid of any type of vegetation. In most cases, the dams were somewhat isolated within the landscape due to previous clearing of the surrounding area and the banks were often impacted by cattle. Several large artificial dams (created from previous mining at the Stratford Mining Complex) occur within the current Stratford mining leases, which provide some potential habitat for waterbirds.

Creeks within the Project area were either in extremely poor condition due to land clearing and impacts from cattle, or did not contain much free water. Due to this, breeding habitat for threatened frog species was considered to be absent.

Artificial wetlands have a very limited distribution in the centre of the study area (Figures 5 and 6). Canopy trees were sparse, restricted to scattered *Melaleuca* spp. and the shrub layer was mostly absent. The ground cover was composed of a variety of grasses, sedges and rushes. Little water was present at the time of the surveys. The habitat is very isolated within the landscape.

Aquatic habitats within the study area are shown on Plate 6.

Plate 6: Aquatic Habitat

Derived Grasslands/Shrub Regrowth

Heavily disturbed dry sclerophyll habitat occurs in the north-eastern section of the study area (Vegetation Type 13) (Figures 5 and 6). Most of this area was cleared prior to the 1960s (Figure 7a) and presently contains only scattered paddock trees, some with hollows which could provide nesting/refuge habitat for mobile hollow-dependant species. Much of the native midstorey and understorey has been removed, and the ground cover is limited mostly to native and exotic grasses. However, in one location despite previous clearing, the understorey is now dominated by patches of dense grassy ground cover or dense thickets of *Leptospermum* spp. These areas still provide habitat for a range of fauna, including some threatened species.

Derived Grasslands/Shrub Regrowth within the Stratford Mining Complex are shown on Plate 7.

Plate 7: Derived Grasslands (left)/Shrub Regrowth (right)

Acacia Regeneration

One small area of regenerating *Acacia* spp. occurred to the south of the Project area (Figures 5 and 6). It was a homogenous stand composed almost entirely of *Acacia* spp. that had formed a relatively dense, low canopy. The ground cover was mostly composed of native grasses and ferns, lacking in certain other features such as large logs.

Plantings

Plantings occur in a number of locations within the Project area and surrounds (Figure 5), most planted to be visual screens. These stands provide some habitat for native fauna, but generally lack certain important features such as structural diversity and old, hollow bearing trees.

Cleared Land

In some locations throughout the Stratford Mining Complex the habitat has been severely disturbed or modified by land clearing (Figure 5). These areas generally contained scattered paddock trees, some with hollows that could provide some nesting/refuge habitat for mobile hollow dependant species. In general, native understorey was mostly absent and ground cover features were also mostly absent (e.g. fallen logs, fallen branches). In some locations the impact of land clearing has been worsened by ongoing cattle grazing, preventing the re-establishment of a native understorey.

4.3.2 Caves

EcoBiological (Appendix F) performed extensive searches for caves along the eastern ridge and a number of deep gullies. Only two locations of caves suitable for bat roost sites were detected (Table 14). AMBS (Appendix G) also performed searches for caves and rock crevices, but did not detect any additional resources potentially suitable for roosting bats or other mammals.

Table 14: Locations of caves identified to the east of the Project area

Cave	Longitude	Latitude
Cave 1	151.9759	-32.1447
Cave 2	151.9793	-32.1409

Cave 1 was found half way up the range to the east of the Project area, below a high point on the ridge line. Cave 1 was a deep cave with a long narrow entrance (Plate 8). Access into the interior was found to be difficult for the majority of larger terrestrial fauna species as it was perched on a steeply sloping rock face. No signs of animal use were found, although this cave would provide suitable habitat for cave-roosting bat species.

Plate 8: Images of Cave 1 (from Appendix F)

Cave 2 was found on a steep sided gully and had number of smaller, relatively shallow roosting sites suitable for a range of smaller fauna species such as the Antechinus (Appendix F). It was considered unlikely these features would provide habitat for cave-dwelling bats (Plate 9).

Plate 9: Images of Cave 2 (from Appendix F)

4.3.3 Food plants

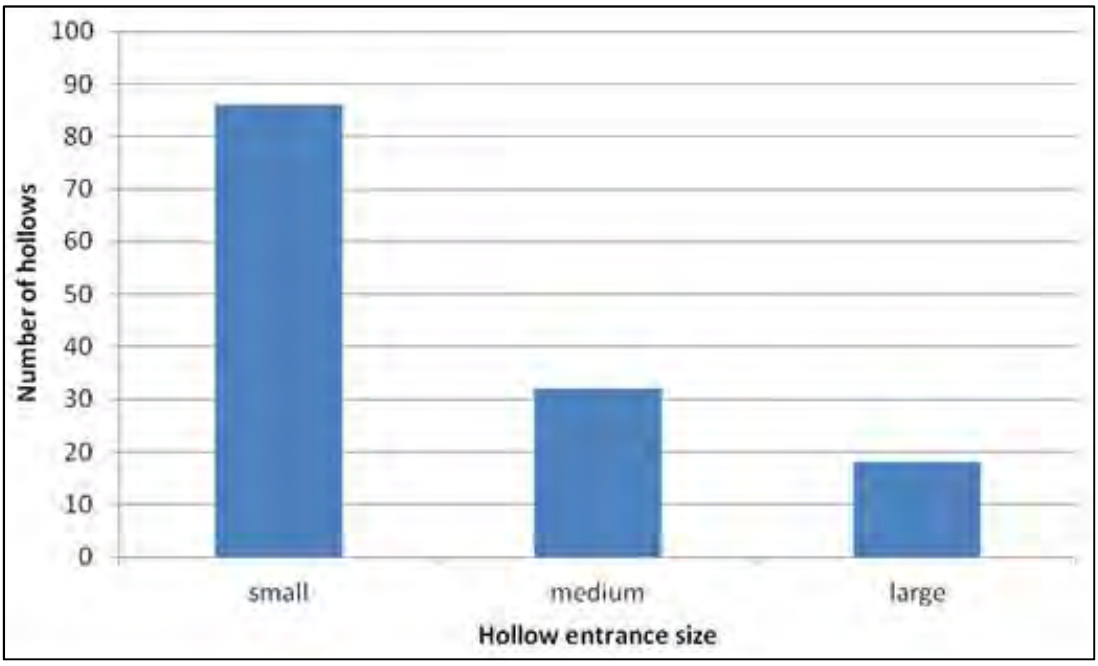
EcoBiological (Appendix F) identified the main plants considered to have high value for fauna that were recorded during their surveys (Table 15). Habitat resources such as nectar, sap and seed were considered widespread and abundant, while the availability of fleshy fruits was poor.

Table 15: Key food plants recorded within the Project area and surrounds (from Appendix F).

Scientific Name	Common Name	Habitat Values
Acacia irrorata subsp. *irrorata*	Wattle	Glider feed tree
Allocasuarina littoralis, *Allocasuarina torulosa*	Forest Oak	Glossy Black-cockatoo feed tree
Angophora subvelutina	Rough-barked Apple	Glider sap tree
Callistemon linearis, *Callistemon salignus*	Bottlebrush	Nectar producing plants
Corymbia maculata	Spotted Gum	Glider sap tree
Eucalyptus amplifolia	Cabbage Gum	Glider sap tree
Eucalyptus crebra	Narrow-leaved Ironbark	Winter-flowering eucalypt
Eucalyptus globoidea	White Stringybark	Winter-flowering eucalypt
Eucalyptus microcorys	Tallowwood	Prime Koala food tree (SEPP 44)
Eucalyptus moluccana	Grey Box	Glider sap tree
Eucalyptus propinqua	Grey Gum	Glider sap tree; Koala food tree
Eucalyptus tereticornis	Forest Red Gum	Glider sap tree; Winter-flowering eucalypt; prime Koala food tree (SEPP 44)
Exocarpos cupressiformis	Native Cherry	Fruit bearing plant
Ficus coronata, Ficus rubiginosa	Figs	Fruit bearing plants
Leptospermum polygalifolium	Tea-tree	Nectar producing plants
Melaleuca decora, M. linariifolia, M. nodosa, M. sieberi, M. styphelioides	Paperbark	Nectar producing plants
Persoonia linearis	Geebung	Fruit bearing plant
Rubus moluccanus, *R. parvifolius*		Fruit bearing plants
Xanthorrhoea glauca	Grass Tree	Nectar bearing plant

4.3.4 Tree hollows

EcoBiological (Appendix F) counted the number and type of tree hollows in a number of 50x20 m quadrats throughout the study area. Sixty-six hollow-bearing living trees and 36 standing dead trees were recorded and 136 hollows were detected, with 86 having small entrances (<8 cm diameter), 32 medium-sized entrances (8-20 cm diameter) and 18 large hollow entrances (>20 cm diameter) (Appendix F) (Figure 8). These numbers represent only a proportion of the total number of hollows and/or hollow bearing trees in the study area.



Source: Appendix F.

Note: The numbers represent a sample only.

Figure 8: Numbers of Hollows of Each Size Counted during Sampling

Using Biometric data collected at flora survey quadrats (n = 80), EcoBiological (Appendix F) averaged the hollow density across the study area. The density of visible hollows was estimated to be mostly less than 10 per ha, although areas of above average density (15-30 per ha) existed along the eastern range and in some lowland woodland patches. Estimated tree hollow density per ha is shown on Figure 9.

AMBS counted the number of tree hollows within 50 x 100 m quadrats (n = 51) across a much larger study area (Appendix G). Similar results were obtained; much of the Project area and surrounds was estimated to contain less than 6 tree hollows per ha, while most areas to the south and east of the averaged between 6 and 20 hollows per ha.

Both studies concluded that while hollow bearing trees were present across the landscape, they were variable in numbers, unevenly distributed and overall considered uncommon.

AMBS (Appendix G) also performed an assessment of the density of hollows within the Offset areas. This is discussed and demonstrated in Section 7.

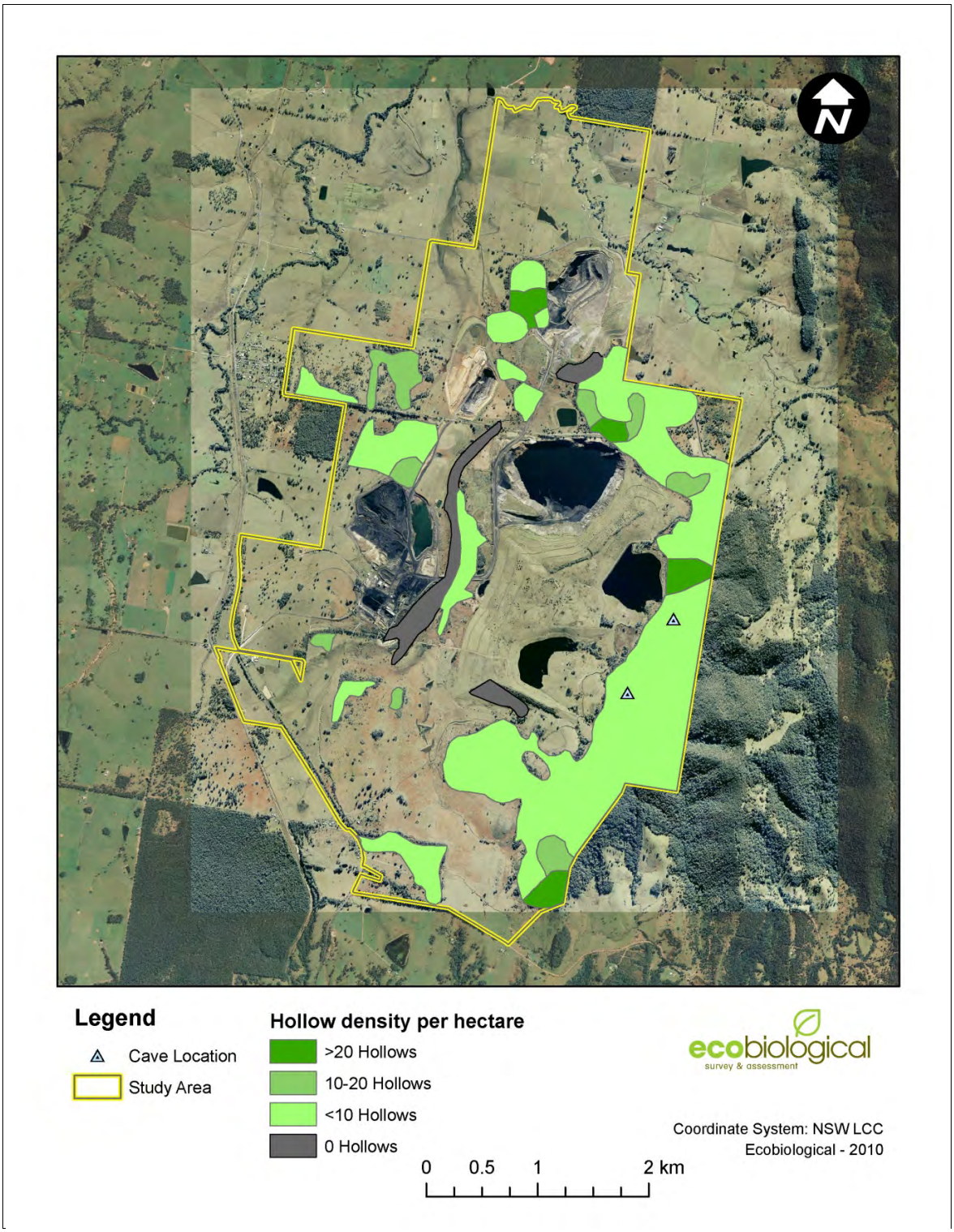


Figure 9: Estimated Tree Hollow Density Per Hectare (Ecobiological, 2011).

4.4 Notable habitat

There are a number of habitat features or areas within the Project area and surrounds that are considered notable resources for threatened fauna.

The areas mapped as Dry Sclerophyll Forest (Vegetation Type 10) and Grassy Woodland (Vegetation Type 8) (Figures 5 and 6) in the valley within the Project area and surrounds are notable habitat from a local perspective given they are a limited resource within the Gloucester CMA. According to the *Vegetation Types Database* (DECC, 2008b) for the Hunter and Central Rivers CMA, Cabbage Gum open forest on flats of the North Coast and New England Tablelands (Vegetation Type 8) is considered to be 70% cleared within this CMA. Spotted Gum-Grey Ironbark dry open forest on lower foothills of the Barrington Tops, North Coast (Vegetation Type 10) is considered to be only 35% cleared within this CMA; however, much of the remaining sections of this community occurs in the foothills of the Great Dividing Range and many patches on the valley floor have been extensively cleared for agriculture. These communities are considered to be important habitat for local populations of threatened fauna species that are associated with these habitat types.

In addition, the Dry Sclerophyll Forest habitats were considered overall to be in moderate to good condition. Generally, the larger, less fragmented areas tended to support the best areas of fauna habitat. These areas contained greater abundance of habitat resources (e.g. hollow logs), fewer weeds, good structural diversity, and a greater level of landscape connectivity (primarily due to the larger patch size).

A number of threatened fauna species have been recorded in these habitat types including: the Squirrel Glider (*Petaurus norfolkensis*), Brush-tailed Phascogale (*Phascogale tapoatafa*), Speckled Warbler (*Pyrrholaemus saggitatus*), Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*), Varied Sittella (*Daphoenositta chrysoptera*), Flame Robin (*Petroica phoenicea*) and Scarlet Robin (*Petroica boodang*). The majority (in some cases, all) of the records of these particular threatened species are concentrated in the lowland valley areas, despite that fact that Dry Sclerophyll Forest Vegetation Type 10 extends into the wooded range east of the Project area.

There are a number of other threatened fauna species for which important habitat resources were recorded within the Project area and these are discussed below.

Glossy Black-cockatoo (*Calyptorhynchus lathami*)
TSC Act: vulnerable EPBC Act: not listed

The species feeds almost exclusively on the cones from *Allocasuarina* spp., and evidence of feeding was detected in several locations within the Project area and surrounds. Based on the data collected from the habitat assessments (Appendix G), the abundance of *Allocasuarina* spp. trees and foraging signs was highest on the lower slopes in the eastern section of the Project area and surrounds. *Allocasuarina* spp. trees became less common as elevation increased, with almost none being found on the ridge top.

New Holland Mouse (*Pseudomys novaehollandiae*)
TSC Act: not listed EPBC Act: vulnerable

This species was recorded in two locations within the Project area and various locations in the surrounds (Appendix I; Figure 4b). Known habitat for the species within the study area consists of areas which contain a high proportion of native plant species, few weeds, and a ground cover dominated by Blady Grass (*Imperata cylindrica*) and subject to nil or slight grazing pressure (Appendix I).

Published literature on the species documents different habitat preferences and is mainly based on information derived from the habitat of coastal populations.

AMBS (Appendix I) found differences between the published literature and the habitat features of sites where it was found in the Stratford area. The species appears to be patchily distributed and may be reliant on particular habitat features. Because of this the known habitat areas in the locality are considered to be an important resource for this species.

Coastal populations appear to prefer heathlands or woodlands with a heathy understorey, sandy substrates, sparse ground litter, high floristic diversity and an abundance of leguminous shrubs (Kemper, 1991; Lock and Wilson, 1999; Kemper and Wilson, 2008). Populations have been shown to recolonise regenerating burnt areas after 1-2 years and rehabilitated sand mined areas after 4-5 years. Populations tend to increase as vegetation regenerates after fire, clearing and sandmining, reaching maximum densities after 2-6 years (Kemper, 1990; Fox and Fox, 1978, 1984; Fox and McKay, 1981, Fox, 1982; Twigg *et al*., 1989; Wilson, 1991).

Long-nosed Potoroo (*Potorous tridactylus tridactylus*)
TSC Act: vulnerable EPBC Act: vulnerable

The species was recorded several times from an infra-red camera to the east of the Project area (Figure 4b). The Long-nosed Potoroo requires open areas of habitat for foraging, which are near dense understorey that they use for shelter. Habitat for this species occurs to the east of the Project area; however, there are areas where the understorey is now dominated by weeds (such as Lantana). The area of known Long-nosed Potoroo habitat is in good condition and can be described as Dry Sclerophyll Forest with an open understorey, adjacent to a Wet Sclerophyll Forest with a thick ferny understorey. This area of habitat is considered to be important for this species.

4.5 Corridors

The key habitat corridors in the vicinity of the Project area are along the ranges to the east and west of the floor of the Gloucester Valley. These corridors trend generally north-south and there is little or no connectivity east-west across the valley floor in the vicinity of the Project. The Project area lies between these major corridors, with the western ranges being some distance away. The vegetation on the eastern edge of the Project area connects well with the large tracts of forested areas of the eastern range, eventually linking to the Glen Nature Reserve and then other reserves further south.

Vegetation connectivity within the Project area and surrounds is limited, except along the eastern side where the vegetated area to the east provides good north-south connectivity with patches of Dry Sclerophyll Forest and Grassy Woodland habitats north and south of the existing mine operation areas. Vegetation connectivity north, south and west of the existing mine operation areas and Project area is generally limited to scattered paddock trees, remnant roadside reserve vegetation and riparian vegetation along the local waterways. Currently, vegetation along the Avon River, Wards River, Dog Trap Creek and Spring Creek provide limited connectivity with ranges to the east and far west of the Stratford Mining Complex. Patches of vegetation adjacent to the existing mine pits are connected to these waterways through road side reserves and scattered paddock trees.

Existing and potential habitat corridors in the Project area and surrounds are depicted on Figure 10.

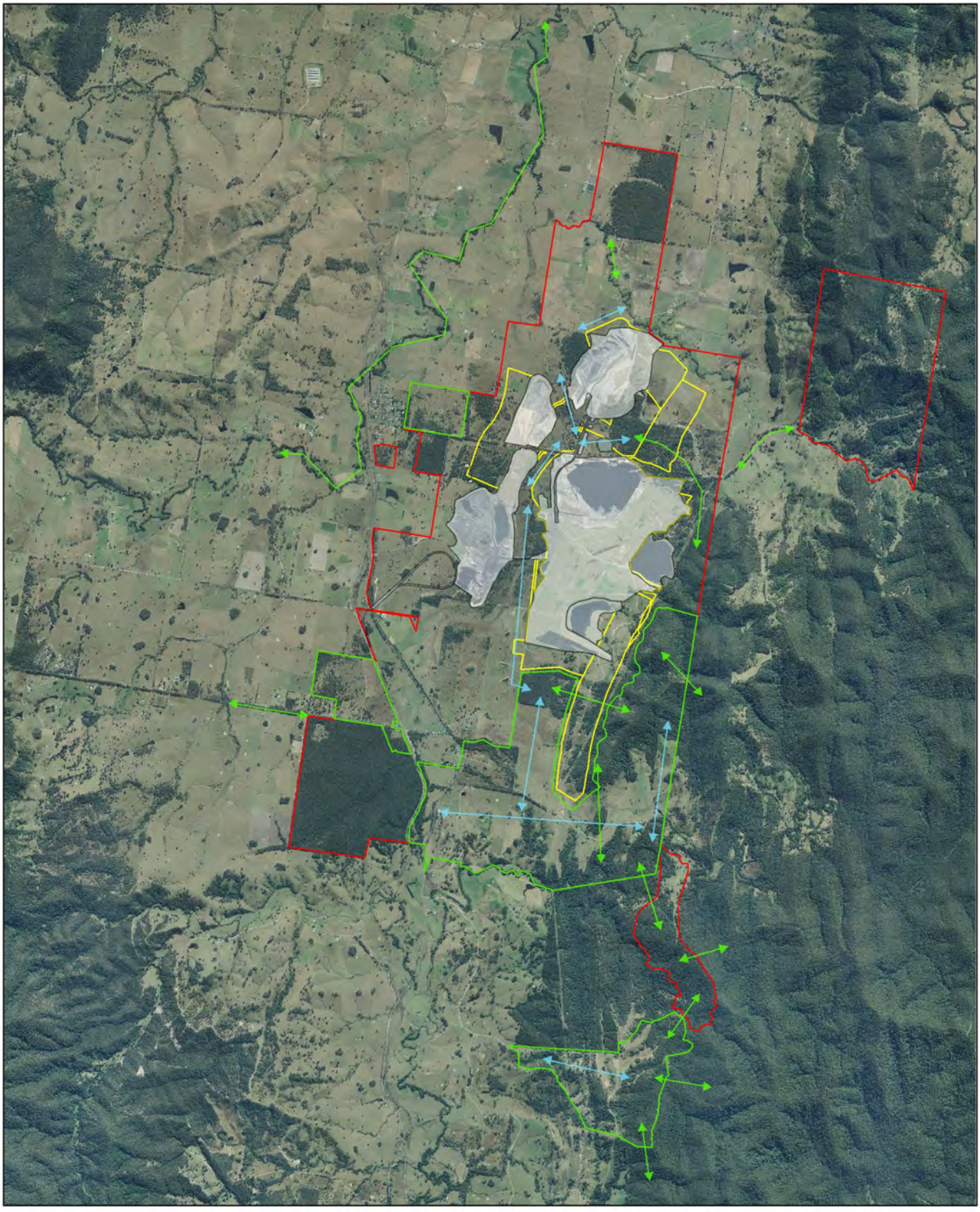


Figure 10: Existing and Potential Habitat Corridors within the Project Area and Surrounds.

5 Potential impacts

This section provides an assessment of the potential impacts of the Project on terrestrial fauna species, including cumulative impacts, in accordance with the Director-General's EARs for the Project.

5.1 Description of likely direct impacts

5.1.1 Loss of habitat

Direct impacts of the Project would include the progressive removal of vegetation and fauna habitat over 11 years. The total disturbance area for the Project is 300 ha, which includes approximately 105 ha of native vegetation communities and 195 ha of introduced or planted vegetation. Most of the disturbance area provides habitat for native fauna, some of which are of conservation significance. The type of fauna habitat that would be removed and the location is described in Table 16 and shown on Figure 5.

Table 16: Loss of each habitat type within the Project area.

Fauna habitat type	Approximate area to be cleared	Location and description
Wet Sclerophyll Forest	19.2	Wet Sclerophyll Forest habitat would be disturbed as a result of the Stratford East Open Cut and proposed surface water diversions in the eastern section of the Project area (Figure 5). Most of the habitat that would be disturbed is in good condition.
Grassy Woodlands	13.5	Grassy Woodland habitat in good condition would be disturbed primarily as a result of the Avon North Open Cut. A comparatively smaller section of disturbed Grassy Woodland habitat would be removed due to the Roseville West Pit Extension, which is in moderate condition (Figure 5).
Dry Sclerophyll Forest	65	Dry Sclerophyll Forest habitat would be disturbed in the north, west and east of the Project area due to all three open pits. The proposed surface water diversions would also disturb habitat in the east of the Project area (Figure 5). Most of the habitat that would be disturbed is in good condition.
Derived Grassland/Shrub Regrowth	5.5	A small portion of Derived Grassland habitat would be disturbed in the north of the Project area due to the Avon North Open Cut and proposed surface water diversions (Figure 5). The habitat is in moderate condition.
Acacia Regeneration	0.5	A small portion of this habitat would be removed in the south of the Project area due to the Stratford East Open Cut (Figure 5).The habitat is in moderate condition.
Cleared Land	190	Widely distributed throughout the Project area (Figure 5), but in general offers few habitat resources for threatened fauna. The majority of the habitat is considered to be in poor condition.
Planted Trees (Plantings)	1.3	One small habitat area within the central section of the Project area (Figure 5). Fauna habitat in this area is considered poor.
Total	**295 (rounded to 300)**	

The majority of the fauna habitat that would be removed is associated with the new open cut pits or pit extensions: Avon North Open Cut, Roseville West Pit Extension and Stratford East Open Cut. Comparatively less fauna habitat would be disturbed as a result of the waste emplacement areas, proposed surface water diversions, road and power line realignments and other mine infrastructure.

Clearing of native vegetation is listed as a key threatening process on Schedule 3 of the TSC Act and *Land clearance* is a related key threatening process listed by the EPBC Act. These are relevant to the Project as clearing will cause impacts to a range of fauna (including a number of threatened fauna species) that are known to occur in the Project area or locality, and potentially to other species that may occur. Clearing of vegetation results in the loss of habitat for species that utilise the vegetation and may also results in the loss of habitat resources, such as food trees, hollow bearing trees, rocks, and fallen timber, which can have further effects on the survival of current and future populations of fauna that rely on these resources. The degree of impact depends upon the extent of clearing of vegetation constituting habitat for each species, the extent to which each species relies on that habitat, and the relative ability, or inability, of individuals of those species to immigrate to other suitable habitats, the availability of alternative habitat areas or resources and the ability of individuals of those species to find and utilise alternative habitat areas or resources. The impacts of clearing of native and other vegetation and associated habitat loss are considered for threatened fauna species predicted or known to occur within the Project area in Section 5.3 and Appendices C and D.

Patch sizes, arrangement and connectivity

The Roseville West Pit Extension is a western extension of the existing Roseville West Pit. It involves the clearance of vegetation from two patches of dry sclerophyll forest and smaller areas of disturbed grassy woodland adjacent to the existing pit. Some of the trees in this area have regrown since the 1970s (see Figure 7b). The impacted habitat is connected to dry sclerophyll forest (remnant, young regrowth and disturbed), plantings and scattered trees to the west, primarily within crown land and the proposed Offset areas (Figure 5).

The Avon North Open Cut would also involve the clearance of dry sclerophyll forest and grassy woodland. The habitat has been extensively cleared in the past and during the 1960s and 1970s the habitat in this area was predominantly scattered trees (Figures 7a and 7b). Since the 1980s the forest and woodland habitat in this area has substantially regrown (Figures 7c to 7e). Presently, this area of habitat is in good condition and a number of hollow bearing trees have been recorded. The Avon North Open Cut would dissect the dry sclerophyll forest/grassy woodland, resulting in the western patch being surrounded by mine landforms and infrastructure. The Project would physically isolate this patch of habitat from surrounding habitat until revegetation of the post-mine landforms (Section 6.7.1).

The Stratford East Open Cut would run along the lower slopes of the range to the east of the Project area. It would involve clearing of wet and dry sclerophyll forest, some of which has regrown since the 1960s and 1970s (Figures 7a to 7e). The existing power line also runs through the proposed Stratford East Open Cut area and the vegetation beneath the power line is regularly slashed to maintain clearance for the power line. An area of dry sclerophyll forest and grassy woodland occurs to the west of the Stratford East Open Cut (Figure 5). The current connection of this patch with the range to the east has minor interruptions by the existing power line corridor, unsealed tracks and cleared land (Figure 5); however, these existing breaks are unlikely to impede the current passage of species with moderate to high mobility. The Project would physically isolate this patch of habitat from the vegetated areas east of the Stratford East Open Cut until revegetation of the Offset area to the south.

Condition of the fauna habitat to be removed
The condition of the habitat to be removed varies. A description of the condition and extent of the range of habitats in the Project area and surrounds is provided in Section 4.3 and the condition of the habitat that will be removed is summarised in Table 16. The majority of the Project area will comprise the broad habitat type Cleared Land, which is in poor condition and provides few resources for native fauna. Areas of native vegetation will also be removed, in particular Dry Sclerophyll Forest. In brief, the Grassy Woodland/Dry Sclerophyll forest on the valley floor is highly fragmented, primarily due to historic agricultural practices (Figures 7a to 7e) and the existing mine. However, these are some of the few remaining large areas of this habitat type remaining in the study area and surrounds. Furthermore, most habitats within the Project area are in moderate to good condition.

Land tenure
The Project is located on company-owned land within mining leases shown on Figure 2.

Management approach
The mine design has been refined to reduce its footprint as described in Section 6.1. Land needing to be cleared would be disturbed progressively over the life of the mine followed by staged progressive rehabilitation of the post-mine landforms (Section 6.7; Figures 11 and 12). In addition, a number of impact mitigation and offset measures would be adopted to reduce the impact of habitat loss. Some of the main measures are:

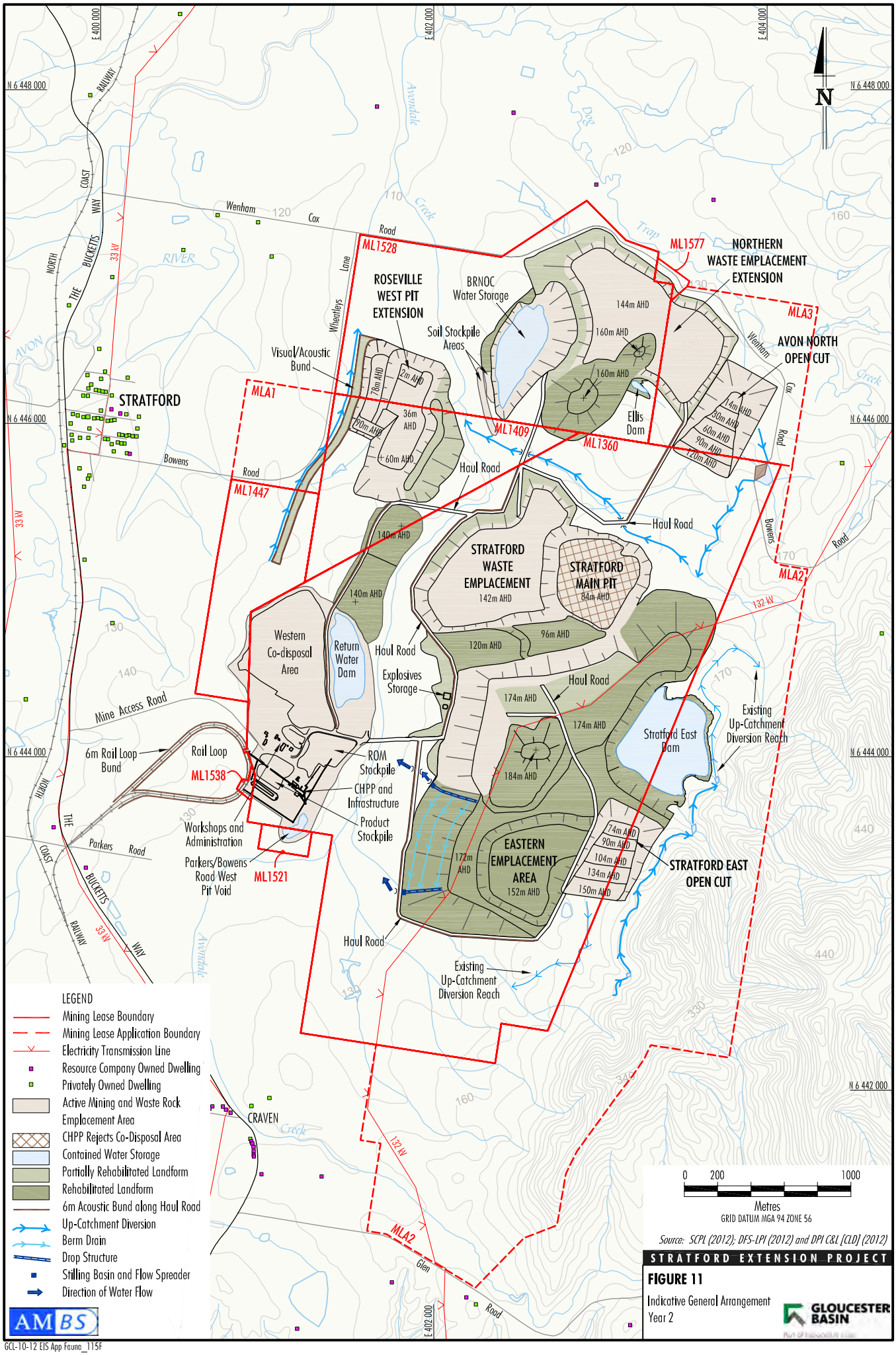
- vegetation clearance procedures;
- supplementing habitat areas with salvaged habitat features (logs, vegetative material tree hollows), nest boxes and select food trees; and
- the Offset strategy, which includes conservation of existing habitat and restoration of forest/woodland habitat types in currently cleared land.

These and other measures are further described in Sections 6 and 7.

5.1.2 Loss of hollow-bearing trees

Loss of hollow bearing trees is listed as a key threatening process under Schedule 3 of the TSC Act. Hollow-bearing trees can be considered a restricted resource given the long time periods involved with the ontogeny of hollow development (Wormington and Lamb, 1999). Hollows are used by a range of vertebrates and invertebrate species for different life cycle stages and are considered to be a limiting factor for population growth for a number of threatened species. Many species that rely on hollows are highly selective and only use hollows of a particular diameter, aspect and shape.

The clearance of fauna habitat from the Project area (Section 5.1.1) would also include the loss of hollow bearing trees. The density of hollow bearing trees has been mapped by EcoBiological (Appendix F; Figure 9) and AMBS (Appendix G). Differences between the predicted densities of hollows, as shown, are likely to be due to the different methods implemented. EcoBiological (Appendix F) performed a greater number of survey points for a smaller survey area, thus their hollow density estimations are likely to be more accurate for the smaller area. AMBS (Appendix G) distributed their survey points across the Project, Offset areas and some other surrounding areas. Nonetheless, both estimates demonstrate that the majority of the Project area has a low hollow density with less than ten hollow bearing trees per ha. Smaller areas of habitat contain 10-20 or greater than 20 hollows per ha. Based on the mapping by AMBS (Appendix G), a greater density of hollow bearing trees (6-20 hollow bearing trees per ha) are likely to occur east and south of the Project area. EcoBiological (Appendix F) estimate 63% of hollows are small, 24% of hollows are medium and 13% of hollows are large.



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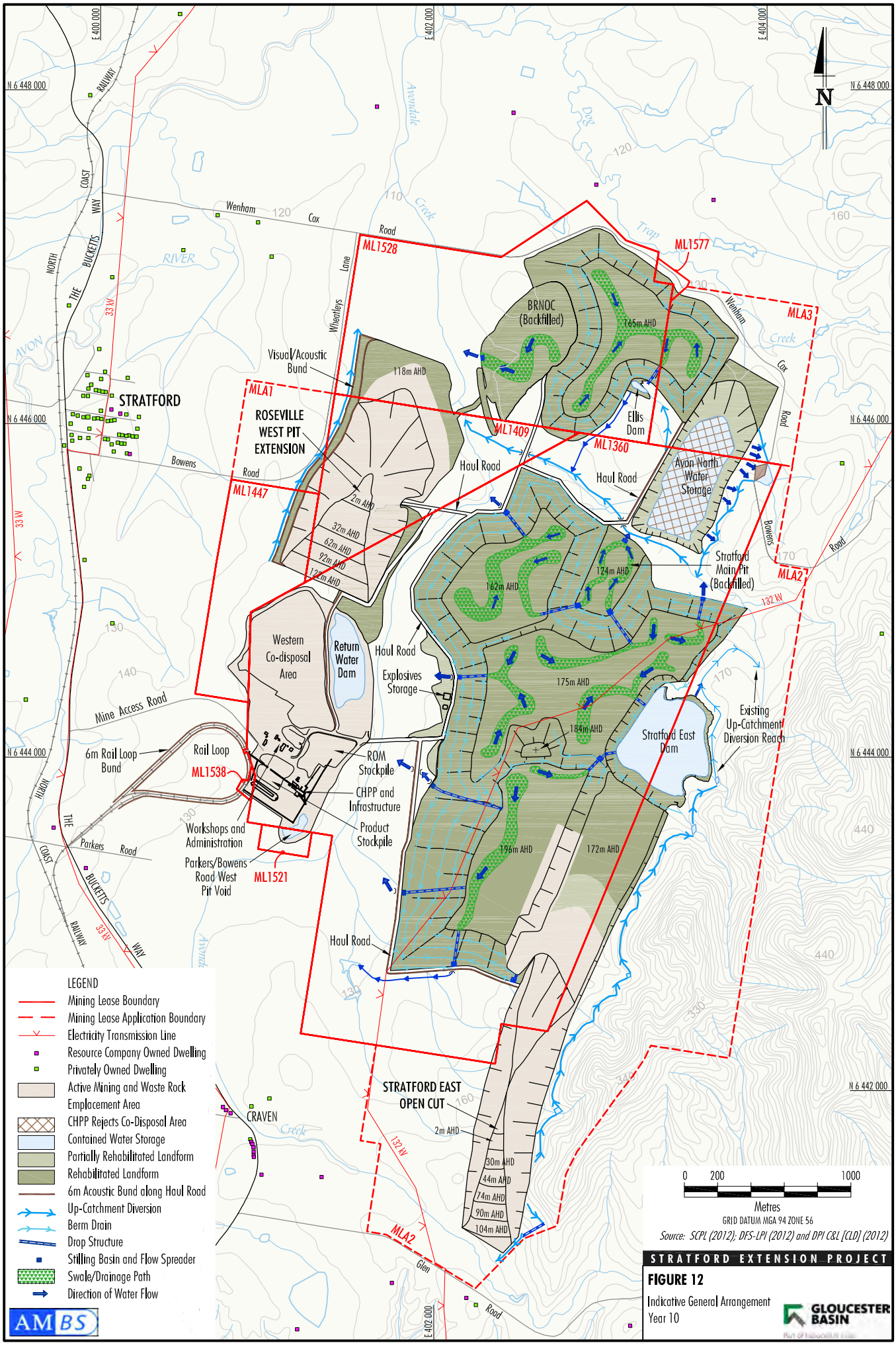

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As described in Section 4.3.1, prior to 1964 large areas of bushland were cleared, particularly on the valley floor and locations in the eastern portion of the mining lease. The aerial photograph from 1964 shows that much of the vegetation at that time was sparse and patchy (Figures 7a to 7e). This historical clearing is likely to be the primary factor responsible for the low abundance of old growth features.

A number of threatened avian and arboreal mammal species are dependent on hollows and have been known or predicted to occur within the Project area or locality. The impacts on threatened fauna species are assessed in Section 5.3 and Appendix C.

Management approach
The following measures have been incorporated into the Project to help reduce the impact of removing hollow-bearing trees:

- land clearance procedures and timing would be adopted to minimise harm to arboreal animals;
- land clearing would be undertaken in stages, within the minimum amount of habitat removed that would allow Project works to continue;
- tree hollows removed would be retained and reintroduced to suitable locations;
- a nest box programme would be designed to specifically target Squirrel Gliders and additional nest boxes of various sizes would be installed for other species of arboreal mammals, birds and bats. This would replace lost hollows of varying sizes at a 1:1 ratio, in Offset areas, the Biodiversity Enhancement Area, and areas nearby the Project area;
- parts of the post-mine landforms would be revegetated to woodland/forest and parts would be open areas with pasture and scattered trees; and
- the Offset strategy includes conservation of existing habitat and restoration of forest/woodland habitat types in currently cleared land.

These measures are further described in Sections 6 and 7.

5.1.3 Removal of dead wood and dead trees

Removal of dead wood and dead trees is listed as a key threatening process under Schedule 3 of the TSC Act. Dead wood and trees provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems. The removal of dead wood can have a range of environmental consequences, including the loss of habitat and disruption of ecosystem processes and soil erosion (DEC, 2003).

This threatening process is relevant because the Project would include the removal of dead standing trees and dead wood on the ground as a part of the clearing of habitat. The removal of these habitat components could result in impacts to a number of threatened fauna species (refer to Section 5.3) as well as some ground dwelling mammals and birds that may use the dead wood such as the threatened Speckled Warbler and Grey-crowned Babbler (eastern subspecies) (Section 5.3; Appendix C).

Despite the extensive past land clearance for agriculture (Figures 7a to 7e), large (>30 cm diameter) logs are patchily distributed throughout the woodland/forest components of the Project area. In some locations, the total combined length of fallen logs was measured to be greater than 250 m within a 50 x 100 m quadrat, while logs were completely absent in other locations. Similarly, dead trees were non-uniformly scattered throughout the landscape. Overall, dead trees were considered an uncommon habitat feature, but various fauna would likely use this resource where it does occur.

Management approach
The management approach for removing dead trees is the same as the approach to reduce the impact of removing hollow-bearing trees (Section 5.1.2). The impacts of removing dead wood are likely to be reduced by the relocation of dead wood in currently cleared areas in the Offset areas and Biodiversity Enhancement Area.

5.1.4 Bushrock

Bushrock removal is listed as a key threatening process under Schedule 3 of the TSC Act and is the removal of natural surface deposits of rock from rock outcrops or from areas of native vegetation. No major rock formations or continuous rock formations are present in the Project area. While bushrocks generally provide a fauna habitat resource, they are unlikely to be critical to threatened species recorded within the Project area or those which possibly occur. Clearing in the Project area would result in some bushrock removal, although it is considered to be a relatively minor impact on fauna. Nonetheless, any disturbed bushrock would be salvaged and relocated to currently cleared areas in the Offset areas and Biodiversity Enhancement Area.

5.1.5 Loss of individual animals

The Project has the potential to cause mortality of some animals as a result of direct encounters with construction works/vehicles or through removal of habitat during clearing. Nocturnal species, species with low mobility, territorial species and some ground-dwelling species (such as lizards and snakes) are particularly susceptible to injury or death during construction and clearing.

It is considered unlikely that wildlife mortality on roads would substantially increase as a result of the Project, given there are existing roads currently in operation, the low traffic volume and proposed management to reduce the potential for this impact to occur.

Management approach
The following impact mitigation measures have been incorporated into the Project to reduce the impact of loss of individual fauna:

- adopting vegetation clearance procedures; and
- speed limit signs to minimise the impacts on native fauna.

These measures are further described in Sections 6 and 7.

5.1.6 Fauna interaction with the final void

At the cessation of mining, final voids would remain in the Roseville West Pit Extension, Avon North Open Cut and Stratford East Open Cut. The salinity of the final void waterbodies is predicted to slowly increase over time (Gilbert & Associates, 2012). The final voids are unlikely to pose a significant risk to native animals given the wider availability of other (more suitable) sources of water and the depth of the final void waterbodies from ground surface (approximately 140 m for the Roseville West Pit Extension, 70 m for the Avon North Open Cut and 180 m for the Stratford East Open Cut).

5.2 Description of potential indirect impacts

5.2.1 Loss of habitat connectivity

Habitat corridors provide essential pathways for the movement of native fauna and play an important role in ensuring the long-term genetic viability of species. Vegetation within the region is connected by significant north-south vegetated ranges to the east and far west of the Project (Figure 10). A number of national parks, wilderness areas and state forests occur in the vegetation corridors along the ranges, the closest of which is the Glen Nature Reserve. The woodland/lowland forest on the valley floor is highly fragmented.

The current fragmentation within the Project area and surrounds can be attributed to historic agricultural practices (Figures 7a to 7e) and the existing mine. However, across the valley floor, some remnant and/or regrowth vegetation patches also exist, which connect to strips of vegetation (e.g. along roads, rivers and creeks), providing limited east-west connectivity.

The Project would involve expansion of the existing mine and further fragmentation of the woodland/forest habitats progressively over 11 years, until vegetation becomes established in the Offset areas, Biodiversity Enhancement Area and on the post-mine landforms.

The Avon North Open Cut would result in the fragmentation of an area of Dry Sclerophyll Forest and Grassy Woodland west of the Avon North Open Cut and north of the Stratford Main Pit (Figure 5). The connection of this patch to the range comprises of predominantly regrowth vegetation (Figures 7a to 7e). The Project would further isolate this patch of habitat (for some species) until rehabilitation and revegetation of the post-mine landforms could be established (Section 6.7). This habitat isolation would affect some species more than others; for example, some bird species would be able to fly to the patch across mine disturbance areas and it is possible that individuals of some small animals (e.g. reptiles and amphibians) may pass through culverts to be installed under the proposed haul road to Avon North Open Cut. The purpose of these culverts is to enable diverted surface water to flow to the Avondale Creek. Surface water would flow intermittently through them.

The Stratford East Open Cut would result in the temporary isolation and fragmentation of an area of Dry Sclerophyll Forest and Grassy Woodland west of the extension and the range to the east (Figure 5). This patch of vegetation is also within the proposed Offset areas (Section 7) and would eventually be reconnected via revegetation.

These two open cuts would effectively remove or limit the connection to the extensive forested areas east of the Project area, which in turn connect to the Glen Nature Reserve and other reserves further to the south. This represents a break in local connectivity and would act as a barrier to dispersal and migration of some fauna. The small size and isolation of these remnants would increase the risk of local species loss for fauna which utilise them, particularly species which have low mobility.

Management approach
The following impact mitigation measures have been incorporated into the Project to reduce the impact of fragmenting habitat:

- installation of glider poles to promote the movement of the Squirrel Glider either side of the existing haul road to BRNOC, the proposed haul road between the Roseville West Pit and the BRNOC, across the proposed haul road to Avon North Open Cut, north of the BRNOC towards Dog Trap Creek, and south from the remnant which occurs west of the Stratford East Open Cut (Section 6.12); and

- an offset strategy that would aim to provide connectivity between isolated woodland remnants via corridors (both existing and planted). This would, over the long-term, facilitate movement of animals between remnants and the large areas of forest to the east and south of the Project area, thereby aiding genetic exchange across the landscape.

These measures are further described in Sections 6 and 7.

5.2.2 Competition and grazing by the feral European rabbit

Competition and grazing by the feral European rabbit is listed as a key threatening process under Schedule 3 of the TSC Act and is also listed by the EPBC Act. Rabbits (*Oryctoagus cuniculus*) have established populations all across southern Australia, occupying approximately 4.5 million square kilometres (km^2) (NSW Scientific Committee, 2002b). Grazing and burrowing rabbits have potential to cause major erosion problems, reduce recruitment and survival rate of native plants and alter entire landscapes. The impact of rabbits across Australia threatens the survival of a number of threatened fauna listed under both the TSC Act and EPBC Act.

Rabbits are known to occur in the Project area and surrounds. Open grassland areas created by clearing trees ahead of mining have the potential to provide increased refuge and foraging areas for rabbits.

Management approach
Vegetation clearance procedures would be adopted to minimise the land cleared ahead of mining. A feral animal control programme is currently implemented at the Stratford Mining Complex and it would be continued for the Project as described in Section 6.5.

5.2.3 Predation by feral cats

Predation by feral cats is listed as a key threatening process under Schedule 3 of the TSC Act and is also listed by the EPBC Act. The feral cat is a common but elusive predator and occurs throughout Australia. Several threatened species that are predicted or known to occur within the Project area and surrounds are vulnerable to predation by feral cats. Species most vulnerable to predation by feral cats are birds and mammals within the critical weight range of 450-500 grams (NSW Scientific Committee, 2000a). There are a few threatened mammal and bird species known or predicted to occur within the Project area and surrounds that are threatened by cat predation. These include, but are not restricted to the: Long-nosed potoroo, New Holland Mouse, Speckled Warbler and Scarlet Robin.

Feral cats are known to have occurred in the Project area and surrounds. The woodland/lowland forest in the Project area and surrounds is highly fragmented and the Project is therefore unlikely to substantially increase the movement of feral cats. Activities associated with the Project may provide increased refuge and scavenging resources for feral cats, unless appropriately managed to discourage these exotic animals.

Management approach
A feral animal control programme is currently implemented at the Stratford Mining Complex and it would be continued for the Project as described in Section 6.5.

5.2.4 Predation by the European red fox

Predation by the European red fox is listed as a key threatening process under Schedule 3 of the TSC Act and is also listed by the EPBC Act. Since their introduction into Australia, foxes have contributed to severe declines and extinctions of a suite of native fauna, particularly among medium size ground dwelling and arboreal mammals and birds (NSW Scientific Committee, 1998). There are a few threatened mammal species known or predicted to occur within the Project area and surrounds that are threatened by fox predation. These include, but are not restricted to the: Long-nosed potoroo, New Holland Mouse and Koala.

Foxes are known to have occurred in the Project area and surrounds. The woodland/lowland forest in the Project area and surrounds is highly fragmented and the Project is therefore unlikely to substantially increase the movement of foxes. Activities associated with the Project may provide increased refuge and scavenging resources for foxes, unless appropriately managed to discourage these exotic animals.

Management approach
A feral animal control programme is currently implemented at the Stratford Mining Complex and it would be continued for the Project as described in Section 6.5.

5.2.5 Ecological consequences of high frequency fires

High Frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition is listed as a key threatening process under Schedule 3 of the TSC Act. The long-term survival of flora and fauna as a result of repeated fire is dependent on the species ability to maintain life cycle processes and the maintenance of vegetation structure over time as habitat for fauna species. High intensity, frequent fires have the ability to interrupt life cycle processes and alter vegetation structure (NSW Scientific Committee, 2000b). Threatened species predicted or known to occur within the Project area and locality that are directly threatened by fire regimes include but are not restricted to: the Squirrel Glider, Long-nosed Potoroo and Glossy Black-cockatoo.

Bushfires have a potential to occur due to various activities undertaken in the Project area (e.g. vehicles traversing long, dry grass, and on-site fuel usage).

Management approach
SCPL would continue to implement strategies to minimise fire risk including the use of diesel vehicles, prohibition of smoking in fire prone areas and rapid response to any outbreak of fire (Section 6.9.5). Consideration would be given to creating fire protection zones and isolation zones for fuel storage. The overall risk of increased bushfire frequency due to the Project is likely to be very low.

5.2.6 Invasion and establishment of exotic vines and scramblers

Invasion and establishment of exotic vines and scramblers is listed as a key threatening process under Schedule 3 of the TSC Act. A number of exotic vines and scramblers have become established in NSW and are having a significant adverse effect on biodiversity. They smother native vegetation and seedlings, preventing recruitment (NSW Scientific Committee, 2006) and may reduce or increase habitat features within an area. If not managed appropriately, this key threatening process can impact on a large range of native fauna.

The Project is unlikely to result in the invasion and establishment of exotic vines and scramblers in the Project area or surrounds (FloraSearch, 2012). Regular removal of weeds (including exotic vines and scramblers) would be undertaken throughout the Stratford Mining Complex, particularly in areas in which a new edge or corridor has been created,

5.2.7 Irrigation

The existing SCM is approved to undertake irrigation on rehabilitation areas within a contained catchment. This irrigation method would be continued for the Project with the proposed irrigation areas draining directly to mine water storages. No additional impacts on existing fauna habitats are expected. No fauna species (e.g. frogs) are considered likely to be adversely impacted by irrigation.

5.2.8 Edge effects

Edge effects are described as an ecological impact of two or more interfacing habitat types. Edge effects are inherent or natural in nature but can have negative impacts if they alter ecological processes. Removal of vegetation induces edge effects, as it causes new environmental conditions to develop along the edges of cleared environments. The removal of vegetation generally promotes the invasion of exotic species and/or disturbance tolerant native plants. With the invasion of these new species, it often becomes difficult for native plant species to recolonise.

Modification of habitats can be to the disadvantage of “interior” fauna assemblages and the advantage of “edge” fauna assemblages, potentially resulting in changes to species composition in these areas. Other potential impacts include changes to humidity, exposure to light and/or wind (Allaby, 2004), increased tree dieback and improved access for predators.

The impacts of edge effects are difficult to quantify, and it is difficult to separate the potential for new effects from existing effects. They are dynamic, can change over time, and vary depending on location, impacts and the species involved (Bali, 2005). Bali (2000) estimated that effects from a new edge would extend “at least 50 m towards the key habitat interior” of forest habitats.

Indirect impacts of the Project would include an increase or extension of edge effects where the proposed disturbance areas would extend adjacent to previously undisturbed vegetation. This is likely to occur at the new edge of each proposed open cut, the electricity transmission line realignment, and potentially from the stream diversions. It should be noted however, that some of these areas are already impacted by edge effects; particularly the smaller or currently fragmented patches.

The Glen Nature Reserve is located approximately 2 km to the south-east of the Project area. No impacts on the fauna in the Glen Nature Reserve are likely as a result of the Project.

Management approach
The management approach is to minimise vegetation clearing where possible, management of weeds (Section 6.6), minimise dust (Section 6.9.1) and management of soil (Section 6.9.2).

5.2.9 Noise

The impacts of noise on fauna have shown varying levels of impact. In relation to birds, noise has been shown to mask calling, change population distribution, increase vigilance, create psychological stress and potentially distract individuals from making biologically important decisions (Chan and Blumstein, 2011). Some animals have shown the ability to adapt (Brumm and Slabbekoorn, 2005), such as birds which have been shown to sing at a higher frequency in response to traffic noise (Slabbekoorn and Peet, 2003). However, species which cannot adapt their breeding behaviour (such as song) may experience reduced breeding. Traffic noise has been identified as the likely cause of reduced body mass, lower abundance, and higher frequency and pitch calls of frogs in a northern Queensland study (Hoskin and Goosem, 2010; Parris *et al*., 2009). Some frogs that call in large chorusing groups appear to be unaffected by urban noise (Herrera-Montes and Aide, 2011).

Some of the habitats are already subject to noise associated with the existing open cut mines, roads and railway. Noise emissions would increase as a result of the Project (SLR Consulting Pty Ltd, 2012). There is a potential for the increased noise to amplify the impacts on local fauna populations, as the new open pits are extended closer to areas of existing fauna habitat. Short-term noise impacts are also likely to result during construction of the proposed surface water flow diversions, particularly within bushland areas.

It is not likely that the increased noise emissions would have a significant adverse impact to local fauna populations, given in some locations these species already co-exist with the noise levels from the current mining operations. Of more concern for these species would be the loss of habitat. Some species with low mobility and smaller home ranges that are known or predicted to occur in the Project area and adjacent habitats, however, may be more impacted by the increased noise emissions; these include but are not restricted to the: Long-nosed Potoroo, New Holland Mouse, Brush-tailed Phascogale and Squirrel Glider.

Management approach
The management approach is to minimise noise where relevant. This is described more in Section 6.9.3.

5.2.10 Pollution

The Project would result in dust emissions when construction vehicles are working in dry conditions and from mining operations (PAE Holmes, 2012). Any impact from dust on fauna or their habitat is likely to be localised and comparatively minor compared to the main impact of habitat loss. This conclusion is based on the observed range of fauna (including threatened species) in habitats adjacent to the existing mines.

There is potential for spills of liquid pollutants (e.g. diesel fuel) and gross pollutants (e.g. general garbage). If not properly contained and managed, these pollutants can degrade natural areas and fauna habitats.

Management approach
The management approach is to minimise dust generation where relevant, and ensure pollutants are properly contained and managed. This is further described in Section 6.9.1.

5.2.11 Artificial lighting

The existing Stratford Mining Complex is currently a day operation. The Project would involve a change to a 24 hour operation (different times for different pits), requiring artificial lighting to be in use for longer periods of time. Artificial lighting for the Project has the potential to affect the behavioural patterns of some fauna species. For example, some bird and bat species are attracted to insects that swarm around artificial lights. As a consequence of this, these bird and bat species could then become vulnerable to predation by larger predators which may lead to changes in population structure and community composition. Some species may also avoid areas with excess lighting.

Artificial lighting would need to minimise the amount in which it spreads into adjacent areas of retained habitat. Provided the lighting is strictly focussed and does not result in a noticeable increase in ambient light levels, it is considered unlikely to have a significant impact on local native fauna.

Management approach
The management approach is to minimise artificial lighting where relevant. This is further described in Section 6.9.4.

5.2.12 Changes to hydrology

Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands is listed as a key threatening process under Schedule 3 of the TSC Act. The NSW Scientific Committee (2002c) describes this threatening process as an alteration to natural flow regimes, reducing or increasing flows, altering seasonality of flows, changing the frequency, duration, magnitude, timing, predictability and variability of flow events, altering surface and subsurface water levels and changing the rate of rise or fall of water levels.

It has relevance to the Project due to the potential for changes to the natural flow regimes from mining pits and building waste emplacements. Gilbert & Associates (2012) advise that no measureable changes in flows in the Avon River, Avondale Creek and Dog Trap Creek downstream of the Stratford Mining Complex would result from the Project.

No/negligible impacts are expected to occur on stream flows from groundwater drawdown along the Avon River (Heritage Computing, 2012). Impacts to stream flows from groundwater drawdown within Avondale Creek and downstream of the Avondale Creek confluence along Dog Trap Creek are anticipated to be negligible, however, small/negligible leakage during low flows may occur (Heritage Computing, 2012). Despite the potential for leakage from Avondale Creek and Dog Trap Creek, the impact on the terrestrial fauna is considered to be very minor as the creeks are naturally ephemeral. FloraSearch (2012) found that no vegetation appears to be associated with groundwater. Therefore no terrestrial fauna habitat is likely to be impacted by the proposed changes to groundwater levels.

Management approach
The Project includes upslope diversions that would divert runoff water away from the open pit. The diversions would direct surface water away from the mine area, and into existing creeks, rivers, or other forms of drainage.

5.3 Significance of impacts

5.3.1 TSC Act – Assessments of Significance

Threatened fauna species known or considered likely to occur in the Project area and immediate surrounds (and therefore have the potential to be affected by the Project) are assessed via an Assessment of Significance under Section 5a of the EP&A Act. The assessments are presented in Appendix C.

The Assessment of Significance is performed to determine the likelihood of a significant impact occurring on threatened species, populations or ecological communities, or their habitats. The Project has been declared a NSW State Significant Development and therefore a *Species Impact Statement* is not applicable. Instead, this document provides an in-depth assessment of potential and likely impacts and provides measures to avoid, mitigate and offset those impacts.

Although the Project would result in potential impacts on species and their habitat, it would also involve the enhancement and conservation of other areas in the vicinity of the mine through an offset strategy (Section 7). The implementation of offset strategy would be monitored and independently audited. A conservation bond (which is held until the objectives are met) is also likely to be required by the government. Proposed measures to mitigate or offset the impacts of the Project were not considered in determining the degree of the effect unless the measure has been used successfully in a similar situation.

The likelihood of a significant impact occurring on a local population of fauna is considered in terms of no potential impact; possible impact but unlikely to be significant; or likely significant impact.

Assessments of Significance were not undertaken for any species that are likely to experience no potential impacts from the Project (Appendix B):

- No potential impacts are likely on threatened amphibian or reptile species, namely, the Stuttering Frog, Giant Barred Frog, Green and Golden Bell Frog, Booroolong Frog, Green-thighed Frog, Davies' Tree Frog, Broad-headed Snake or Stephens' Banded Snake.
- No potential impacts are likely on various threatened birds, namely, the Magpie Goose, Black-necked Stork, Spotted Harrier, Bush Stone-curlew, Australian Painted Snipe, Wompoo Fruit-Dove, Rose-crowned Fruit-Dove, Superb Fruit-Dove, Major Mitchell's Cockatoo, Turquoise Parrot, Rufous Scrub-bird, White-fronted Chat, Olive Whistler and Comb-crested Jacana.
- No impacts are likely on the Eastern Pygmy-possum, Yellow-bellied Glider, Rufous Bettong, Parma Wallaby, Brush-tailed Rock-wallaby, Red-legged Pademelon, Golden-tipped Bat and Hastings River Mouse.

Thirty-three threatened fauna species listed under the TSC Act have the potential to be affected by the Project to some extent, and are assessed via the Assessment of Significance (Table 17). In addition, an assessment of significance was carried out in relation to the Regent Honeyeater, on the basis of its Critically Endangered status under the TSC Act.

Table 17: Threatened fauna species or their habitat known or considered likely to occur in the Project area and immediate surrounds.

Common name	Scientific name	Conservation Status[1]	
		TSC Act	EPBC Act
Birds			
Little Eagle	*Hieraaetus morphnoides*	V	-
Glossy Black-cockatoo	*Calyptorhynchus lathami*	V	-
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V	-
Little Lorikeet	*Glossopsitta pusilla*	V	-
Swift Parrot	*Lathamus discolor*	E	E
Sooty Owl	*Tyto tenebricosa*	V	-
Masked Owl	*Tyto novaehollandiae*	V	-
Powerful Owl	*Ninox strenua*	V	-
Barking Owl	*Ninox connivens*	V	-
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	-
Speckled Warbler	*Pyrrholaemus saggitatus*	V	-
Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	-
Flame Robin	*Petroica phoenicea*	V	-
Scarlet Robin	*Petroica boodang*	V	-
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V	-
Varied Sittella	*Daphoenositta chrysoptera*	V	-
Diamond Firetail	*Stagonoplleura guttata*	V	-
Mammals			
Spotted-tailed Quoll	*Dasyurus maculatus maculatus*	V	E
Brush-tailed Phascogale	*Phascogale tapoatafa*	V	-
Common Planigale	*Planigale maculata*	V	-
Koala	*Phascolarctos cinereus*	V	-
Squirrel Glider	*Petaurus norfolcensis*	V	-
Long-nosed Potoroo	*Potorous tridactylus*	V	V
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-
Eastern Freetail-bat	*Mormopterus norfolkensis*	V	-
Little Bentwing-bat	*Miniopterus australis*	V	-
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V	-
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V
Southern Myotis	*Myotis macropus*	V	-
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-
Eastern Cave Bat	*Vespadelus troughtoni*	V	-

[1] Threatened fauna species status under the TSC Act and/or EPBC Act (current as at 16 February 2012).
V = Vulnerable, CE = Critically Endangered, E = Endangered

The conclusion of the assessments was that the Project is unlikely to significantly impact any species, with the exception of the Squirrel Glider, which was considered to have the potential to be significantly impacted in the short-term. However, those impacts, while significant, are not likely to be so great as to extirpate the entire local population of Squirrel Glider.

The species is likely to persist in at least one of the three currently known locations in the Project area or immediate surrounds. Because the Squirrel Glider is currently persisting in a few small patches, the offset strategy has the potential to improve the conservation of the local Squirrel Glider population in the medium to long-term.

For all species listed in Table 17, the conclusions to all assessments of significance are provided below.

Little Eagle (*Hieraaetus morphnoides*)
It is anticipated that the Project would potentially impact on the Little Eagle due to the removal of potential foraging habitat for this species. Overall, the Project is unlikely to have a significant impact on the Little Eagle such that a local viable population would be placed at risk of extinction given:

- the species has not been recorded in the Project area and has only been reported once in the wider area;
- a relatively small amount of potential habitat would be cleared (105 ha primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and a further 90 ha of cleared land that provides potential foraging habitat) (Section 7), compared to the amount of potential habitat in region and the surrounding area; and
- any potential habitat that would be fragmented or isolated is unlikely to have more than a negligible impact for this highly mobile and wide-ranging species.

Further to the above, post-mining landforms would be rehabilitated and revegetated, and a considerable amount of potential habitat would be conserved and enhanced in the proposed Offset areas (490 ha of native vegetation composed of equivalent and/or additional vegetation types and 40 ha of cleared land that this species could utilise) (Section 7). Additional potential habitat would be created through revegetation of cleared land in offsets (up to 435 ha) and post-mining landforms (Section 7).

Glossy Black-cockatoo (*Calyptorhynchus lathami*)
The Project would impact the Glossy-black Cockatoo through removal of known foraging habitat and some potential breeding habitat. Approximately 18% of the area of potential habitat with high abundance of *Allocasuarina* spp. in the study area would be removed. However, the Project is unlikely to have a significant impact on the Glossy-black Cockatoo because:

- from a regional perspective, only a small amount of potential and/or known foraging habitat would be removed (approximately 25 ha of native vegetation with high abundance of *Allocasuarina* spp. and 14 ha with low abundance) (Section 7);
- known foraging habitat consisting of stands of *Allocasuarina* spp. would be conserved in the Offset areas (63 ha with high abundance of *Allocasuarina* spp. and 166 ha with low abundance) (Section 7);
- additional areas of known foraging habitat also exist in nearby locations outside the Project and Offset areas;
- potential breeding habitat would be conserved in the Offset areas, given the presence of hollows, known foraging habitat and observational records for the species;
- the impacts of habitat fragmentation from the Project are only likely to be minor for this highly mobile and wide-ranging species; and
- the species occurs throughout the Gloucester Valley, including in the Offset areas and in the Glen Nature Reserve.

Further to the above, revegetation programmes within the area, including plantings of stands of *Allocasuarina* spp., would be undertaken in parts of the Offset areas (Section 7) and some of the post-mining landforms would also be rehabilitated and revegetated with *Allocasuarina* spp.

Gang-gang Cockatoo (*Callocephalon fimbriatum*)
It is anticipated that the Project would potentially impact on the Gang-gang Cockatoo due to the removal of potential foraging habitat for this species. Overall, the Project is unlikely to have a significant impact on the Gang-gang Cockatoo such that a local viable population would be placed at risk of extinction given:

- the Gang-gang Cockatoo has not been recorded within the Stratford Mining Complex, and few records exist from the wider locality;
- from a regional perspective, the Project would only remove a small area of potential foraging habitat (105 ha primarily composed of dry sclerophyll forest, grassy woodland and wet sclerophyll forest, and a further 26 ha of cleared land);
- the impacts of habitat fragmentation from the Project are only likely to be minor for this highly mobile and wide-ranging species; and
- there is likely to be substantial habitat for this species in the surrounding areas.

Further to the above, potential habitat for the species would be conserved and improved in the region in the long-term due to the proposed Offset areas, including conservation of 490 ha of wet sclerophyll forest, grassy woodland and dry sclerophyll forest composed of equivalent and/or additional vegetation types, and 40 ha of cleared land (Section 7). Additional potential habitat would be created through revegetation of cleared land in Offset areas (up to 435 ha), and post-mining landforms would be rehabilitated and revegetated.

Little Lorikeet (*Glossopsitta pusilla*)
It is anticipated that the Project would potentially impact the Little Lorikeet due to the removal of potential foraging and breeding habitat for the species. In the short-term there is likely to be a relatively small increase in a key threatening process (clearing and loss of hollows). However, the Project is not likely to have a significant adverse impact on this species such that a local viable population would be placed at risk of extinction given:

- the Little Lorikeet has only rarely been recorded in the area (one occasion Figure 4a);
- only a relative small amount of potential habitat would be cleared (105 ha of potential foraging habitat in native vegetation [i.e. primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest]) and a further 26 ha of cleared land that could be utilised by this species (Section 7);
- the impacts of habitat fragmentation from the Project are only likely to be minor for this highly mobile and wide-ranging species; and
- there are substantial extant areas of habitat for this species in the region and in the surrounding area, including in the Glen Nature Reserve where this species is known to occur.

Further to the above, potential habitat in the Offset areas would be conserved and improved (approximately 490 ha of wet sclerophyll forest, grassy woodlands and dry sclerophyll forest composed of equivalent and/or additional vegetation types and 40 ha of cleared land that this species could utilise) (Section 7). Additional potential habitat would be created through revegetation of cleared land in offsets (up to 435 ha) and post-mining landforms (Section 7).

Swift Parrot (*Lathamus discolour*)
It is anticipated that the Project would potentially impact on the Swift Parrot due to the removal of potential foraging habitat for this species. Overall, the Project is unlikely to have a significant impact on the Swift Parrot such that a local viable population would be placed at risk of extinction given:

- the Swift Parrot has only rarely been recorded in the general wider locality (one occasion);

- from a regional perspective, the Project would only remove a small area of potential foraging habitat (105 ha primarily composed of dry sclerophyll forest, grassy woodland and wet sclerophyll forest, and a further 28 ha of cleared land) (Section 7); and
- the impacts of habitat fragmentation from the Project are only likely to be minor for this highly mobile and wide-ranging species.

Further to the above, potential habitat for the species would be conserved and improved in the region in the long-term due to the proposed Offset areas, including conservation of 490 ha of wet sclerophyll forest, grassy woodland and dry sclerophyll forest composed of equivalent and/or additional vegetation types, and 40 ha of cleared land (Section 7). Additional potential habitat would be created through revegetation of cleared land in Offset areas (up to 435 ha) and rehabilitated post-mining landforms (Section 7).

Forest Owls: Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Masked Owl (*Tyto novaehollandiae*) and Sooty Owl (*Tyto tenebricosa*)
It is anticipated that the Project would potentially impact these large forest owls due to the removal of potential foraging and breeding habitat for these species. In the short-term there is likely to be a relatively small increase in a key threatening process (clearing and loss of hollows). Similarly, the Project would remove potential foraging and breeding habitat for prey species. Overall, the Project is unlikely to have a significant impact on these species such that a local viable population would be placed at risk of extinction considering that:

- the Masked Owl and Sooty Owl have only been rarely recorded in the Project area or surrounds;
- the Powerful Owl and Barking Owl have not been previously recorded in the Project area or surrounds;
- from a regional perspective, the Project would only remove a relatively small area of potential foraging and breeding habitat for these species, consisting of the following (Section 7):
  - Masked Owl: 105 ha primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and 90 ha of cleared land that this species could utilise; and
  - Powerful Owl: 105 ha primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and 90 ha of cleared land that this species could utilise;
  - Barking Owl: 105 ha primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and 90 ha of cleared land that this species could utilise;
  - Sooty Owl: 105 ha of native vegetation potential foraging habitat, and 90 ha of cleared land that this species could utilise. Most likely roosting habitat within the Project Area is composed of 0.1 ha of wet sclerophyll forest;
- there is substantial habitat for these species in the surrounding area; and
- the impacts of habitat fragmentation from the Project are only likely to be minor for these highly mobile and wide-ranging species.

Further to the above, potential habitat in the Offset areas would be conserved and improved (490 ha of native vegetation composed of equivalent and/or additional vegetation types and 231 ha of cleared land that these species could utilise) (Section 7). Potential habitat would be created through revegetation of cleared land in offsets (up to 435 ha) and post-mining landforms (Section 7).

Brown Treecreeper (*Climacteris picumnus victoriae*), and Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*)

It is anticipated that the Project would potentially impact these threatened woodland birds due to the removal of potential foraging and breeding habitat for these species. However, the Project is not likely to have a significant impact on these species such that a local viable population would be placed at risk of extinction given:

- few records exist of the species in the locality and they have not recently been recorded at the Stratford Mining Complex (last records in 1994) and resident populations of either species are unlikely to exist in the Project area;
- from a regional perspective, only a relative small amount of potential foraging and breeding habitat would be cleared for each species, consisting of the following (Section 7):
  - Brown Treecreeper: 66 ha primarily composed of grassy woodland and dry sclerophyll forest;
  - Hooded Robin (south-eastern form): 73 ha primarily composed of grassy woodland and dry sclerophyll forest; and
- potential habitat for these species occurs in the surrounding area; and
- the Project would result in only the temporary fragmentation and isolation of potential habitat, until the revegetation programmes become established (no known habitat would be impacted).

Further to the above, potential foraging and breeding habitat in the Offset areas would be conserved and improved (231 ha for the Hooded Robin [south-eastern form], and 137 ha for the Brown Treecreeper, of native vegetation composed of equivalent and/or additional vegetation types) (Section 7). In addition potential habitat would be created through revegetation of cleared land in offsets (up to 435 ha) and post-mining landforms (Section 7).

Speckled Warbler (*Pyrrholaemus sagittata*)

It is anticipated that the Project would impact on the Speckled Warbler considering the species requires large, relatively undisturbed remnants to persist in an area; further, they are highly territorial and sedentary. In addition, the species is uncommon in the area and the valley habitat (e.g. grassy woodland) that this species is dependent upon is limited in the wider locality. Overall, the Project is not anticipated to have a significant impact on the persistence of the species in the locality given that:

- the single location where Speckled Warbler was recorded during recent surveys would remain largely unaffected by the Project (Figure 4a);
- from a regional perspective, the Project would only remove approximately 52 ha of potential habitat composed primarily of grassy woodland and dry sclerophyll forest (Section 7);
- potential habitat exists in locations outside the Project area that would remain unaffected (e.g. the Voluntary Conservation Area where there are historical records); and
- the Project would only temporarily fragment areas of potential habitat, until revegetation programmes become established.

Further to the above, Offset areas are likely to expand and improve suitable habitat for the species in perpetuity (123 ha of native vegetation composed of equivalent and/or additional vegetation types) and cleared land would be revegetated throughout the Offset areas (up to 435 ha), and post-mining landforms would be rehabilitated and revegetated (Section 7). These revegetation programmes are likely to provide potential habitat for the species in the future (Section 7).

Regent Honeyeater (*Anthochaera phrygia*)
Potential foraging habitat for the Regent Honeyeater would be removed; however, the species is a generalist forager and is known to undertake extensive nomadic movements in relation to spatial availability of food sources. Overall, the Project is unlikely to have a significant impact on the Regent Honeyeater such that a local viable population would be placed at risk of extinction given that:

- database searches did not reveal any records for this species within approximately 23 km of the Project area, and the species is therefore not likely to depend on the habitat in the Project area, and is only likely to occur as a very occasional vagrant;
- from a regional perspective, the Project would only remove approximately 105 ha of potential foraging habitat, composed primarily of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and potentially 28 ha of cleared land (Section 7);
- potential habitat would be fragmented on a small scale in the short-term, until the revegetation programmes are established; and
- the Project would not impact on any known key breeding areas.

Further to the above, potential habitat for the species would be conserved and improved in the region in the long-term in the proposed Offset areas, including conservation of 490 ha of wet sclerophyll forest, grassy woodland and dry sclerophyll forest composed of equivalent and/or additional vegetation types, and 40 ha of cleared land that the species could utilise (Section 7). Up to 435 ha of land would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Flame Robin (*Petroica phoenicea*)
It is anticipated the Project would potentially impact the Flame Robin due to the removal of potential foraging habitat for the species. The Project would temporarily impact potential movement between the highlands and the lowlands, until lowland areas are revegetated. However, this impact is not considered to be significant such that a local viable population would be placed at risk of extinction given:

- the species is not known to use the habitat in the Project area, with only a single record from near the Project area in the crown reserve, and one additional record near Offset area 4 (Figure 4a);
- from a regional perspective, the impact area is relatively small (105 ha of native vegetation primarily composed of grassy woodland and 26 ha of cleared land that this species could utilise) (Section 7);
- the Project would only temporarily fragment areas of potential habitat until revegetation; and
- potential habitat for this species exists in the surrounding area.

Further to the above, potential habitat in the Offset areas would be conserved and improved (490 ha wet sclerophyll forest, grassy woodland and dry sclerophyll forest composed of the equivalent and/or additional vegetation types and 40 ha of cleared land that this species could utilise) (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7) and revegetation of post-mining landforms.

Scarlet Robin (*Petroica boodang*)
It is anticipated that the Project would potentially impact the Scarlet Robin due to the removal of potential foraging and breeding habitat for this species. However, the Project is not likely to have a significant impact on this species such that a local viable population would be placed at risk of extinction given:

- the Scarlet Robin has only rarely been recorded in the area;
- from a regional perspective, the Project would only remove a small area of potential habitat in native vegetation (73 ha) primarily composed of grassy woodland and dry sclerophyll forest (Section 7);

- potential habitat for this species occurs in the surrounding area; and
- the Project would result in only the temporary fragmentation and isolation of potential habitat, until the revegetation programmes become established.

Further to the above, potential habitat (231 ha) composed of equivalent and/or additional vegetation types for the species would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). In addition, areas of land that would be revegetated throughout the Offset areas (up to 435 ha) may provide potential habitat for the species in the future (Section 7), as well as the revegetated areas of post-mining landforms.

Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)
It is anticipated that the Project would have an impact on the Grey-crowned Babbler (eastern subspecies) considering the Project would remove some known nesting sites and foraging habitat. The species is highly territorial, sedentary and utilises the same nests year after year. Furthermore, the species is generally unable to cross large open patches due to its laborious flight and the valley habitat (e.g. grassy woodland) that this species is dependent upon is limited in the wider locality. However, the Project is unlikely to have a significant impact on the Grey-crowned Babbler (eastern subspecies) such that a local viable population would be placed at risk of extinction given:

- the species is relatively widespread in and around the Project area and locality (Figure 4a);
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of grassy woodland and dry sclerophyll forest, and 56 ha of cleared land) of potential foraging and breeding habitat within the Project area (Section 7); and
- the Project would only temporarily isolate areas of potential habitat for this species.

Further to the above, potential habitat for the species (665 ha of native vegetation composed of the equivalent and/or additional vegetation types and cleared land) would be conserved and improved in the region in the long-term due to the proposed offset (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Varied Sittella (*Daphoenositta chrysoptera*)
It is anticipated that the Project would have an impact on the Varied Sittella considering the species is sedentary, and decreases in patch size and connectivity are important requirements for sedentary species. Further, this species is associated with the valley habitats which are limited in the wider locality. However, the Project is unlikely to have a significant impact on the Varied Sittella such that a local viable population would be placed at risk of extinction given:

- the species has been recorded in several locations outside the Project area (Figure 4a);
- from a regional perspective, only a relatively small area of potential habitat would be cleared (105 ha of native vegetation composed primarily of grassy woodlands, dry sclerophyll forest and wet sclerophyll forest) and a further 26 ha of cleared land that this species could utilise (Section 7); and
- the Project would only temporarily fragment areas of potential habitat for this species.

Further to the above, potential habitat for the species (490 ha of native vegetation composed of the equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term due to the proposed Offset areas (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7), and rehabilitation and revegetation of post-mining landforms.

Diamond Firetail (*Stagonopleura guttata*)
It is anticipated that the Project would potentially impact the Diamond Firetail through the removal of potential foraging and breeding habitat. However, the Project is not likely to have a significant impact on this species such that a local viable population would be placed at risk of extinction considering that:

- few records exist of the species in the locality and it has not recently been recorded at the Stratford Mining Complex (last records in 1994) and resident populations of the species is unlikely to exist in the Project area;
- from a regional perspective, only a relative small amount of potential foraging and breeding habitat would be cleared (105 ha primarily composed of grassy woodland and dry sclerophyll forest, and 98 ha of cleared land) and potential habitat for this species occurs in the surrounding area (Section 7); and
- the impacts of habitat fragmentation from the Project are only likely to be minor given the species can utilise fragmented landscapes to some extent.

Further to the above, potential foraging and breeding habitat in the Offset areas would be conserved and improved (515 ha that this species could potentially use) (Section 7). In addition potential habitat would be created through revegetation of cleared land in offsets (up to 435 ha) (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Spotted-tailed Quoll (*Dasyurus maculatus*)
It is anticipated that the Project would potentially impact on the Spotted-tailed Quoll due to the removal of potential foraging habitat. Overall, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the species was not recorded during any surveys in the study area;
- from a regional perspective, only a relatively small area of potential habitat would cleared (105 ha of potential habitat in native vegetation, primarily composed of wet sclerophyll forest, grass woodland, and dry sclerophyll forest) and a further 90 ha of cleared land that could be utilised by this species (Section 7);
- there is substantial less fragmented habitat for this species in the surrounding area, including the Glen Nature Reserve; and
- no known area of habitat would be fragmented or isolated as a result of the Project.

Further to the above, potential habitat in the Offset areas would be conserved and improved (447 ha of native vegetation composed of the equivalent and/or additional vegetation types, and 10 ha of planted trees) (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7), and revegetation of rehabilitated post-mining landforms.

Brush-tailed Phascogale (*Phascogale tapoatafa*)
It is anticipated the Project would have an impact on the Brush-tailed Phascogale considering the preferred habitat for the species (dry sclerophyll forest) is limited throughout the valley, and the Project is likely to remove some potential foraging and shelter/nesting habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the species has been recorded in several locations outside the Project area;
- from a regional perspective, the Project would only remove a small area (52 ha of good quality habitat and 63 ha of patchy habitat, primarily composed of grassy woodland, dry sclerophyll forest, and wet sclerophyll forest) of potential habitat within the Project area (Section 7); and
- the Project would only temporarily fragment areas of potential habitat for the species, until the revegetation programmes are established.

Further to the above, potential habitat for the species (157 ha of good quality habitat and 191 ha of patchy habitat composed of the equivalent and/or additional vegetation types) would be conserved and improved in the region in the long-term due to the proposed offset areas (Section 7), which includes the extension of known Brush-tailed Phascogale habitat as a result of proposed Offset area 2. Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Common Planigale (*Planigale maculata*)
It is anticipated that the Project would potentially impact on the Common Planigale due to the removal of potential foraging and breeding habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the species' is known to occur in a large range of habitats, including rainforest, eucalypt forest, heathland, marshland, grassland, and rocky areas, so is unlikely to be specifically reliant on the valley habitats that would be disturbed;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of grassy woodland, wet sclerophyll forest, dry sclerophyll forest, and an additional 25 ha of cleared land) of potential habitat within the Project area (Section 7);
- potential habitat is likely to occur in the surrounding area; and
- the Project would only temporarily fragment areas of potential habitat for the species, until revegetation programmes become established.

Further to the above, potential habitat in the Offset areas would be conserved and improved (490 ha of native vegetation composed of the equivalent and/or additional vegetation types that this species could utilise) (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7), and rehabilitated post-mining landforms would be revegetated.

Koala (*Phascolarctos cinereus*)
It is anticipated that the Project would potentially impact on the Koala due to the removal of potential habitat. However, the Project is not likely to have a significant impact such that a local viable population would be placed at risk of extinction given:

- the species was not recorded in the Project area during any surveys in the study area;
- from a regional perspective, only a relatively small area of potential habitat would cleared (105 ha of potential habitat in native vegetation primarily composed of wet sclerophyll forest, grass woodland, and dry sclerophyll forest) and a further 25 ha of cleared land that could be utilised by this species (Section 7);
- the species has been recorded in several other locations outside the Project area (Figure 4b);
- there is substantial habitat for the species in the surrounding area, including the Glen Nature Reserve, Offset areas and Voluntary Conservation Area, where it is known to occur; and
- no known area of habitat would be fragmented or isolated as a result of the Project.

Further to the above, known and potential habitat in the Offset areas would be conserved and improved (478 ha of potential habitat in native vegetation composed of the equivalent and/or additional vegetation types that the species could utilise) (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land, some of which may provide potential habitat for the species in the future (Section 7). Further, post-mining landforms would be rehabilitated and revegetated.

Squirrel Glider (*Petaurus norfolcensis*)
The Project would impact on the Squirrel Glider due to the removal and isolation of known areas of habitat. The Project is considered likely to have a significant impact on a local population of this species in the short-term, on the basis that:

- the local population is only known from three locations within the Project area and immediate surrounds; and
- the Project would remove areas of known and potential habitat (93 ha in native vegetation primarily composed of grassy woodland and dry sclerophyll forest), directly impacting on two of the known habitat areas and potentially indirectly impact on the third (Section 7).

These impacts, while potentially significant in the short-term, are not considered likely to result in the extirpation of the entire local population. Because the Squirrel Glider is currently persisting in a few relatively small patches, the offset strategy has the potential to improve the conservation of the local Squirrel Glider population in the medium to long-term.

Long-nosed Potoroo (*Potorous tridactylus tridactylus*)
It is anticipated that the Project would have an impact on the Long-nosed Potoroo considering that known habitat for the species would be directly impacted by the Project. In addition, the species is considered uncommon in area and occupies a small home range size (approximately 2 to 5 ha). Overall, the Project is unlikely to have a significant impact on the species such that a viable population would be placed at risk of extinction given:

- from a regional perspective, the Project would only remove a small area of approximately 37 ha of native vegetation, primarily composed of wet sclerophyll forest and dry sclerophyll forest, most of which would be removed only from the edge of an area of potential habitat (Section 7);
- direct impacts to known habitat for the species are only likely to be minimal and short-term, during construction of the drainage diversions in the eastern section of the Project area;
- areas of more suitable habitat occur in locations outside the Project area; and
- the proposed works would not isolate any significant area of known habitat from other areas of potential habitat for this species.

Further to the above, known and potential habitat for the species (224 ha of native vegetation composed of equivalent and/or additional vegetation types, and 10 ha of planted trees) would be conserved and improved in the region in the long-term due to the proposed Offset areas (Section 7). Additional potential habitat could be gained through the revegetation of cleared land in the Offset areas (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Grey-headed Flying-fox (*Pteropus poliocephalus*)
It is anticipated that the Project would potentially impact on the Grey-headed Flying-fox due to the removal of potential foraging habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the species has only rarely been recorded in the study area;
- from a regional perspective, only a relatively small area of potential habitat would cleared (105 ha of potential habitat in native vegetation [i.e. primarily composed of wet sclerophyll forest, grass woodland, and dry sclerophyll forest]) and a further 28 ha of cleared land that could be utilised by this species (Section 7);
- there is substantial potential habitat for this species in the surrounding area;
- the Project would not isolate an area of known habitat from currently interconnecting areas of potential habitat for this highly mobile and wide ranging species; and
- the Project would not impact on any known camp sites.

Further to the above, potential habitat for the species would be conserved and improved in the region in the long-term in the proposed Offset areas (490 ha of equivalent and/or additional vegetation types) and 40 ha of cleared land that the species could utilise (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)
It is anticipated that the Project would potentially impact on the Yellow-bellied Sheathtail-bat due to the removal of potential foraging and roosting habitat. However, the Project is unlikely to have a significant impact such that a local viable population would be placed at risk of extinction given:

- the species has not been recorded in the Project area during previous surveys;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and an additional 28 ha of cleared land) of potential foraging and roosting habitat (Section 7);
- potential habitat for this species is likely to occur in the surrounding area; and
- no known area of habitat would be fragmented or isolated as a result of the Project.

Further to the above, potential habitat for this species would be conserved and improved in the region in the long-term in the proposed Offset areas (490 ha of equivalent and/or additional vegetation types) and 40 ha of cleared land that the species could utilise (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land, some of which may provide potential habitat for the species in the future (Section 7). Post-mining landforms would also be rehabilitated and revegetated.

Eastern Freetail-bat (*Mormopterus norfolkensis*)
It is anticipated that the Project would potentially impact on the Eastern Freetail-bat due to the removal of potential foraging and roosting habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- there are few records for the species from within the Project area;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and an additional 28 ha of cleared land) of potential foraging and roosting habitat (Section 7);
- there are numerous records for the species and potential habitat in locations outside the Project area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, known and potential habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Little Bentwing-bat (*Miniopterus australis*)
It is anticipated that the Project would potentially impact on the Little Bentwing-bat due to the removal of potential foraging and roosting habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the Project would not impact on any known maternity sites (e.g. caves);

- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland, and dry sclerophyll forest and an additional 28 ha of clear land) of potential foraging and roosting habitat (Section 7);
- there are numerous records for the species and potential habitat in locations outside the Project area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, known and potential foraging and roosting habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
It is anticipated that the Project would potentially impact on the Eastern Bentwing-bat due to the removal of potential foraging habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- there are few records for the species from within the Project area;
- the Project would not impact on any known maternity sites (e.g. caves), with impacts likely to be limited to loss of potential foraging habitat;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland, and dry sclerophyll forest and an additional 28 ha of clear land) of potential foraging habitat (Section 7);
- there are numerous records for the species and potential habitat in locations outside the Project area including the Offset areas and Voluntary Conservation Area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, potential foraging habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7).

Large-eared Pied Bat (*Chalinolobus dwyeri*)
It is anticipated that the Project would potentially impact on the Large-eared Pied Bat due to the removal of potential foraging habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the species has not been recorded from within the Project area, and only possibly recorded from the study area;
- the Project would not impact on any known roosting habitat (e.g. caves), with impacts likely to be limited to loss of potential foraging habitat;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of dry sclerophyll forest, wet sclerophyll forest and grassy woodland, and an additional 28 ha of clear land) of potential foraging habitat (Section 7);
- potential habitat for this species is likely to occur in the surrounding area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, potential foraging habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)

It is anticipated that the Project would potentially impact on the Eastern False Pipistrelle due to the removal of potential foraging and roosting habitat. However, the Project is unlikely to have a significant impact such that a local viable population would be placed at risk of extinction given:

- the species has not been recorded from within the Project area;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and an additional 28 ha of cleared land) of potential foraging and roosting habitat (Section 7);
- the habitat that would be removed is unlikely to constitute preferred habitat, and potential habitat for this species is likely to occur in the surrounding area; and
- the Project is unlikely to fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, potential habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Southern Myotis (*Myotis macropus*)

It is anticipated that the Project would potentially impact on the Southern Myotis due to the removal of potential roosting habitat. However, the Project is unlikely to have a significant impact such that a local viable population would be placed at risk of extinction given that:

- the species has not been recorded from within the Project area;
- the Project is unlikely to impact any areas of potential foraging habitat (i.e. waterbodies);
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and an additional 28 ha of clear land) of potential roosting habitat (Section 7);
- there are records for the species outside the Project area, and potential habitat for this species is likely to occur in the surrounding area; and
- the Project is unlikely to fragment areas of known habitat for this highly mobile and wide ranging species.

Further to the above, potential roosting habitat (489 ha equivalent and/or additional vegetation types) and known foraging habitat for this species would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha) of cleared land would be revegetated throughout the Offset areas, some of which may provide potential roosting habitat for the species in the future (Section 7). Post-mining landforms would also be rehabilitated and revegetated.

Greater Broad-nosed Bat (*Scoteanax rueppellii*)
It is anticipated that the Project would potentially impact on the Greater Broad-nosed Bat due to the removal of potential foraging and roosting habitat. However, the Project is unlikely to have a significant impact such that a local viable population would be placed at risk of extinction given:

- the species has not been recorded from within the Project area;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and an additional 28 ha of cleared land) of potential foraging and roosting habitat (Section 7);
- less fragmented and more extensive habitat for this species is likely to occur in the surrounding area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, potential habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Eastern Cave Bat (*Vespadelus troughtoni*)
It is anticipated that the Project would potentially impact on the Eastern Cave Bat due to the removal of potential foraging habitat. However, the Project is unlikely to have a significant impact such that a local viable population would be placed at risk of extinction given that:

- the species has not been recorded from within the Project area;
- the Project would not impact on any known maternity sites (e.g. caves), with impacts likely to be limited to loss of potential foraging habitat;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of grassy woodland and dry sclerophyll forest, and an additional 26 ha of clear land) of potential foraging habitat (Section 7);
- potential habitat for this species is likely to occur in the surrounding area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, potential foraging habitat for this species (243 ha of equivalent and/or additional vegetation types) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

5.3.2 EPBC Act –Significance Tests

The Project was referred under the EPBC Act in October 2011. On 5 December 2011, a delegate of the Commonwealth Minister declared the Project to be a 'controlled action' for the purposes of the EPBC Act due to potential impacts on the following controlling provisions under Part 3 of the EPBC Act:

- listed threatened species and communities (sections 18 and 18A); and
- listed migratory species (sections 20 and 20A).

The Commonwealth of Australia and the State of NSW governments have signed a Bilateral Agreement which accredits the NSW assessment regime under Part 3A of the EP&A Act. The Bilateral Agreement was enacted in January 2007 and applies to the actions that the Commonwealth Minister has determined are controlled actions under the EPBC Act. As a result of the operation of the Bilateral Agreement, the Project EA will only be subject to the environmental assessment process under the EP&A Act, as opposed to the environmental assessment processes under both the EP&A Act and the EPBC Act.

Matters of national environmental significance that are relevant to the fauna assessment (e.g. threatened fauna species and listed migratory species) are assessed in this document. Seven species listed under the EPBC Act were assessed using the 'Significance Criterion' Assessment of Significance based on the occurrence of suitable habitat and/or the known records within the SCM or close vicinity (Appendix D; Table 18). A number of other EPBC Act listed species were not assessed given the limited presence of suitable habitat within the Project area.

Table 18: Threatened fauna species listed under the EPBC Act that have been assessed.

Common name	Scientific name	Conservation Status[1]	
		TSC Act	EPBC Act
Birds			
Swift Parrot	*Lathamus discolor*	E	E
Regent Honeyeater	*Anthochaera phrygia*	CE	E
Mammals			
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E
Long-nosed Potoroo	*Potorous tridactylus*	V	V
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V
New Holland Mouse	*Pseudomys novaehollandiae*	-	V

[1] Threatened fauna species status under the TSC Act and/or EPBC Act (current as at 16 February 2012).

V = Vulnerable, CE = Critically Endangered, E = Endangered

The conclusion of the Assessment of Significance was that no species are likely to be significantly impacted by the Project.

Swift Parrot (*Lathamus discolour*)
The Project would be unlikely to significantly impact upon the Swift Parrot given that:

- from a regional perspective the Project would involve a small area of habitat loss relative to the extensive tracts of bushland which occur immediately adjacent to the study area;
- no breeding habitat would be disturbed;
- the proposed Offset areas will result in potential habitat for this species being conserved and improved in perpetuity; and
- cleared land within the Offset areas would be revegetated (up to 435 ha).

Regent Honeyeater (*Anthochaera Phrygia*)
The Project would be unlikely to significantly impact upon the Regent Honeyeater given that:

- the Project would not impact on any known key breeding areas;
- no key nectar feed trees would be removed;
- from a regional perspective, the area of vegetation proposed to be removed is considered minimal in comparison to the large areas of available habitat in the surrounding area;
- the proposed Offset areas would conserve and improve potential habitat for the species in perpetuity; and
- cleared land within the Offset areas would be revegetated (up to 435 ha).

Spotted-tailed Quoll (*Dasyurus maculatus*)
The Project would be unlikely to significantly impact upon the Spotted-tailed Quoll given that:

- the species has not been recorded in the Project area;
- from a regional perspective, only a relatively small area of potential habitat will be removed in comparison to the less fragmented potential habitat that exists adjacent to the Project area;
- potential habitat would be conserved and improved in the Offset areas in perpetuity; and
- cleared land within the Offset areas would be revegetated (up to 435 ha), which may benefit the species in the future.

Long-nosed Potoroo (*Potorous tridactylus tridactylus*)
The Project would be unlikely to significantly impact upon the Long-nosed Potoroo given that:

- from a regional perspective, only a small area of habitat would be removed or disturbed (37 ha);
- the area of habitat that would be removed is along the edge of the habitat for the species;
- the area that would be disturbed for the surface diversions is relatively small and the disturbance is likely to be relatively minor and of short duration;
- the species occurs in at least two other locations to the south-east of the Project area, including one location within the Offset areas;
- known and potential habitat would be conserved and improved in the Offset areas in perpetuity; and
- cleared land within the Offset areas would be revegetated (up to 435 ha), which may benefit the species in the future.

Grey-headed Flying-fox (*Pteropus poliocephalus*)
The Project is unlikely to have a significant impact upon the Grey-headed Flying Fox considering that:

- no campsites would be removed or disturbed;
- from a regional perspective, only a small amount of foraging habitat would be removed;
- large areas of foraging habitat exists adjacent to the study area;
- potential habitat will be conserved and improved in the offset area in perpetuity; and
- cleared land within the Offset areas would be revegetated (up to 435 ha).

Large-eared Pied Bat (Chalinolobus dwyeri)
The Project is unlikely to impose a significant impact on the Large-eared Pied Bat given that:

- no known roosting sites (e.g. caves) would be impacted;
- from a regional perspective, only a relatively small area of foraging habitat for the species would be removed (105 ha);
- no barriers to movement for this highly mobile species would be created;
- substantial potential habitat for this species will be conserved and enhanced in the Offset areas (490 ha); and
- cleared land within the Offset areas would be revegetated (up to 435 ha), which may benefit the species in the future.

New Holland Mouse (*Pseudomys novaehollandiae*)
The Project would be unlikely to significantly impact upon the New Holland Mouse given that:

- the Project would remove only a small area of potential habitat (17 ha of core habitat and 102 ha of patchy/marginal habitat), relative to the availability of known or potential suitable habitat in the Offset areas (85 ha of core habitat and 227 ha of patchy/marginal habitat);
- the locations in which most records for the species were obtained are outside the Project area, including several within the Offset area; and

- the Project will include the consideration of current known habitat for this species in the Offset areas in perpetuity, the revegetation of cleared lands within other parts of the Offset areas, the progressive rehabilitation of post-mine landforms, the development of a Biodiversity Management Plan and impact mitigation and management measures targeted specifically at the conservation of this species.

5.3.3 State Environmental Planning Policy No. 44 – Koala Habitat Protection

There are two important definitions that apply when considering Koala habitat under SEPP 44:

- "core koala habitat" means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population; and
- "potential koala habitat" means areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

EcoBiological (Appendix F) determined areas of "potential koala habitat" within the Stratford Mining Complex based on the requirements of SEPP 44. Within the areas mapped by EcoBiological (Appendix F), only Forest Red Gum (*Eucalyptus tereticornis*) and Tallowwood (*E. microcorys*) constituted greater than 15% of the total number of trees. Using the SAT no evidence of Koala activity was found and no individuals were observed. Individuals and/or evidence of individuals have been recorded within or in close proximity to the southern Offset area and within the western Voluntary Conservation Area (Figure 4b).

In addition to the species listed in SEPP 44, the koala recovery plan (DECC, 2008a) lists Cabbage Gum (*Eucalyptus amplifolia*) as a primary food tree species (Appendix F). This species occurs within the Stratford Mining Complex in Vegetation Type 8, and may also provide potential habitat for the Koala.

Potential koala habitat is mapped on Figures 13 and 14. Based on the requirements of SEPP 44, potential Koala habitat occurs within the study area, but core Koala habitat does not occur within the Project area.

5.3.4 Listed migratory species

Eleven migratory bird species listed under the EPBC Act have been recorded within a 20 km radius of the Project area. Searches of the EPBC Act *Protected Matters* database returned an additional four bird species that were predicted to have potential habitat (Appendix E). Impacts on these species were assessed according to the 'significant impact criteria' (DEWHA, 2009), which are:

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it would:

1) *Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;*
2) *Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or*
3) *Seriously disrupt the life cycle (breeding, feeding, migration, or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

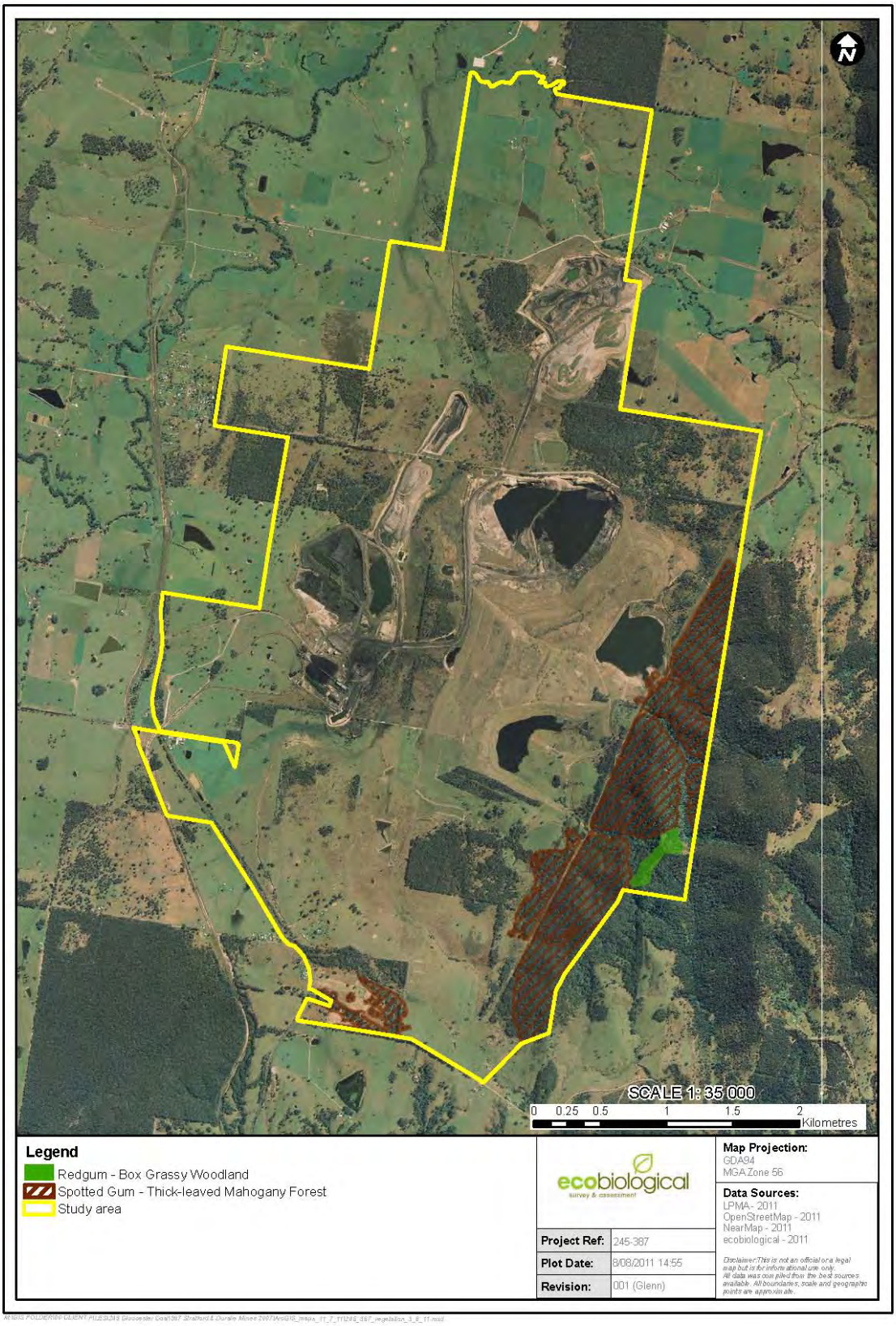


Figure 13: Potential Koala Habitat Based on SEPP 44 Criteria (Appendix F).

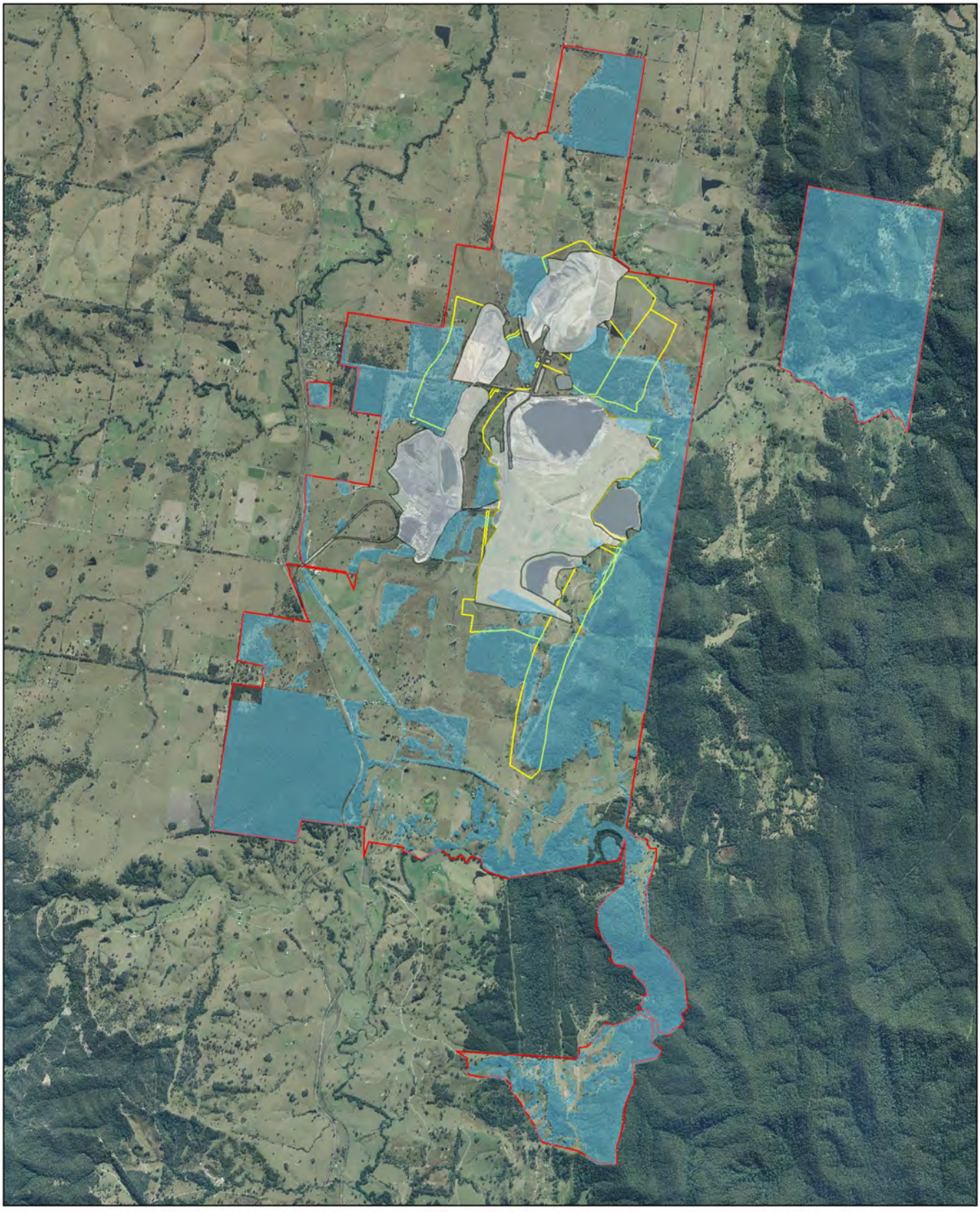


Figure 14: Potential Koala Habitat in the Project area and Parts of the Surrounding Landscape.

An area of 'important habitat' for a migratory species is:

a) Habitat utilised by a migratory species occasionally of 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.

The results of these assessments are presented in Appendix E. In summary, it was concluded that the Project is not likely to significantly impact any listed migratory species under the EPBC Act, on the basis of the following:

- no 'important habitat' exists within the Project area for any listed migratory species;
- the Project would not result in an invasive species that is harmful to any migratory species becoming established in an area of important habitat; and
- the Project would not disrupt the life cycle of an ecologically significant proportion of any population of any migratory species.

5.4 Cumulative impacts on fauna

Cumulative impacts are the successive, incremental and combined impacts (both positive and negative) of an activity on society, the economy and the environment (Franks *et al.*, 2010). They can arise from the compounding activities of a single operation given the interaction of that operation with past, current and future activities that may or may not be related to the existing development. Cumulative impacts may also arise through the interaction of one development with other types of activities and industries, such as grazing and broad scale agriculture.

In relation to the Project, the cumulative impacts are considered to be the total impact on the environment that would result from incremental impacts (including both direct and indirect impacts) of the Project works added to other existing impacts. The likely direct impacts of the Project may be obvious; however, the indirect impacts may be less identifiable. Clearing of vegetation during construction of the Project would result in a number of cumulative effects relating to edge effects, weed invasion and changes in surface runoff patterns (see Section 6).

The regional setting of the Project and surrounding land use are described in Section 2. The Gloucester Valley area has two mining projects, the existing Stratford Mining Complex and the DCM, located approximately 20 km south of the Stratford Mining Complex. Both mines have or would have a number of new pits and expansions added.

In addition, The Stage 1 of the Gloucester Gas Project was granted Project Approval in February 2011 (AGL Gloucester LE Pty Ltd [AGL] is the proponent). Gloucester Resource Limited (GRL) is undertaking exploration activities within Exploration Licence (EL) 6523, EL 6524 and EL 6563, north and west of the Stratford Mining Complex (Figure 1). The Stroud to Taree Project would involve construction of a single-circuit 330 kV transmission line between Essential Energy's Stroud Substation and a new substation near Lansdowne (north of Taree). TransGrid is the proponent of the Stroud to Taree Project. In addition to these, the Rocky Hill Coal Project would involve the construction of an open cut coal mine approximately 3.5 km north of the Stratford Mining Complex (Ecotone, 2012; Ecotone and RW Corkery, 2012). It would involve four individual open cut pits, on-site handling, an overland conveyor, and rail load-out facility. The Project life is up to 21 years, and would involve all open cut pits being rehabilitated to reflect the existing landform. GRL is the proponent of the Rocky Hill Coal Project. Beyond these developments, the main industries and land uses in the surrounding locality are cattle grazing on native and improved pastures, along with some poultry farming and other agricultural production.

The majority of the Project area has been cleared or partially cleared in the past due to historical agricultural practices and logging. Despite historical clearing, remnant old growth vegetation still occurs in some mosaic patches across the study area. Past and present actions have been considered in the assessment of cumulative impacts.

This assessment has considered the following:

- species present;
- patterns of species distribution (based on known or potential fauna habitat using associated vegetation communities and classification); and
- broad habitat types (the ecological niches for the range of species present).

In relation to past and present mining, it is likely that the range and scale of impacts would be similar to those described for the DCM and existing Stratford Mining Complex. The primary cumulative impacts of the Project are associated with Project impacts described in Section 6. The condition and composition of the habitats to be cleared for the Project area are described in the background reports for the Project (refer to Sections 3.1 and 4). It is also likely that the accumulating impacts would increase linearly and proportionally with the area of disturbance. The cumulative impacts described are likely to be fully expressed within a few years of the completion of mining.

The biodiversity impacts are likely to have been greater from the combined existing mines than the Project. The cumulative impacts of the existing mines would include a greater clearing of native vegetation, including potential threatened species habitat. It is estimated that a total of 105 ha of native vegetation and fauna habitat would be cleared for the Project. This is in addition to native vegetation that has been removed in previous phases of mining associated with the Stratford Mining Complex. Projected native vegetation losses at the DCM are expected to total 87 ha of native vegetation (Cenwest Environmental Services and Resource Strategies, 2010). The greatest consequence of this vegetation clearing is that much of the vegetation and associated fauna habitat is already in low proportions on a regional context given the high fertility of the soils in the valley floor and as such, the vegetation to be removed by the Project further depletes these already highly cleared vegetation types and the associated fauna habitat within it.

The proposed impact avoidance, mitigation (including the recommended species-specific management protocols) and offset measures described in Sections 6 and 7 of this report are likely to assist with the maintenance of regional fauna biodiversity in the short-term and to potentially enhance it in the medium to long-term once rehabilitation and revegetation programmes become more established.

6 Measures to avoid and mitigate impacts on fauna

The following section identifies the measures that have or will be implemented in order to avoid and mitigate impacts on fauna and fauna habitat that may occur as a result of the Project. The measures outlined in Table 19 and described in the subsections below would be adopted as part of the Project to avoid or mitigate impacts on fauna or their habitats. These measures would be accompanied by the implementation of an Offset strategy, which is described in Section 7.

Table 19: Measures to avoid and/or mitigate impacts on fauna or their habitats.

Aspect	Component
Impact Avoidance	• Impact avoidance – refinements to the design of the Project (Section 6.1).
Impact Mitigation	• Habitat supplementation (Section 6.2): - salvage and relocation of logs, vegetative material and rocks; - salvage and relocation of tree hollows; - nest box programme; and - collection and propagation of seed. • Timing land clearance to minimise fauna harm (Section 6.3). • Vegetation clearance procedures (Section 6.4). • Management of exotic animals (Section 6.5). • Management of weeds (Section 6.6). • Rehabilitation of the post-mine landforms (Section 6.7). • Land management – Biodiversity Enhancement Area (Section 6.8). • Other programmes (Section 6.9): - dust management; - soil management; - noise management; - artificial lighting; - fire management; and - vehicle speed limits and movement. • New Holland Mouse (Section 6.10). • Glossy Black-cockatoo (Section 6.11). • Squirrel Glider (Section 6.12).
Monitoring	• Squirrel Glider mitigation (Section 6.12). • General monitoring (covered throughout the above sections).

Most of the measures described below form part of threat abatement plans, recovery plans and priority actions recommended by OEH and SEWPaC for threatened fauna species or populations. The measures would be described within a Biodiversity Management Plan that would be prepared for the Stratford Mining Complex, covering management and monitoring of terrestrial fauna and their habitat within the Project area and close surrounds, a Biodiversity Enhancement Area (Section 6.8) and the Offset areas. The Biodiversity Management Plan would be prepared and revised by suitably qualified person(s) every three years to provide for adaptive management. Monitoring would take place as outlined in the following sections and the results presented in an Annual Report.

Threatened fauna that are likely to be adversely impacted by the Project would be subject to focused management protocols developed within the fauna section of the Biodiversity Management Plan. These species consist of the following: Glossy Black-cockatoo, Speckled Warbler, Varied Sittella, Grey-crowned Babbler (eastern subspecies), Brush-tailed Phascogale, Squirrel Glider, Long-nosed Potoroo and New Holland Mouse

6.1 Impact avoidance - refinements to the design of the project

Several refinements to the design of the Project have resulted in avoiding potential impacts to flora and fauna and their habitats. These measures are summarised below:

- Optimising the area of the open cut pit that is backfilled to minimise the overall mine footprint if the material was to be placed in waste emplacements. This includes the eventual complete backfill of the Stratford Main Pit and BRNOC as well as partial backfilling of the Roseville West Pit Extension and Stratford East Open Cut.
- Continued use of several existing features at the Stratford Mining Complex, rather than the commissioning of new infrastructure including:
  - open cut voids for water and rejects storage;
  - Stratford East Dam for water management;
  - CHPP; and
  - rail facilities.
- Avoiding clearance of areas of bushland including:
  - dry sclerophyll forest and grassy woodland habitat between the Stratford Main Pit, the Stratford Waste Emplacement, the proposed Avon North Open Cut and the proposed Northern Waste Emplacement Extension;
  - dry sclerophyll forest west of the BRNOC; and
  - dry sclerophyll forest and grassy woodland habitat south of the Stratford Waste Emplacement and west of the proposed Stratford East Open Cut.
- Avoiding disturbance to Avondale Creek (apart from a creek crossing).
- Increasing the maximum height of the existing waste emplacements, thereby minimising the overall mine footprint (height will be comparable to surrounding landform heights and less than the maximum height of ridge line to the east of the Development Application Area [475 m AHD]).

6.2 Habitat supplementation

Habitat assessments would be undertaken prior to vegetation clearing, recording important habitat features that could be relocated to nearby areas (in the rehabilitation areas, biodiversity enhancement areas [Section 6.8] or Offset areas [Section 7]). These habitat features are discussed below.

6.2.1 Salvage and relocation of logs, vegetative material and rocks

Habitat features (e.g. trunks, logs, large rocks, branches, small stumps and roots) would be salvaged during vegetation clearance activities and stockpiled for relocation to nearby areas. Features would be placed into currently cleared areas that are proposed for revegetation in the rehabilitation areas, Biodiversity Enhancement Areas (Section 6.8) or Offset areas (Section 7). When relocated, these features are likely to provide habitat resources for a range of invertebrate and ground dwelling fauna. Further, relocation of trunks, logs, branches, small stumps and roots to rehabilitation areas can benefit the revegetation by increasing the mulch cover for the soil. The ground-layer vegetation and low shrubs would be incorporated into the topsoil when it is stripped. This would possibly enhance the soil seed bank.

6.2.2 Salvage and relocation of tree hollows

Some tree hollows salvaged during vegetation clearance activities would be selectively chosen for placement in areas where habitat enhancement is required. These features may be securely attached to suitable trees or placed on the ground. Tree hollows placed in trees would be monitored according to the nest box programme (Section 6.2.3).

6.2.3 Nest box programme

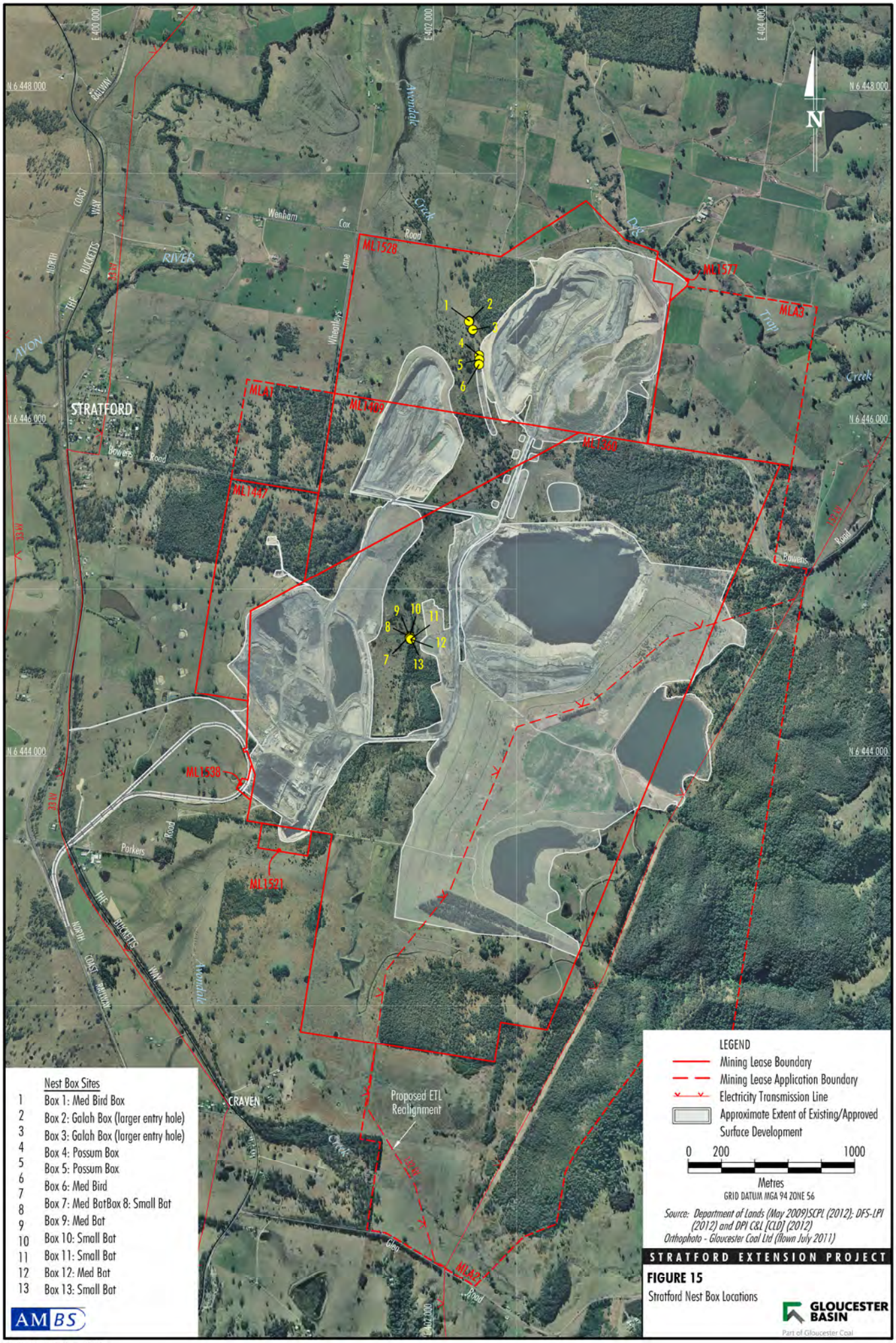
A number of hollow-dwelling fauna are known to use habitats within the Project area and immediate surrounds. Because tree hollows are scarce in some areas of predominantly regrowing vegetation, there is an opportunity to design and implement a nest box programme to help alleviate some of the pressure on hollow-dependant species.

Nest boxes, also called artificial roosts, could be used to replace some tree hollows, but they would be specifically designed and located to suit the requirements of target threatened fauna. Different type, style and sized nest boxes would be required for different species (Franks and Franks, 2003).

The programme would supplement the existing nest box programme commenced at the SCM, in accordance with the BRNOC Flora and Fauna Management Plan (SCPL, 2002), to provide nesting habitat for birds, arboreal mammals, and bats. A variety of boxes were installed within the Biodiversity Enhancement Area (Section 6.8) and are shown on Plate 10. The locations of these 13 boxes are depicted on Figure 15 and included the following types:

- two medium bird boxes;
- one Galah box (large entry hole);
- one Galah box (small entry hole);
- two possum boxes;
- three medium bat boxes; and
- four small bat boxes.

Plate 10: Medium Bird Box and Galah Box installed near Avondale Creek (between the BRNOC and the Roseville West Pit)



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Additional nest boxes would be installed at an appropriate ratio to compensate for the loss of hollows during the vegetation clearance. Nest boxes would be installed within the Offset areas, Biodiversity Enhancement Area and (possibly) Voluntary Conservation Areas, in currently vegetated areas as well as areas proposed for revegetation. Nest box numbers and placement would need to take into consideration the target species and the existing tree hollow density of the area in which they would be installed. The appropriate ratio for the Project would be determined after pre-clearance surveys for hollow bearing trees are completed, and take into account the existing nest box programme. As a minimum, the nest boxes would replace lost tree hollows at a 1:1 ratio. It is recommended that a variety of different sized nest boxes are ordered and available for installation within 12 months of project approval to minimise short-term impacts. If required, additional nest boxes would be installed following the post-vegetation clearing tree hollow assessment.

While the nest box installation programme is unlikely to compensate for the direct loss of large hollow-bearing trees, it is likely to assist in the short to medium-term with the replacement of potential roost/nesting habitat for some species until existing regrowth vegetation becomes sufficiently mature to develop hollows. Further, with the part removal and decrease in livestock grazing over the past 50 years, some of the landscape surrounding the mine has begun to regenerate and opportunities for hollow-dwelling fauna are likely to improve over time.

Nest boxes are known to deteriorate with time and would require dedicated management (including maintenance and replacement). The nest boxes would be inspected to check for usage and for maintenance purposes. Once installed, the nest boxes would be monitored by suitably qualified personnel to observe fauna usage. If the nest box has not been occupied after two years, consideration would be given to moving the nest box to an alternative location.

A monitoring report would be prepared annually that includes a summary of previous monitoring reports. The monitoring results would be reported in the Annual Report.

6.2.4 Collection and propagation of seed

Seed present during clearance activities would be collected for use in plant propagation programmes to provide tube stock for revegetation activities. Seed from mature Forest Oak (*Allocasuarina torulosa*) would be specifically salvaged during vegetation clearing, wherever possible, to assist with the re-establishment of foraging habitat for local Glossy Black-cockatoo populations.

6.3 Timing land clearance to minimise fauna harm

Where practicable, vegetation clearing would occur during late summer or early autumn. This would minimise impacts to a large range of fauna breeding during spring and summer, and fauna which would hibernate during winter (e.g. microbats). The amount of vegetation cleared would be the minimum required to allow mining operations to continue for the ongoing year, where practicable (taking into consideration requirements for erosion control). This would also allow revegetation works greater time to establish. If vegetation clearance is required outside of this time period, then suitably qualified personnel would assess the habitat to be disturbed and determine the appropriate vegetation clearance procedures.

The construction of the surface water diversions east of the Stratford East Open Cut would occur in as short a time frame as possible. This would aim to minimise the period of potential disturbance to the Long-nosed Potoroo habitat in the vicinity of the location where the species has been recorded to the east of the Project area (Appendix C). This component is particularly important within a 1 km radius of the record for the species. The construction of the diversion would be undertaken progressively on a campaign basis.

6.4 Vegetation clearance procedures

Vegetation clearance would be undertaken progressively over the life of the Project with areas progressively being rehabilitated. A Vegetation Clearance Protocol was developed for the Stratford Mining Complex (SCPL, 2002). The purpose of a Vegetation Clearance Protocol is to restrict clearing to the minimum area necessary to undertake the Project and minimise the impacts on fauna present during clearing. An updated Vegetation Clearance Protocol would be followed during all land clearance activities for the Project. Important components and some additional information of the Vegetation Clearance Protocol are discussed below.

Pre-clearance
Boundaries for areas identified for clearing would be clearly marked prior to construction using highly visible flagging tape or spray paint to prevent accidental clearing. A suitably qualified ecologist would initially undertake pre-clearance surveys of the area to identify features which would provide potential resources for fauna. This would include thorough assessments of ground cover, and identification of habitat trees (diameter at breast height [DBH] >400 cm), stags, nests, rocks and potential hollow bearing trees. The habitat assessments would also record important habitat features that would be relocated to the adjacent Biodiversity Enhancement Area or Offset areas. Any habitat trees would be marked with paint or tape.

Areas planned to be cleared and identified as having potential habitat resources would be surveyed by suitably qualified personnel, to determine the vertebrate fauna present. As a minimum surveys are likely to include:

- diurnal and nocturnal spotlighting surveys for nest birds, investigation of ground and arboreal habitats;
- nocturnal spotlighting for arboreal mammals and birds, particularly near hollow-bearing trees; and
- stag-watching at any medium or large hollows.

Where possible, Project works would defer clearing of breeding habitat until the site is vacated. This is particularly important for (but not necessarily limited to) the New Holland Mouse, Long-nosed Potoroo, Brush-tail Phascogale, Squirrel Glider, Grey crowned Babbler and Varied Sittella. Furthermore, where possible, Project works would defer clearing of *Allocasuarina* spp. if evidence of current foraging by Glossy Black-cockatoos is recorded, since this species is known to utilise selected foraging trees for up to a few weeks before moving on to a new area.

Vegetation clearance
A suitably trained and qualified person(s) to the satisfaction of the Director-General would be present during vegetation clearance to manage animals that may be encountered during land clearing. The vegetation clearing would then be undertaken as follows:

1. All non-habitat trees would be removed first.
2. All remaining habitat trees would be knocked (gently tapping with plant equipment) to locate arboreal mammals or other fauna that may be present.
3. At least 48 hours after non habitat trees have been felled, each habitat tree would be carefully removed in the presence of a suitably qualified ecologist and/or fauna rescue personnel and thoroughly searched for the presence of animals.

Groundcover habitat features (e.g. logs, rocks) would be removed and searched by a qualified ecologist during either step 1 or step 3. In locations where groundcover features are abundant, it would be more practical to remove and search the areas during step 1.

A suitably qualified individual would be required to instruct the plant equipment operators on 'how' and to what side to fell habitat trees, so that habitat resources can be quickly and easily checked for fauna once the tree has been felled. In some circumstances sections of a tree containing a hollow or habitat may be individually removed, independently from the whole tree prior to felling, particularly if threatened species are predicted or known to be inhabiting that tree. For example, a hollow branch could be individually removed and placed gently on the ground, after which the fauna rescue personnel can check for or rescue the inhabiting fauna.

Fauna found during the clearance searches would be either left to move into adjacent habitat on their own accord or captured and released into adjacent suitable habitat, at a time suitable for the subject species. Diurnal fauna would be either left to move on their own accord or captured and released as soon as practical in an adjacent location that would not be impact by the vegetation clearance. Nocturnal fauna would be captured and held in captivity under suitable conditions and released at dusk. Injured fauna would be held in captivity and the advice of a local wildlife rescue organisation sought, or in some cases that of a veterinarian, to advise on the best way to proceed. Any fauna captured or found would be recorded including details such as species, gender, age, injured or not injured, pouch young, etc.

Cleared areas would be managed to minimise the invasion of noxious weeds through to, and during, the operational phase of the Project.

A report would be prepared annually that documents the animals found during the surveys. The report would detail the species, number and condition of the animals encountered. It would also include a record of all the hollow-bearing or habitat trees removed during clearing, including details such as number of hollow-bearing trees; number of hollows per tree; estimated size of each hollow; and tree species. A summary would be provided in the Annual Report.

Fauna management post-vegetation clearing

The removal of fauna habitat is likely to disrupt native fauna, with individuals being displaced likely to be at risk of injury or death from collisions with vehicles on roads. Speed limits within the SCM would be maximum 60 km/hr during times when vegetation is being cleared, and continue for three days after the clearing has ceased.

6.5 Management of exotic animals

Exotic animals previously recorded within ML 1579 are listed in Section 4.2.1. A feral animal management programme in consultation with relevant experts would be implemented in the mining leases, Biodiversity Enhancement Areas and proposed Offset areas. The programme would focus on the control of European foxes, rabbits and feral cats, feral dogs, exotic bees and bird species. Some feral animal prevention and management techniques include 1080 fox baiting and Pindone poison carrots for rabbits implemented in a manner that would minimise or eliminate collateral mortality of native fauna.

Appropriately qualified persons(s) would be engaged to undertake feral animal control. The monitoring results would be reported in the Annual Review Report. If there is still evidence of increased predation or grazing by feral species within the Biodiversity Enhancement Area and proposed Offset areas, SCPL would develop an alternative or amplified control programme in consultation with relevant experts.

6.6 Management of weeds

A weed management plan would be developed as part of the Biodiversity Management Plan and implemented in the mining leases, Biodiversity Enhancement Area and proposed Offset areas. This is particularly important near newly created edges, for example where the surface water diversions would be constructed. Weed control measures would consider the NSW Department of Primary Industries (Agriculture) (2012) guidelines and would include as a minimum:

- Identification of weeds via regular site inspections and communication with landholders and regulatory authorities.
- Particular focus on areas of potential new outbreak (e.g. soil stockpiles, roadsides, disturbed areas, surface water diversions).
- Mechanical removal of identified weeds and and/or the application of approved herbicides in authorised areas.
- Follow-up site inspections to determine the effectiveness of eradication programmes.
- Minimisation of seed transport from the site during construction and operation through the use of the wash bay for footwear and vehicles.
- Specific control of noxious weeds, including these which have been recorded in the area.

Throughout the offset and revegetation areas appropriate, regeneration of native groundcover and shrub layer vegetation would be carried out to reduce edge effects. Where possible, planting would use plants from local seed stock or locally occurring species. Re-establishment of native vegetation cover would reduce the potential for invasion by noxious weeds.

Appropriately qualified persons would be engaged to undertake weed control. Follow-up site inspections would occur to determine the effectiveness of weed control. The monitoring results would be reported in the Annual Review Report.

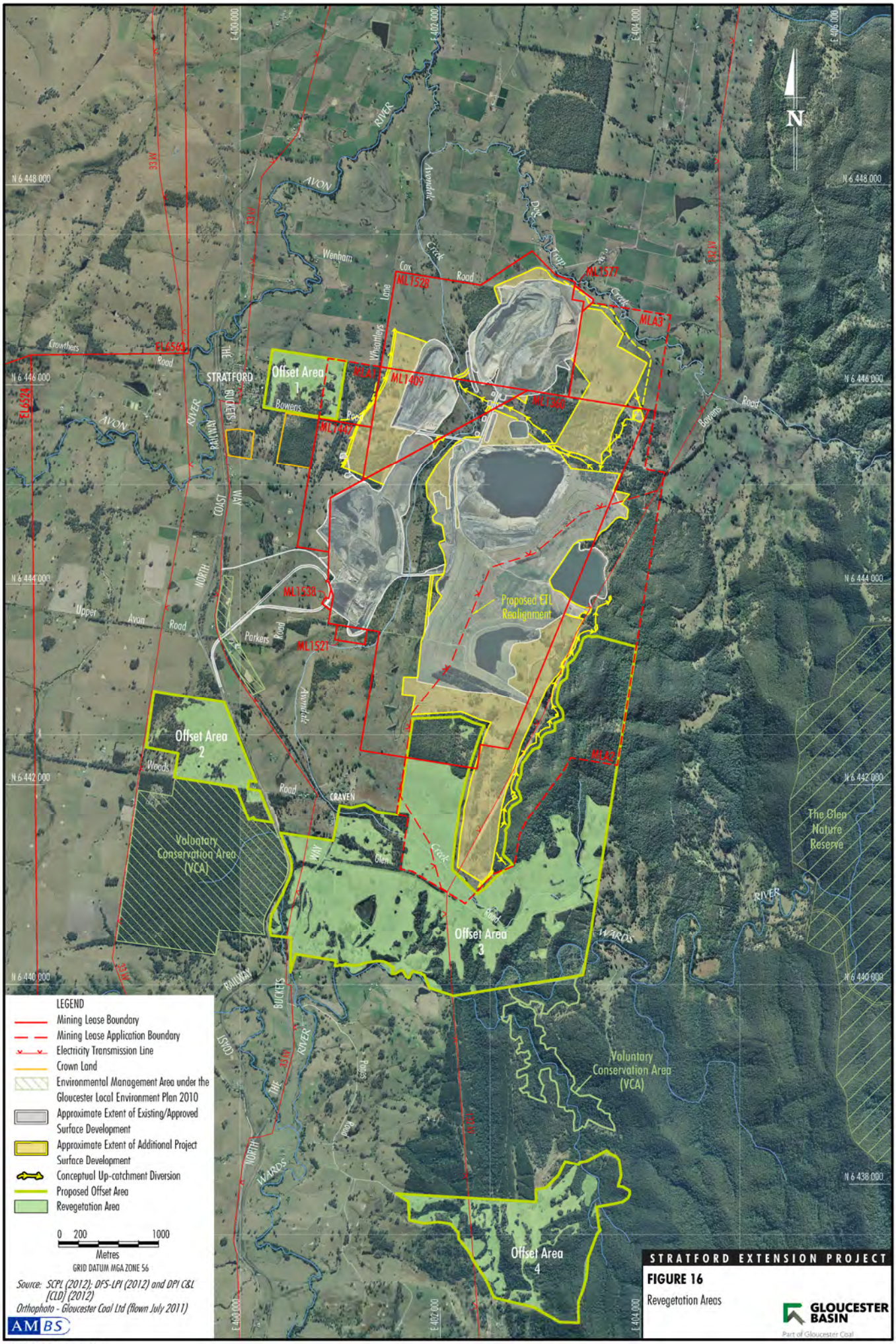
6.7 Rehabilitation of post-mine landforms

6.7.1 Revegetation

The disturbance areas associated with the Project would be progressively rehabilitated and revegetated with species characteristic of native woodland/open forest (350 ha) and pasture with scattered trees (300 ha) (Figures 16 and 17). An objective of the rehabilitation programme is to restore ecosystem function to land affected by the mine development, including maintaining or establishing self-sustaining ecosystems (SCPL, 2011).

Important aspects of the revegetation would include the following (Figures 16 and 17):

- the areas rehabilitated would expand from existing areas of fauna habitat were possible, to assist fauna dispersal;
- scattered trees across the pasture areas could provide habitat for a range of fauna that use open woodland habitats;
- the post-mine landforms would be revegetated progressively with plant species comparable to those which originally occurred prior to the disturbance;
- livestock, would be exclude from all areas that are being revegetated through appropriate fencing;
- restriction of vehicles and people within the revegetation areas through appropriate fencing and signage;
- irrigation to promote revegetation (where required) from an appropriate local water source to prevent the invasion of weeds and nutrients; and
- planting of appropriate tube stock (e.g. native reeds, sedges) around dams to encourage use by native fauna and to assist with the stabilisation of the banks.



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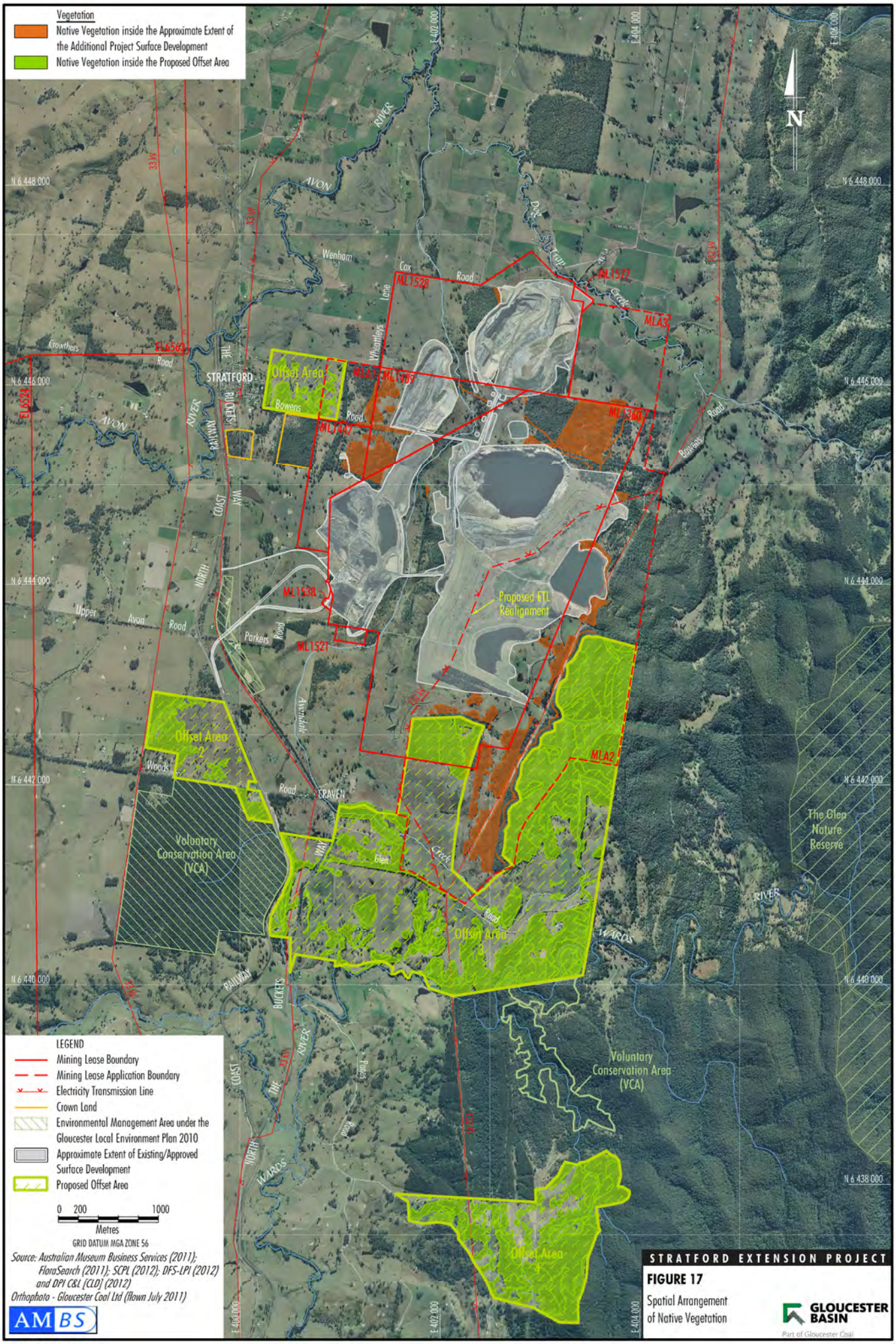

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After the revegetation programme is established a number of fauna monitoring surveys would be performed by the appropriately qualified personnel. It is recommended that these surveys are undertaken at a minimum of twice yearly. The objective would be to identify the success level of the revegetation programme and determine if any changes are required to improve the outcomes of the revegetation strategy. Monitoring during different seasons would allow seasonal migrants to be detected. The monitoring programme would be developed to target all fauna groups that may be present.

Revegetation in the rehabilitation sites would aim to minimise large gaps between stepping stone habitat remnants by planting trees in cleared and/or around scattered paddock trees to provide linkages for sedentary and/or less mobile species that are dependent on specific habitat types.

6.7.2 Management of post-mine waterbodies

Native vegetation in and surrounding a farm dam provides habitat for a range of animals including invertebrates, frogs, reptiles and birds. A well-managed farm dam can provide habitat for wildlife and water for livestock. The Stratford East Dam would be enhanced by:

- installing plain wire fencing to exclude livestock grazing from 50% of the dam perimeter;
- planting a range of submerged and fringing vegetation (rushes, shrubs, trees);
- placing a partially submerged log in the dam for use by a variety of fauna; and
- placing a log pile for refuge habitat on the dam shores.

6.8 Land management of the biodiversity enhancement area

The mining leases associated with the Stratford Mining Complex are managed to provide a mixed land use – mining, agriculture (grazing livestock) and biodiversity conservation. An area designated as a wildlife corridor through the Stratford Mining Complex was proposed as part of the original EIS (AGC Woodward-Clyde, 1994) for the SCM. The proposal was intended to link existing areas of vegetation within the mining leases with larger areas of natural vegetation to the east of the Project.

The areas outside of the Project area would continue to be used for both grazing livestock and conservation of biodiversity. To incorporate the Project disturbance areas, the original design of wildlife corridor (here in referred to as the Biodiversity Enhancement Area) has been modified while still maintaining the overall intent for the managed land (i.e. to link existing areas of vegetation).

The modified Biodiversity Enhancement Area covers approximately 240 ha. The extent of the Biodiversity Enhancement Area would maximise the area of connectivity with existing remnants and rehabilitated landforms. Within the Biodiversity Enhancement Area, cattle and other feral herbivores would be excluded, revegetation works would be undertaken, and some of the nest box programme would be implemented in this area. Revegetation works would aim to re-create a native grassy woodland habitat in this area, therefore minimising the extent of scattered paddock trees that currently exist and provide a better wildlife corridor for native fauna.

The installation of glider poles either side of the existing haul road to BRNOC and the proposed haul road to Avon North Open Cut is proposed. There is potential to further reduce habitat loss and connectivity impacts to individuals and family groups in the remnant vegetation patches west of the Stratford East Open Cut and the Roseville West Pit Extension through the planting of fast growing, mid-storey feed tree species.

6.9 Other programmes

Several other programmes would be undertaken throughout the course of the Project, to minimise impacts to fauna and their habitats.

6.9.1 Dust management

Dust controls include minimising the clearing of vegetation ahead of construction, progressive rehabilitation, and where necessary, spraying water on haul roads.

6.9.2 Soil management

Soil erosion and sedimentation controls would be implemented prior to vegetation clearing work and during operation of the mine complex. Mulching or revegetation of cleared areas is to be undertaken as soon as possible to permanently stabilise the soil and reduce erosion and run-off.

6.9.3 Noise management

Noise management measures would be implemented including use of low noise equipment and operational controls where possible, and ongoing monitor and modelling of existing noise levels.

6.9.4 Artificial lighting

Lighting strategies/control measures to minimise potential artificial lighting impacts would include the use of unidirectional lighting fixtures.

6.9.5 Fire management

Bushfire prevention measures would also be undertaken. Fire regime requirements of threatened fauna species would be considered when planning asset management burning in adjacent bushland habitats.

6.9.6 Vehicle speed limits and movement

The on-site speed limit of 60 km/hr would continue to be applied to new haul roads and internal roads.

6.10 New Holland Mouse mitigation and management

The local population of this species has a high potential to be impacted by the Project if not managed appropriately. Mitigation measures are proposed to lessen the impact of the decrease in available habitat, to enhance the habitat values of vegetation that will be retained in areas adjacent to the Project/Offset areas and to assist in minimising any long-term impacts to the local population. These consist of the following:

- ecological burns, implemented at appropriate time intervals, to enhance flora species diversity and condition of the vegetation understorey within revegetation areas and in particular offset area 4; and
- bush regeneration in remnant vegetation including weed control, seed dispersal and further planting of appropriate native species within revegetation areas and in particular offset area 4.

Three mitigation measures to be implemented for the pre-clearance phase of the Project include:

- installation of fencing adjacent to the Project area suitable to prevent movement of individuals to the disturbance area;
- an intensive trapping programme prior to clearing to remove any individuals within the Project area and then relocate them to suitable habitat in adjoining areas; and
- further discourage re-entry of individuals into the Project area through habitat disturbance immediately following the trapping and clearing of individuals (e.g. low intensity fire).

6.11 Glossy Black-cockatoo mitigation

Local populations of this species have a high potential to be impacted by the Project if they are not managed appropriately. Mitigation measures are proposed to reduce the impact of the loss of foraging habitat. These aim to enhance the habitat values of vegetation that will be retained, and increase foraging opportunities in areas adjacent to the Project area, assisting in minimising any long-term impacts to the local population. Mitigation measures consist of the following:

- planting new *Allocasuarina* spp. tube-stock as a midstorey species (not large dense homogenous stands) in the biodiversity enhancement area and Offset areas;
- fencing areas of remnant *Allocasuarina* spp. (in the biodiversity enhancement area and Offset areas) to protect them from grazing cattle; and
- fire management (i.e. fire would be prevented for at least the first five years after planting tube-stock).

Locations recommended for planting *Allocasuarina* spp. are shown in Figure 18.

6.12 Squirrel Glider mitigation and monitoring

Mitigation measures, such as nest boxes and relocation of cleared hollows, additional plantings of feed trees/shrubs for the species, glider poles and ongoing population monitoring of the local population, are likely to help ameliorate the short-term impacts on the Squirrel Glider relating to habitat loss and connectivity of the local population. In the medium to long-term, the conservation and enhancement of potential habitat in the Offset areas would provide connectivity between currently fragmented/isolated Squirrel Glider habitats.

a) Connectivity Improvement – glider poles

Significant distances between trees can create barriers to the movement of Squirrel Gliders within an area. The ability of this animal to freely move about the canopy is hindered by gaps in the vegetation greater than the average 'glide distance'. It is considered that gaps greater than 75 m can pose a significant barrier to the movement of Squirrel Gliders (van der Ree *et al.*, 2003). Mitigation measures should therefore apply in situations where vegetation clearance would create significant gaps. Glider poles have been shown to successfully provide habitat connectivity for Squirrel Gliders across 50-75 m canopy gaps (Goldingay *et al.*, 2011). To provide for the continued movement of the individuals or family groups within and around the Project area, five locations would be targeted for installation of glider poles (Figure 19). These include:

1. At the location of the new haul road that would occur between the existing Stratford Main Pit and the proposed Avon North Open Cut. A small band of vegetation is likely to be maintained either side of the road which may provide limited connection between the remaining vegetation patch to the west of the proposed pit and the greater tract of vegetation to the east and south east. This connection may be enhanced with the placement of glider poles or rope bridges (depending on the height of the mine vehicles using the haul road).

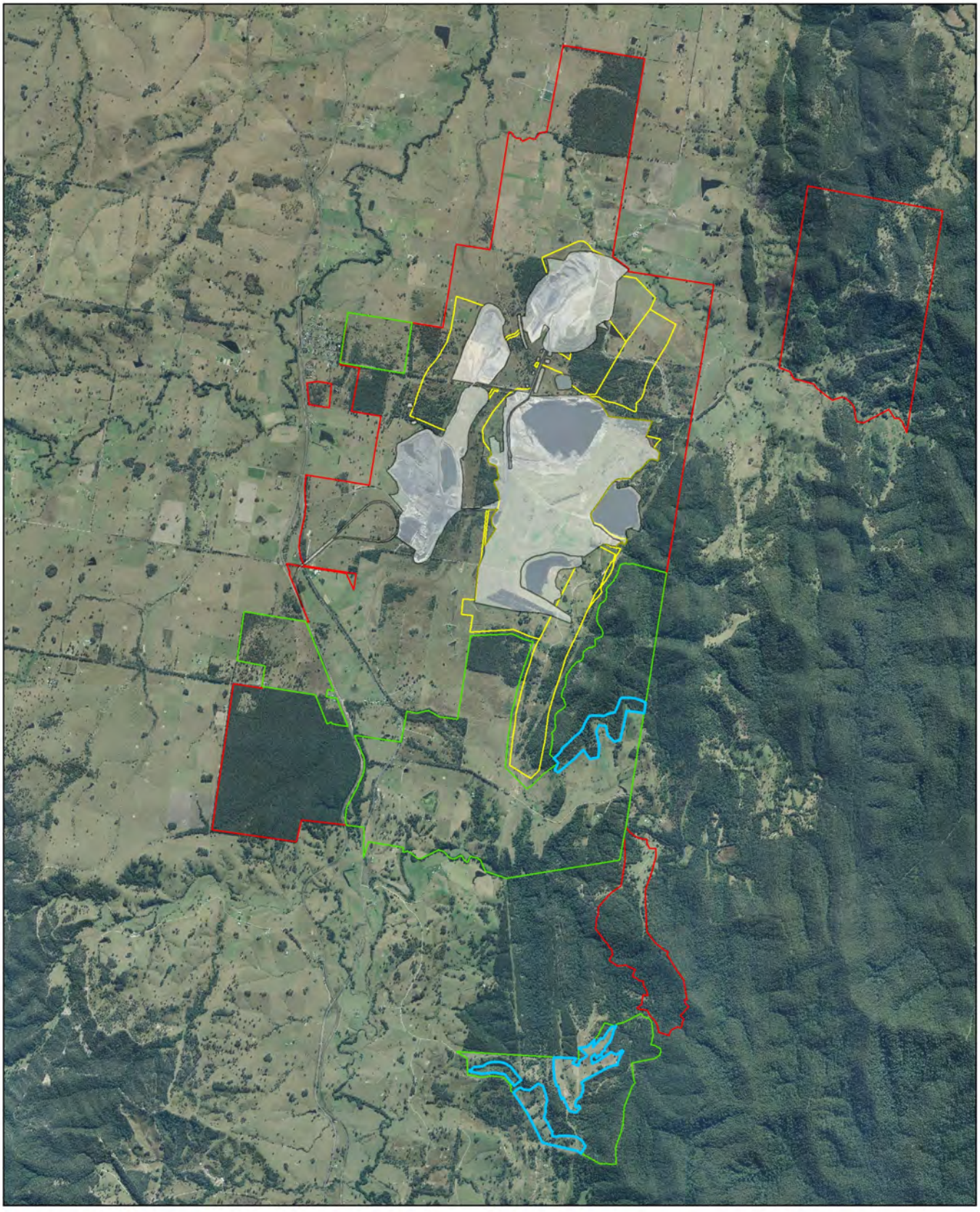


Figure 18: Locations Recommended for Allocasuarina Plantings.

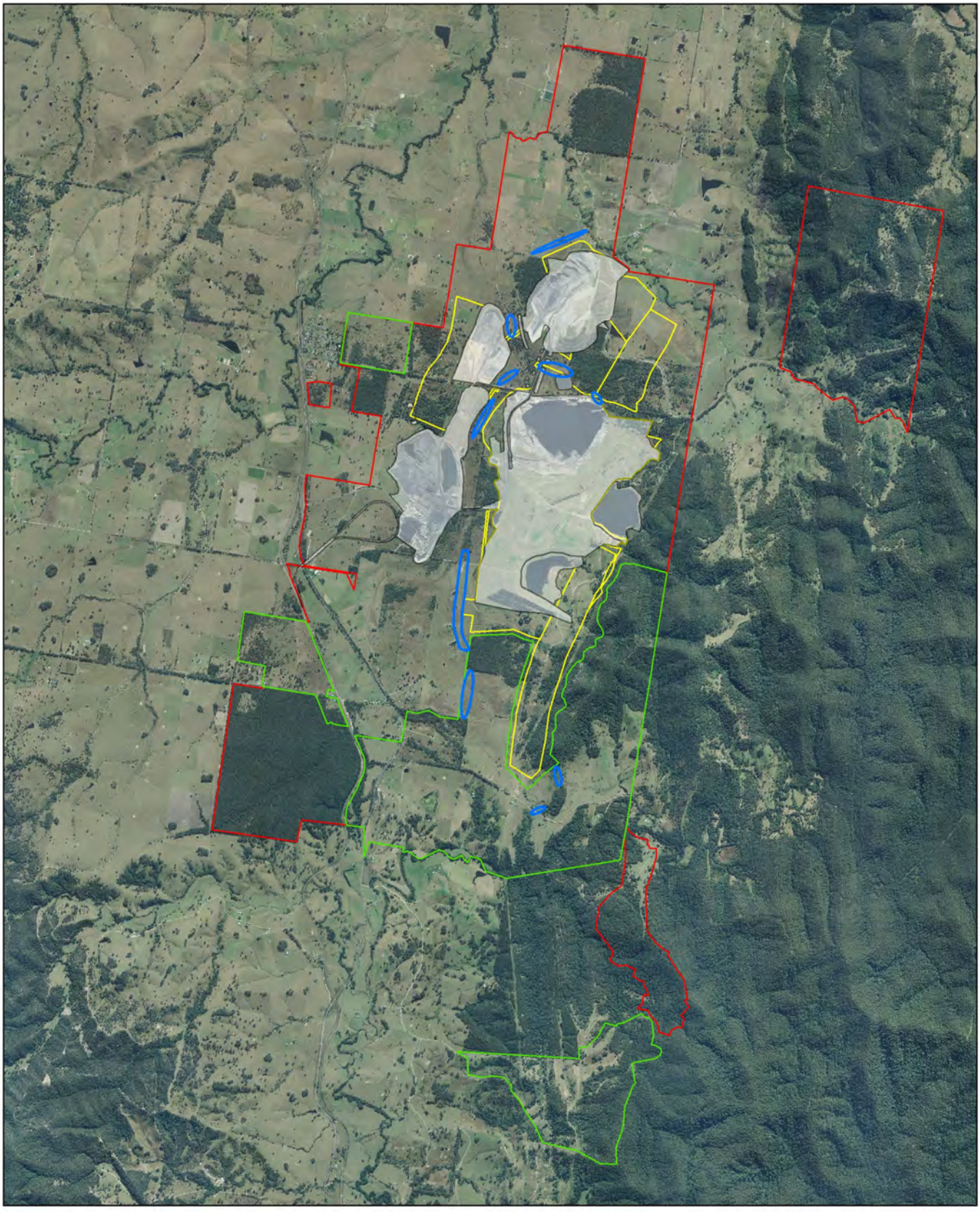


Figure 19: Locations Recommended for Installation of Glider Poles and Intensive Plantings

2. In the section between the BRNOC and the Stratford Main Pit on either side of the existing haul road and in a small area east of the haul road. Currently there is very limited habitat connectivity between the vegetation patches in the northern section of the Biodiversity Enhancement Area and the area west of the proposed Avon North Open Cut. Given the Biodiversity Enhancement Area is likely to be improved in the near future through management programmes, there is some potential to provide additional habitat to individuals or families within the vegetation patch west of the proposed Avon North Open Cut. It is noted however, that some revegetation of the area between BRNOC and the Stratford Main Pit would also be required in conjunction with glider poles to provide a viable wildlife corridor through the area and to lower the predation potential for individuals in the area.
3. In the small section between the Roseville West Pit and the BRNOC where there appears to be a gap of approximately 100 m or more between linear vegetation patches. There may be some merit in re-connecting this area as it leads to a larger remnant/regrowth woodland patch and known habitat to the north-west.
4. Within Offset area 3: from the south-west corner of the area of potential habitat west of the Stratford East Open Cut, there is currently limited connectivity, with the nearest area of vegetation approximately 550 m south. Installation of glider poles between these areas of vegetation may provide opportunities for individual dispersal. Through a series of primarily linear strips of vegetation, the southern area of potential habitat eventually connects with Offset area 2 and the Voluntary Conservation Area. It is estimated that approximately 10 to 20 glider poles would be required in the area to facilitate potential movement and would need to be implemented in combination with intensive revegetation of fast-growing plant species. Revegetation efforts would aim to provide a vegetation corridor of 50-100 m.
5. North of the BRNOC: the area of potential habitat to the west of the BRNOC is approximately 1.3 km south of the area of known habitat. Dog Trap Creek extends south, and could provide potential dispersing habitat, however, the vegetation along the creek becomes progressively sparse the further south and east the creek extends. Installation of glider poles in combination with intensive revegetation through this area may improve connectivity of the northern patch with the habitats of the Project Area.

Glider poles would be installed within 12 months of project approval. Glider poles would be placed at 20-40 m intervals. A detailed pole placement plan would be prepared as part of the Biodiversity Management Plan. Table 20 gives an example of possible heights and distances for placing gliding poles, taking into account landing height (van der Ree *et al*., 2003).

Table 20: Glider pole heights and average glide distance from poles.

Pole Height (m)	Average glide distance (m)
25	40
20	32
15	22
10	12

Glider poles would need to be installed in combination with nest boxes specifically designed for the Squirrel Glider, to provide appropriate shelter and protection in areas where there is little canopy protection.

b) Connectivity Improvement – foraging resources

Impacts resulting from habitat loss and connectivity would be ameliorated to some extent by intensive planting in strategic locations. This would involve planting fast growing mid-storey feed tree species, as well as appropriately selected canopy tree species. Fast growing mid-storey plant species would be planted as soon as practical after project approval (and within a maximum of 12 months from project approval), potentially providing additional foraging habitat resources, and given the speed in which mid-storey species such as *Banksia* spp. and *Acacia* spp. can grow when colonising an area, this may also assist in reconnecting areas of potential habitat in the short-term. Planting foraging resources is particularly important in areas where glider poles are installed. Canopy tree species would also be planted to provide potential foraging, dispersal, and shelter resources in the medium to long-term. The following areas would be targeted for intensive revegetation:

1. All areas described above in which glider poles would be installed (section a).
2. Offset area 1, where at present habitat is restricted young regrowth.
3. The Wildlife Corridor within the Biodiversity Enhancement Area.

Tree species planted would need to take into consideration the ecological requirements of the species, and the vegetation which is being removed. Squirrel Gliders are known to require a mix of *Eucalyptus* spp., *Angophora* spp. or *Corymbia* spp. overstorey species, and a shrubby understorey of *Acacia* spp. or *Banksia* spp. (van der Ree and Sucking, 2008). They require a diverse range of foraging resources, and appear to be sensitive to loss or failure of winter flowering tree species (van der Ree and Sucking, 2008; Sharpe, 2009). Sharpe (2009) found that an inadequate supply of nectar can cause increased mortality and reduce reproduction. The management implication is that there is potential for the loss of one or two key tree species to threaten a Squirrel Glider population, even if the remaining habitat is unaffected (Sharpe and Goldingay, 2007). The planting of tree species would need to provide a mixture of spring and winter foraging resources, and similar types of plants species that would be removed as a result of the Project.

c) Nest Boxes

The Project has the potential to remove viable nesting/refuge habitat for the species. Squirrel Gliders are hollow-dependent and as such the installation of species-specific nest boxes and/or the re-use of cleared hollows are recommended to ameliorate the net loss of the nesting/refuge habitat for the species. Squirrel Gliders have been shown to utilise nest boxes, with varying degrees of success. Ball *et al.* (2011) reported 20% of 56 nest boxes installed were used after 3 years, while Goldingay *et al.* (2006) detected evidence of use in over 50% of the 24 nest boxes installed. Ball (2007) found 5.6% nest boxes installed displayed use by Squirrel Gliders. Installation of nest boxes has the potential to reduce the impacts of the loss of hollow bearing trees to some extent. It is recommended as minimum, that two nest boxes suitable for the Squirrel Glider be installed for each potential hollow which is removed. Installation of nest boxes will commence within 12 months of project approval. Characteristics of nest boxes that are likely to be appropriate for the Squirrel Glider are shown in Table 21 (from Beyer and Goldingay, 2006). Ball *et al.* (2011) also provides a detailed description of the nest box design; rear-entry box with dimensions 40 x 25 x 18 cm, 45-50 mm diameter entrance, and installed at least 3 m above the ground. Carpet should be attached to the inside of the roof to discourage nest construction by bees (Ball *et al.*, 2011).

Table 21: Nest box characteristics designed for the Squirrel Glider.

Box Variable	Value
Entrance diameter	3–4.9 cm
Volume	0.005–0.03 m^3
Height above ground	2–3.9 m

m^3 = cubic metres

Ongoing monitoring of nest boxes would be necessary to check that non-target species are not restricting use of the nest boxes for the Squirrel Glider.

d) Monitoring and feedback mechanism

Monitoring of the Squirrel Glider should be undertaken throughout the Project area to monitor the health and viability of the local population. Three components of the recommended monitoring are outlined below:

1. Radio-tracking of family groups in each of the known habitat areas should be undertaken. The programme would aim to trap and radio-collar individuals within each family group as soon as possible after project approval. This would allow home-ranges to be estimated, and identification of important habitat resources (e.g. den trees and foraging areas). The information would be applied to minimise impacts to the species. For example, if important den sites are identified and are due to be cleared, additional nest boxes may be installed and/or the important hollows relocated. If family groups are known to regularly utilise certain areas for foraging, additional plantings may be necessary to reduce the impact of the vegetation clearing. Furthermore, knowledge of the location of individuals would reduce the risk of injury during clearance activities.

   The radio-tracking programme may allow for the ongoing monitoring of dens sites and reproductive success. Sub-adults would be targeted for radio-tracking prior to dispersal, which usually occurs between 12-18 months of age (van der Ree and Suckling, 2008). The success of young individuals dispersing, and their survival, is likely to provide an indication of the health of the population as the Project disturbance continues. If offspring are failing to survive and successfully reproduce, management interventions may be applied, for example installing additional nest boxes or glider poles, and/or increasing planting of feed trees.
2. Monitoring of nest boxes would provide information on usage and potentially the presence of the population. If individuals utilise the nest boxes regularly for den sites, data on reproductive success may also be obtained. If nest boxes are not being used consideration would need to be given to installing additional boxes, to increase availability and choice for family groups.
3. Monitoring of glider poles would provide valuable information on usage. Two commonly used techniques are hair tubes and camera traps. If glider poles are not being used by individuals for dispersal, monitoring of existing family groups would become increasingly important. Consideration would also be given to increasing plantings, or installation of additional poles.

Implementing the three components outlined above may ameliorate the short-term impacts of the Project, until the ecological benefits of the Offset areas and Biodiversity Enhancement Area become established. The monitoring would provide feedback with regard to the success or limitations of the strategies, and allow for ongoing adaptive management.

7 Offset proposal

This section describes the offset proposal, which aims to address residual impacts that cannot be mitigated. The objective of the offset proposal is to maintain or improve biodiversity values (including fauna habitat) in the region in the medium to long-term, through the conservation, management and improvement of land near the Stratford Mining Complex in perpetuity. In particular, additional areas of fauna habitat would be created through a strategic revegetation programme. The land within the Offset areas would be subject to ongoing monitoring, independent audits and stringent completion criteria, allowing for ongoing adaption management,

The offset proposal is described in Section 7.1, the characteristics of the Offset areas are described in Section 7.2, a reconciliation of the proposed offset strategy against OEH Offset Principles and SEWPaC Offset Requirements is outlined in Section 7.3, and the ecological gains of the proposed offset are described in Section 7.4.

7.1 Offset area proposal management, security, monitoring and auditing

There are four proposed Offset areas, which are located in the vicinity of the Project area (Figure 20). Each Offset area contains both vegetated areas and cleared land. The sub-sections below provide detail on the proposed method of conserving the Offset areas in perpetuity, and the proposed management, monitoring, independent audits and completion criteria. These sub-sections have been cross-referenced with the offset sections of the FloraSearch (2012) report to maintain consistency between the flora and fauna offset management procedures.

7.1.1 Conservation in perpetuity

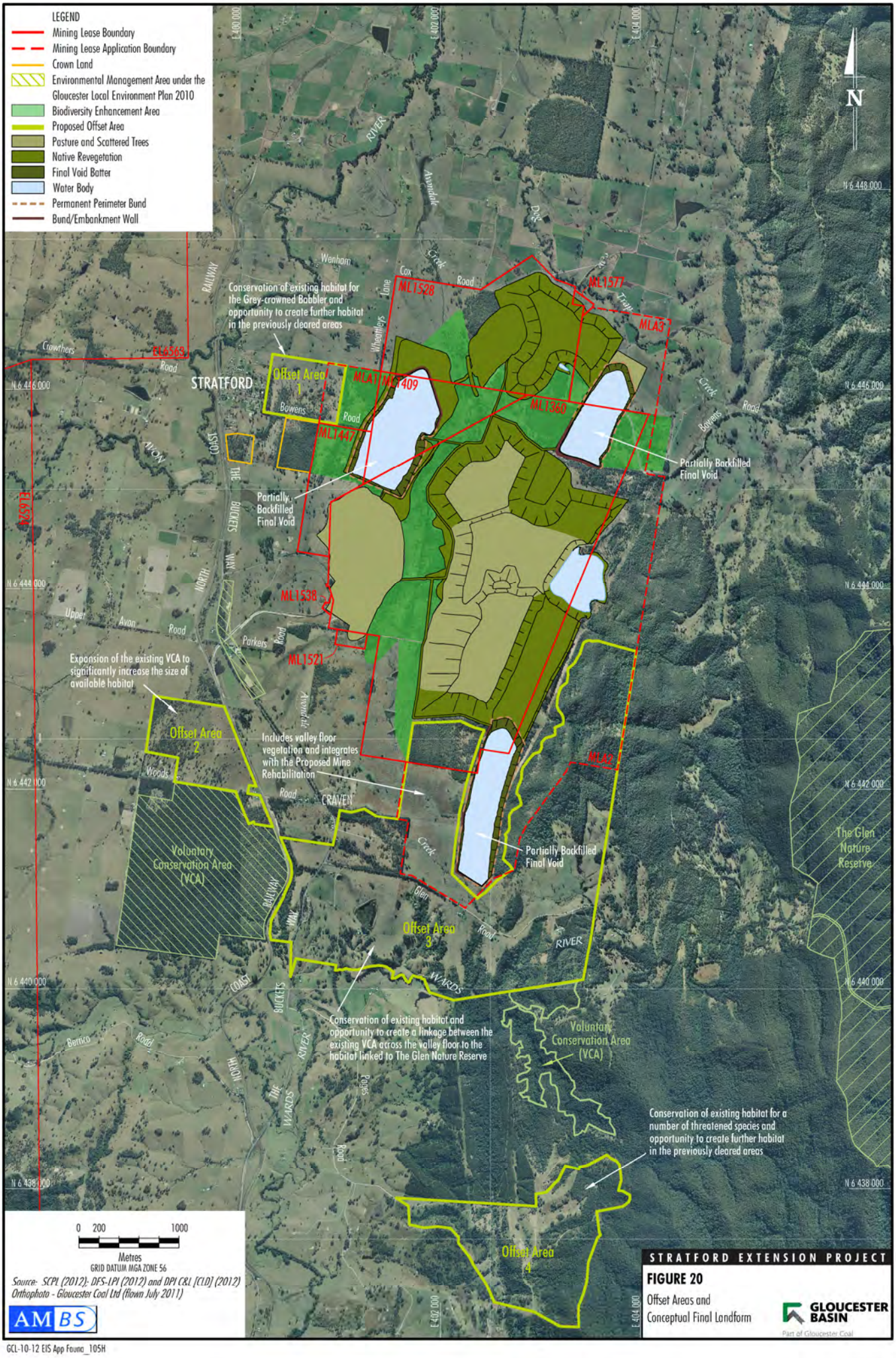
Within 12 months of the Project being approved, an arrangement would be made to make sure that the Offset areas are protected and managed in the long-term. This would be achieved through, for example, a voluntary conservation agreement pursuant to Section 69B of the NPW Act, as described in contemporary Project approval conditions pertaining to offsets.

7.1.2 Proposed management plan

The management of the Offset areas would be described within the Biodiversity Management Plan.

A number of management measures are listed and described below based on detailed flora and fauna surveys of the proposed Offset areas and an assessment of the measures required to enhance the flora and fauna values of the area. These measures would include:

- revegetation of cleared land to substantially increase the area of native vegetation in the area and maximise habitat diversity and a range of successional stages;
- management of livestock grazing;
- control of weeds to enable natural regeneration of native vegetation;
- exotic animal management to benefit native wildlife;
- bushfire management; and
- controlling vehicular access.



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All of these measures would need to be considered and balance the specific habitat requirements for specialised threatened fauna species known or predicted to occur in the Offset areas in addition to a range of generalist species and protected (but not threatened) fauna. For example, the revegetation, bushfire and exotic animal management programmes would need to consider the specialised fire regimes, dense understorey shelter/foraging habitat requirements and the appropriate control of specific exotic fauna species within designated habitat areas for the New Holland Mouse. The development of specific habitat for Squirrel Glider in some circumstances may be different to the requirements of the New Holland Mouse, given the gliders require a more open woodland/forest habitat for foraging and require less frequent fire regimes to persist in a given area (NSW Scientific Committee, 2008; Kemper and Wilson, 2008). Refer to Table 22 below for the specific habitat requirements, mitigation and management measures to 'maintain or enhance' threatened species habitat and populations within the Offset areas.

Table 22: Targeted management actions for threatened species in the Offset areas

Threatened Species/Groups	Targeted management action	Important habitat type within the Offset areas
Glossy Black-cockatoo	• Replant local providence *Allocasuarina* spp. as a mid-storey species, within appropriate habitat types to provide food source. • Reduce fires in areas of existing and new plantings of *Allocasuarina* spp. to retain diverse understorey species and in particular to permit the regeneration of She-oaks. • Exclude livestock from *Allocasuarina* spp. stands both existing and new plantings.	Wet Sclerophyll Forest and Dry Sclerophyll Forest in the foothills.
Threatened Woodland Birds: • Speckled Warbler • Varied Sittella	• Retain and enhance dead timber using appropriate load levels on the ground in new revegetation grassy woodland/dry sclerophyll forest areas. • Ecological burns appropriate for grassy woodland/dry open forests. • Control weeds in areas of known habitat, especially the exotic, winter-fruiting shrubs such as cotoneasters, hawthorns, firethorns and privets that could support Pied Currawongs. • Exclude livestock from suitable woodland habitats, particularly those with native grassy understorey and an intact native ground plant layer. • Maintain and create linkages between grassy woodland/open forest habitats both within the Offset areas and adjacent area. • Undertake fox and feral cat control programmes to prevent increased predation.	Grassy Woodland and Dry Sclerophyll Forest with rough barked species.
Grey-crowned Babbler	• Retain dead timber on the ground in existing open woodland areas and establish appropriate timber loads in revegetation areas. • Encourage regeneration of habitat by fencing remnant stands to restrict livestock access. • Increase the size of existing remnants. • Minimise the distance between trees in revegetation areas to decrease predation potential for the species and provide for greater movement throughout the area.	Dry Sclerophyll Forest and Grassy Woodland.

Threatened Species/Groups	Targeted management action	Important habitat type within the Offset areas
Brush-tailed Phascogale	• Undertake fox and feral cat control programmes to prevent increased predation. • Install and monitor an appropriate number of nest boxes for the species to minimise the impact of the loss of habitat in the Project area. • Retain and plant nest trees and recruitment trees (future hollow-bearing trees).	Dry Sclerophyll Forest and Grassy Woodland.
Squirrel Glider	• Maintain glider movement corridors between known habitat areas by providing tree links and glider poles in the interim; less than 75 m apart (refer to Section 6.12). • Ecological burns appropriate for box-ironbark communities and minimise fire related impacts for this species (e.g. minimise fire in den sites). • Retain den trees and retain/plant recruitment trees (future hollow-bearing trees) such as Grey Box (*Eucalyptus moluccana*), Cabbage Gum (*Eucalyptus amplifolia*) and Forest Red Gum (*Eucalyptus tereticornis*). • Install and monitor an appropriate number of nest boxes for the species in the interim, to minimise the impact of the loss of habitat in the Project area. • Retain food resources, particularly sap feeding trees and winter flowering trees, and replant local providence understorey and winter flowering feed species such as *Acacia* spp., *Banksias* spp. and *Eucalyptus amplifolia*. • Prevent or minimise predation on squirrel glider and competition with exotic species by reducing the presence of exotic pests (particularly European Fox, feral cats and exotic bees) from known habitats.	Grassy Woodland and Dry Sclerophyll Forest in the valley and lower foothills.
Long-nosed Potoroo	• Apply fire regimes that maintain dense understorey vegetation cover. • Where fire control is necessary apply mosaic pattern hazard reduction burns so the same areas are not burned continuously. • Undertake fox, feral dog and cat control programmes to prevent increased predation.	Wet Sclerophyll Forest and Dry Sclerophyll Forest.
New Holland Mouse	• Replant moderately dense and diverse understorey species (e.g. Blady Grass [*Imperata cylindrical*] or Common Bracken [*Pteridium esculentum*]) for food and shelter resources. • Ecological burns to enhance flora species diversity and to maintain the required understorey density.	Wet Sclerophyll Forest, Dry Sclerophyll Forest and Grassy Woodland with dense understorey and disturbed sites with dense cover of Blady Grass.

It is proposed that to account for these differences in habitat requirements for the suite of threatened species within the Offset areas, that patches of interconnected mosaic habitat types are established particularly in areas that are currently cleared. The design would target species that currently have limited representation, a potentially higher level of impact within the Project area and/or highly specialised habitat requirements. These species include the Glossy Black-cockatoo, Speckled Warbler, Grey-crowned Babbler (eastern subspecies), Varied Sittella, Brush-tailed Phascogale, Squirrel Glider, Long-nosed Potoroo and New Holland Mouse.

In some circumstances one species could be used as an 'umbrella' species for the conservation and enhancement of habitat for other threatened species. For instance the establishment and management of Squirrel Glider habitat within the Offset area may also provide suitable habitat for a number of threatened woodland birds (e.g. Brown Treecreeper and Speckled Warbler), which also have a strong association with Box-ironbark vegetation communities.

Specific management requirements for the aforementioned species would be detailed in the Biodiversity Management Plan.

Revegetation

The proposed Offset areas provide for a combination of protection and improvement of existing remnant vegetation and fauna habitat as well as active revegetation to increase the overall biodiversity of the area. This would be achieved by restoring the internal connectivity of woodland/forest habitats within the proposed Offset areas.

A considerable part of the proposed Offset areas are cleared lands (435 ha) (including an additional 10 ha of planted trees which would be retained) comprising predominantly introduced grasses. These cleared lands are between patches of native remnant vegetation comprising mainly wet sclerophyll forest, grassy woodlands and dry sclerophyll forests. The aim of revegetation would be to establish a range of habitat niches through revegetation (including canopy, understorey and ground cover). It is anticipated that these cleared patches would be formed as interconnected mosaic patches of suitable habitat for the most sensitive threatened species present or predicted to occur within the Project areas, Offset areas and surrounds (Table 17). Each ecological niche would be managed in a manner appropriate for the target species in those areas. The formation of each habitat niche would also need to consider as a minimum, nutrient levels remaining in the soil, soil type, remaining seed bank, aspect, geology, existing weed invasions and existing landscape connectivity.

Revegetation would also aim to compensate for the loss of specific habitat resources for threatened fauna.

Where possible, additional planting would be undertaken in areas adjacent to the Project area to promote mid storey growth in areas where the Project creates a sharp contrasting edge. This may assist with reconnecting vegetation remnants for the short-term, given the speed in which mid-storey species such as *Banksia* spp. and *Acacia* spp. can grow when colonising an area. This measure would be specifically required in the vegetation west of the Stratford Pit Extension to reconnect the patch with the vegetation in the ranges to the east or to the north with the Biodiversity Enhancement Area. It could however be applied across the areas adjacent to the Project. Further, this measure may ameliorate incremental edge effects (see Section 6.6) and in turn provide additional foraging resources for nectivorous species such as the Grey-Headed Flying Fox, Squirrel Glider and Little Lorikeet.

To attempt to mitigate the loss of foraging habitat for the Glossy Black-cockatoo, Forest Oak (*Allocasuarina torulosa*) would be replanted in locations along the foothills in areas of similar habitat that are currently cleared (e.g. foothills areas in Offset area 3 and 4) (Figure 20). The number of plantings would be at least 15-20% greater than that removed, to account for plantings that do not become established. Seed from these species would be salvaged during vegetation clearing wherever possible. The aim would be to establish Allocasuarina plantings as a midstorey species within or adjacent to currently vegetated areas, rather than creating dense homogenous stands. Suggested locations are shown in Figure 18.

Additional habitat features

Nest box installation

An appropriate nest box programme that incorporates the existing programme with the new requirements relating to this Project would be implemented throughout the Biodiversity Enhancement Area and Offset areas. As a minimum the recommended replacement ratio is 1:1 (i.e. 1 nest box of appropriate size, to replace 1 hollow of similar size and properties). Refer to Section 6.2.3 for further detail. Nest boxes usage should be monitored as a minimum once every 6 months.

Placement of fallen timber

Fallen timber accumulated from felled trees and existing logs in the Project footprint would be relocated throughout the Biodiversity Enhancement Area and the Offset areas, in revegetation areas. An appropriate relocation plan would be detailed in the Biodiversity Management Plan.

Management of livestock grazing
Offset areas will be appropriately fenced to prevent unauthorised grazing by livestock. The Biodiversity Management Plan would detail a grazing policy, which would consider the potential for grazing to be appropriately managed as part of a fuel reduction scheme and management of exotic plants.

Control of weeds
Four flora species listed as Noxious in the Gloucester Shire and Great Lakes Council under the *Noxious Weeds Act, 1993* have been recorded in the proposed Offset areas (Appendix G). Three of these species are listed as Class 4 weeds (Crofton Weed [*Ageratina adenophora*], Blackberry [*Rubus fruticosus*], Lantana [*Lantana camara*], and one is listed as a Class 3 weed, Green Cestrum (*Cestrum parqui*). These and other weeds would be controlled and monitored by an appropriately qualified contractor using standard methods. The Biodiversity Management Plan would detail a grazing policy, which would consider the potential for grazing to assist in the management of weeds.

Animal pest management
Seven introduced land-based species have been located during past surveys of the proposed Offset areas, namely the House Mouse (*Mus musculus*), Black Rat (*Rattus rattus*), Red Fox (*Vulpes vulpes*), Feral Dog (*Canis lupis familiaris*), Feral Cat (*Felis catus*), European Hare (*Lepus europeaus*) and European Rabbit (*Oryctolagus cuniculus*) (Appendix G). These animal pests would be controlled and monitored by an appropriately qualified contractor using standard methods. Introduced predators are a known threat to a number of threatened species that occur or could potentially occur in the area, so control of pests would be beneficial to the recovery of these native species.

It is noted that it would help if the surrounding land owners/managers could co-ordinate with the pest management programmes undertaken in the Offset areas, and undertake parallel control strategies to increase the success of the programme. Otherwise, feral species would be quick to reinvade Offset areas from adjacent areas.

European bees (*Apis mellifera*) and exotic birds such as Common Starling (*Sturnus vulgaris*) would also be controlled and monitored by an appropriate contractor, to reduce the use of hollows and nest boxes by feral species.

Fire management
Some access tracks throughout the proposed Offset areas would be maintained for fire management. The Stratford Mining Complex Biodiversity Management Plan would describe fire management procedures applicable to the proposed Offset areas. The OEH and the rural fire brigade would be consulted when developing appropriate fire regimes. Fire management would be undertaken as mosaic ecological burns appropriate for the vegetation type and threatened species known or predicted to occur in those areas.

Controlling vehicular access
The Offset areas would be signed and fenced to control vehicular access. Any vehicular movements within the Offset areas would be mostly confined to designated vehicle tracks. This would include, stringent control of access along existing public roads (e.g. through fencing).

7.1.3 Monitoring

A monitoring programme would be implemented to assess and report on the effectiveness of the measures and the performance of the offsets in conserving and improving native vegetation and habitat for native fauna. This would include, as a minimum, standardised fauna surveys performed twice every three years, throughout the Offset areas targeting all vertebrate fauna groups (i.e. mammals, birds, reptiles and frogs). Surveys would be best undertaken during winter, and late spring/early summer. Survey techniques implemented would include but not necessarily be limited to habitat assessments, diurnal bird surveys, remote cameras, spotlighting, Elliott trapping, hair funnels, call playback (for mammals and forest owls), and reptile and frog searches. Summary reporting would be carried out following each survey and comprehensive reporting would be carried out following the independent environmental audit (see below). The monitoring would be performed by suitably qualified persons.

Monitoring of landscape function may also be appropriate and should be investigated for its applicability to the study area (see Ludwig and Tongway, 1997).

7.1.4 Independent audits

The proposed Offset areas would be independently audited at intervals agreed to with relevant authorities. The audits would be performed by a suitably qualified person(s) to:

- assess compliance with the management plan;
- assess the performance of the proposed Offset areas;
- review the adequacy of the management measures and monitoring programme; and
- recommend actions or measures to improve the performance of the offset, management plan, or monitoring programme.

7.1.5 Completion criteria

Completion criteria are present in Table 23.

Table 23: Proposed offset completion criteria

Component of Offset	Completion Criteria
Enhancement Areas (i.e. existing rainforest, riparian forest, wet sclerophyll forest, grassy woodlands, dry sclerophyll forests)	Areas of existing remnant vegetation within the Offset areas (490 ha) have been conserved and enhanced
Revegetation Areas (i.e. derived grasslands and cleared land	435 ha of revegetated land as a self-sustaining ecosystem[1,2,3]. Evidence of native fauna, in particular threatened species using this land.
Forest Oak (*Allocasuarina torulosa*) Plantings	Evidence of foraging by Glossy Black-cockatoos.
Direct links between the Offset areas and Rehabilitation area	Native vegetation has been established which directly links vegetation areas of the Offset areas with the Rehabilitation area. Evidence of native fauna, in particular threatened species using these links.

[1] The methodology for determining a self-sustaining ecosystem shall be to the satisfaction of the Director-General.

[2] Woodland/forest would not be restored along the power line easement in accordance with the relevant requirements of the power authority (i.e. ground cover vegetation only).

[3] Plus 10 ha of existing planted trees.

7.2 Fauna characteristics of the offset areas

AMBS (Appendix G) performed fauna surveys and habitat assessments throughout the Offset areas. A summary of the results of this study are provided in the following sections.

7.2.1 Regional location

The proposed Offset areas are located within the same CMA region as the Project area (i.e. the Hunter-Central Rivers CMA Region) and therefore have the capacity to benefit biodiversity values in the same region as the Project. Vegetation communities can change in plant and animal composition over distances due to differences in environmental factors. The proposed Offset areas are suitably located because it is near the area proposed to be disturbed and has a greater chance of maintaining and improving the biodiversity that would be affected by the Project.

7.2.2 Existing reserve system

The proposed Offset areas complement the existing reserve system in NSW. Part of the offset (Offset areas 2 and 3) are adjacent to two existing areas conserved under a voluntary conservation agreement. The habitat within Offset area 3 is linked through private properties to The Glen Nature Reserve. The Offset areas do not link to the Glen Nature Reserve because:

- The proposed Offset areas are more representative of the vegetation that would be cleared for the Project. The Glen Nature Reserve is located on elevated land of the Wards River Catchment. The composition of the habitats and the suite of animals that occur higher in the catchment are different to that on the Gloucester Valley floor.
- A vegetated link already exists between the proposed offset and the Glen Nature Reserve. The vegetation between the areas is protected under the *Native Vegetation Act 1999*. This vegetation and the fauna within that area already have some protection because it is elevated and therefore less likely to be impacted by grazing than the Gloucester Valley floor.

7.2.3 Regional conservation priorities

Landscape Corridors
Offset area 3 is located within an OEH recognised climate change corridor as described and mapped in the Fauna Corridors For Climate Change - Landscape Selection Process Key Altitudinal, Latitudinal and Coastal Corridors for response to Climate Change Hunter Central Rivers CMA (DECC, 2007).

Valley Floor Vegetation
The vegetation on the valley floor is identified as Vegetation Type 8: Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands (HU526). This vegetation type is 70% cleared in the CMA. Even though the Project would involve clearance of approximately 13.5 ha of this vegetation type it would conserve and enhance approximately 30 ha. A further benefit would be that large areas of cleared land adjoining the existing patches would regenerate following stock exclusion and active management, thus providing additional habitat for fauna. In addition, the areas within the Offset areas would be retained for conservation in perpetuity.

Watercourses
The Offset areas contain a number of watercourses that would be subject to conservation and enhancement:

- two reaches of the Wards River occur in the proposed Offset area 3 (approximately 0.5 km and 0.65 km);
- upper reach of the Avondale Creek in the proposed Offset area 3 (approximately 4.4 km); and
- other drainage lines (Figure 20).

7.2.4 Tenure of the proposed offset area

The proposed Offset areas are located on the following tenure (lot and DP): 1, 997092; 1, 1082739; 1, 998562; 1, 997290; 1, 116325; 1, 778861; 1, 815045; 1, 855240; 2, 1082739; 2, 737421; 2, 778861; 2, 815045; 5, 722748; 7, 722748; 45, 979859; 64, 979859; 66, 1008585; 70, 979859; 70, 979859; 110, 874013; 392, 876813; 506, 1014670; 508, 1014670; 1221, 806209; A, 116326. As previously stated, the land tenure underlying the proposed Offset areas would be secured in perpetuity for wildlife conservation.

7.2.5 Fauna species

AMBS performed fauna surveys throughout an offset investigation area (Appendix G). A total of 213 vertebrate fauna species were recorded during these surveys, including 47 mammals, 131 birds, 19 reptiles and 16 frogs. Twenty-five species that were recorded are listed as threatened under the TSC Act and or EBPC Act, some of which were recorded within or near the Offset areas.

7.2.6 Fauna habitat types

The Offset areas contain a range of fauna habitat types including rainforest, riparian forest, wet sclerophyll forest, grassy woodlands, dry sclerophyll forests and cleared land (Appendix G). Table 24 compares the vegetation types and fauna habitats within the study area with those in the proposed Offset areas.

All broad fauna habitats located in the Project area also occur within the Offset areas, and the areas that would be conserved are greater than the amount that would be lost due to the Project. Through appropriate management, in the medium to long-term, the presence of these habitat types in the Offset areas will represent a biodiversity gain.

Table 24: Area of fauna habitat type in the disturbance area and Offset areas

Fauna Habitat Type	Approx. Area to be Cleared (ha)	Approx. Area to be Offset (ha)
Rainforest	0	9.2
Wet Sclerophyll Forest	19.2	249
Grassy Woodland	13.5	80
Dry Sclerophyll Forest	65	145.5
Derived Grasslands/Shrub Regrowth*	5.5	0
Acacia Regeneration	0.5	2
Artificial Wetlands	0	8
	103.7 ha (rounded to 105 ha)	493.7 ha (rounded to 490 ha)

* This is a derived version of the dry sclerophyll forest broad habitat type which has regenerated following clearing.

Further, the density of hollows in the Offset areas is at least comparable, and potentially greater, compared to those available in the Project area (Figure 21). It is however, noted that current hollow densities within both the offset and Project areas are only an estimation (i.e. there are likely to be patches within the broad areas identified within Figure 21, which contain greater or fewer hollows than are indicated).

In addition, the Project would result in the loss of 190 ha of cleared land and 1.3 ha of planted trees, while 435 ha and 10 ha of these habitats respectively are within the Offset areas.

In general, the habitat within the proposed Offset areas is considered to be in comparable or better condition than the equivalent habitats that would be disturbed by the Project. The presence of old growth features was similar to that observed within the Project area. Estimates of hollow bearing tree density suggest the Offset areas possess similar numbers (possibly greater) in comparison to the Project area (Figure 21), and in the long-term the old growth features will become more abundant.

Fauna habitat types within the Offset areas that are different to the broad habitat type equivalent within the Project area are described below.

Rainforest habitat (Vegetation Type 2) (Plate 11; Figure 6) occurred in the western section of Offset area 3 (Figure 20). It occurred on either side of a deeply incised gully which contained a rocky creek composed of boulders and sand. Water was present along most of its length, sometimes forming small pools. The canopy was approximately 20 to 35 m tall but was mostly restricted to the upper reaches of the gully, containing a variety of Eucalypts. Midstorey trees occurring on the banks included Grey Myrtle (*Backhousia myrtifolia*) and Water Gums. Tree hollows were not observed, but rock crevices were abundant. Leaf litter was thin and sparse.

Disturbed Rainforest occurred upslope in close proximity to the Bucketts Way. In this location the habitat was impacted by edge effects and grazing by cattle. Based on the historical aerial photograph (Figure 7a), this area was cleared prior to 1964.

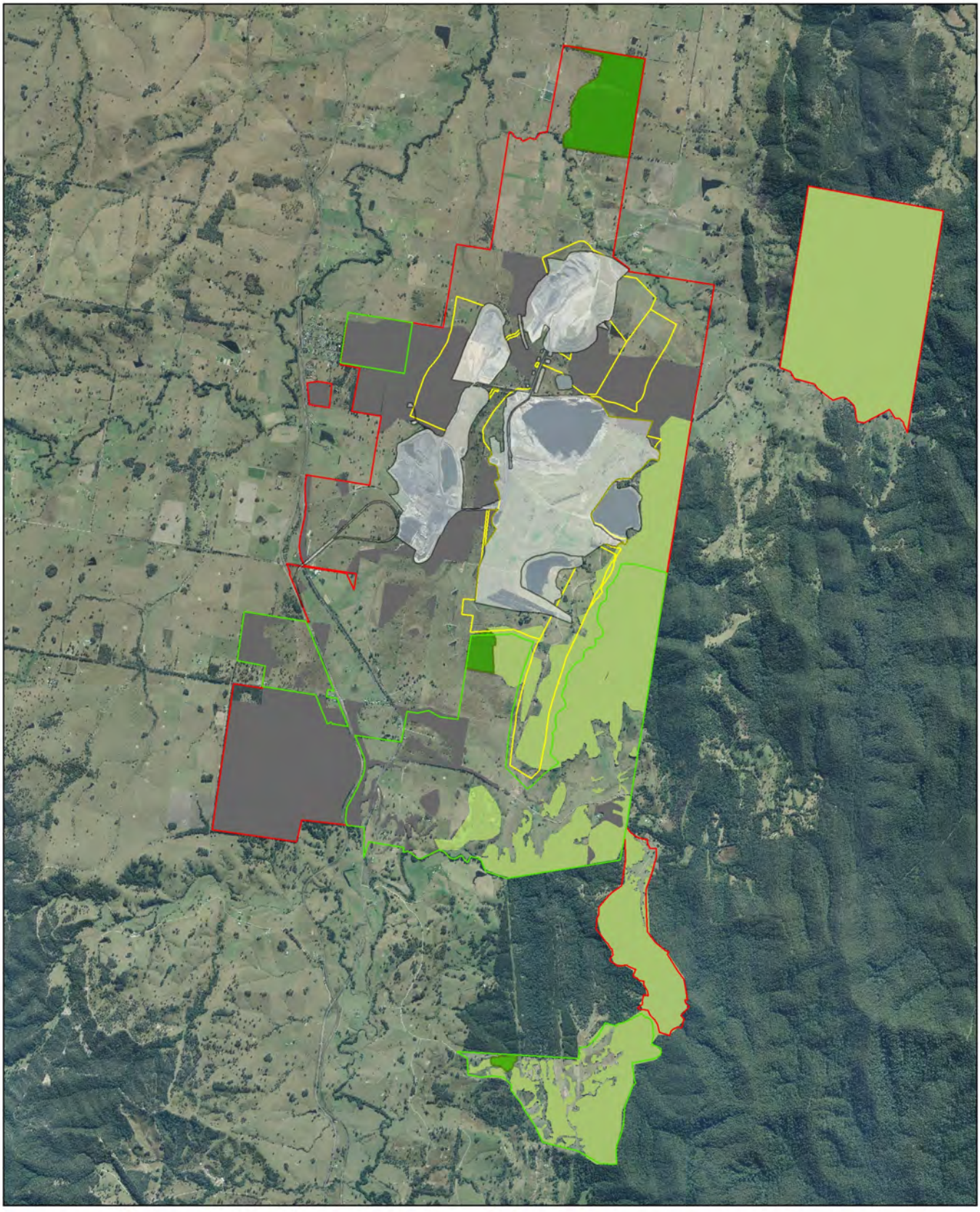

Figure 21: Density of Hollow Bearing Trees per 0.5 hectare.

Plate 11: Rainforest Habitat in Offset Area 3

Wet Sclerophyll Forest habitats (Vegetation types 5 and 6) (Plate 12; Figure 6) occurred in Offset areas 3 and 4 (Figure 20). Habitat condition throughout was highly variable. Age and structure was generally similar to the forest on the slope east of the Project area. Habitat was open forest between 20 to 35 m high (average approximately 30 m), most areas were classified as early to mid- mature. Some areas contained emergent mature or late mature trees but these were not dominant across the landscape. Similarly, some locations contained forest dominated by young to early mature regrowth. Canopy trees were a mixture of *Eucalyptus* spp., with common species including Ironbarks, Spotted Gums, Grey Gum (*Corymbia maculata*), Tallowwood and Stringybarks. The midstorey was composed of regrowth *Eucalyptus* spp., *Allocasuarina* spp. and Turpentines. The *Allocasuarina* spp. were less widespread compared with locations on the eastern slope, but did occur in several dense stands in which chewed cones were observed (Offset area 4). The shrub layer was generally sparse, but diverse (e.g. *Acacia* spp., *Persoonia* spp., *Podolobium* sp.). In the gullies or near creeks, rainforest species became more common including Grey Myrtle (*Backhousia myrtifolia*) and *Pittosporum* spp. The ground cover was mostly composed of a variety of native grass and leaf litter, with Blady Grass (*Imperata cylindrica*) being particularly widespread. Hollow bearing trees were mostly uncommon, but were present in varying sizes. Fallen logs were abundant, with greater than 100 m per 0.5 ha recorded in several locations. Rock crevices were generally uncommon. Weeds were mostly rare with the exception of some gully areas in the southern section of the study area. There was little evidence of grazing, with the exception of the area of disturbed Wet Sclerophyll Forest in the eastern section of Offset area 3, which was heavily grazed. In this location, where grazing was not evident there was usually heavy weed infestations.

In the southern section of Offset area 3, Wet Sclerophyll Forest (Vegetation type 7) was associated with disturbed gullies, having been severely degraded by previous land clearing. *Eucalyptus* spp. were present in the canopy, but the understorey contained weedy components. A variety of native shrubs were recorded however on the edge of the cleared land and lower down within the gully habitat. The area is likely to provide some habitat for fauna along the Wards River, and would be expected to improve in quality with appropriate management.

Plate 12: Wet Sclerophyll Forest Habitat in Offset Area 4

Grassy Woodland (Vegetation type 9) (Plate 13; Figure 6) was patchily distributed throughout Offset area 4 (Figure 20). Most of the vegetation type was classified as early to mid-mature, but some areas of young vigorous regrowth were observed. The canopy ranged from 15 to 35 m high, averaging approximately 30 m. Common species included Forest Red Gum (*Eucalyptus tereticornis*), Ironbarks, Stringybarks, Grey Gums and Spotted Gum (*Corymbia maculata*). The midstorey and understorey were generally open and sparse, composed of regrowth *Eucalyptus* spp., *Allocasuarina* sp., *Exocarpus* sp., and a variety of native shrubs (e.g. *Acacia* spp., *Persoonia* spp., *Podolobium* spp.). The ground cover was mostly a mixture of native grasses (e.g. *Imperata cylindrical*), leaf litter and bracken, but some rocky open areas were observed. Tree hollows were uncommon, but small hollows were observed in a few locations. Fallen logs were abundant in some locations and absent in others. Weeds were generally rare throughout. The habitat became increasingly fragmented further west.

7.2.7 Threatened fauna species

A list of threatened fauna that have been recorded in the Offset areas is provided in Table 25. Table 26 lists threatened fauna species recorded in the study area along with whether they occur in an Offset area, the area of their habitat that will be impacted by the Project, and the area of their habitat that will be conserved in an Offset area. The estimated areas of habitat that would be impacted by the Project and conserved in the Offset areas were based on potential habitat maps for each threatened species that were considered to have potential to occur in the study area.

Plate 13: Grassy Woodland Habitat in Offset Area 4

Table 25: Threatened species recorded in Offset areas

Scientific Name	Common Name	Conservation Status[1]		Comment
		TSC Act	EPBC Act	
Birds				
Irediparra gallinacea	Comb-crested Jacana	V	-	The Comb-crested Jacana was recorded within an artificial wetland during a standard diurnal bird survey (Figure 4a) (Appendix G). Two individuals were present. They were sighted again opportunistically the next day.
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-	The Glossy Black-cockatoo was recorded several times throughout the study area, including foraging signs (Figure 4a) (Appendix G).
Tyto novaehollandiae	Masked Owl	V	-	The Masked Owl was recorded during a standard call playback survey (Figure 4a) (Appendix G). One individual responded to conspecific call broadcast.
Petroica boodang	Scarlet Robin	V		One individual Scarlet Robin was recorded during recent surveys within Dry Sclerophyll Forest (Figure 4a) (Appendix G).
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	The Grey-crowned Babbler (eastern subspecies) was recorded on multiple occasions surveys (Figure 4a) (Appendix G). Group sizes ranged from two individuals to seven, and mostly occurred within Dry Sclerophyll Forest in lowland areas.

Scientific Name	Common Name	Conservation Status[1]		Comment
		TSC Act	EPBC Act	
Daphoenositta chrysoptera	Varied Sittella	V	-	The Varied Sittella was recorded on multiple occasions during the current surveys, within dry and wet eucalypt forest (Figure 4a) (Appendix G). The species inhabits dry or wet eucalypt forests and woodlands, particularly areas with rough-barked species or trees with many dead branches.
Mammals				
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	The Brush-tailed Phascogale was recorded on seven occasions during the current surveys with a variety of methods (Figure 4b) (Appendix G).
Phascolarctos cinereus	Koala	V	-	The Koala was recorded on multiple occasions during recent surveys from both dry and wet sclerophyll forest (Figure 4b) (Appendix G).
Petaurus australis	Yellow-bellied Glider	V	-	An individual Yellow-bellied Glider was heard during a call playback session performed in the southern section of the study area (Figure 4b) (Appendix G).
Petaurus norfolcensis	Squirrel Glider	V	-	Two individuals of the Squirrel Glider were recorded in Dry Sclerophyll Forest within Offset area 3 (Figure 4b) (Appendix G).
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	The Long-nosed Potoroo was recorded from two locations using remote monitoring cameras (Figure 4b) (Appendix G).
Pteropus poliocephalus	Grey-headed Flying Fox	V	V	Three individuals of the species were observed foraging in a flowering eucalypt within Offset area 3 (Figure 4b) Appendix G).
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	This species was recorded in numerous locations throughout the study area from Anabat recordings (Figure 4c) (Appendix G).
Miniopterus australis	Little Bentwing-bat	V	-	This species was recorded in numerous locations throughout the study area, from both direct capture and Anabat recordings (Figure 4c) (Appendix G).
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	This species was recorded in numerous locations throughout the study area, from both direct capture and Anabat recordings (Figure 4c) (Appendix G).
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	This species was possibly recorded in numerous locations throughout the study area from Anabat recordings (Figure 4d) (Appendix G).
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	This species was possibly recorded within Offset area 2 from Anabat recordings (Figure 4d) (Appendix G).
Myotis macropus	Southern Myotis	V	-	This species was recorded in two locations throughout the study area, from both direct capture, and several other possible records from Anabat recordings (Figure 4c) (Appendix G).
Scoteanax ruepellii	Greater Broad-nosed Bat	V	-	This species was possibly recorded in numerous locations throughout the study area from Anabat recordings (Figure 4d) (Appendix G).
Vespadelus troughtoni	Eastern Cave Bat	V	-	This species was possibly recorded in numerous locations throughout the study area from Anabat recordings (Figure 4d) (Appendix G).

Scientific Name	Common Name	Conservation Status[1]		Comment
		TSC Act	EPBC Act	
Pseudomys novaehollandiae	New Holland Mouse	-	V	The New Holland Mouse was recorded in five locations in the Offset areas. There is also a possible record from a sixth location from a hair sample. In each location, habitat for the species was classified as wet or dry eucalypt forest with a sparse shrub layer and grassy understorey.

[1] Threatened species status under the TSC Act and EPBC Act (current as at 16 February 2012).
V Vulnerable E Endangered

Table 26: Habitat for threatened fauna known or considered likely to occur in the Project area and offset area.

Common Name	Conservation Status[1]		Area Impacted (ha)	Area Conserved in Offset Area (ha)	Existing Conserved Area between Offset Area 2 and Offset area 3 (ha)	Recorded in Offset Area
	TSC Act	EPBC Act				
Birds						
Little Eagle	V	-	105 (195)	490 (530)	220	No
Glossy Black-Cockatoo (high*)	V	-	25	63	-	Yes
Glossy Black-Cockatoo (low*)	V	-	14	166	220	Yes
Gang-gang Cockatoo	V	-	105 (131)	490 (530)	220	No
Little Lorikeet	V	-	105 (131)	490 (530)	220	No
Swift Parrot	E	E	105 (133)	490 (530)	220	No
Sooty Owl	V	-	105 (195)	490 (721)	220	No
Masked Owl	V	-	105 (195)	490 (721)	220	Yes
Powerful Owl	V	-	105 (195)	490 (721)	220	No
Barking Owl	V	-	105 (195)	490 (721)	220	No
Brown Treecreeper (eastern subspecies)	V	-	66[2]	137[3]	220	No
Speckled Warbler	V	-	52[2]	123[3]	220	No
Hooded Robin (south-eastern form)	V	-	73[2]	231[3]	220	No
Flame Robin	V	-	105 (131)	490 (530)	-	No
Scarlet Robin	V	-	73[2]	231[3]	220	Yes
Grey-crowned Babbler (eastern subspecies)	V	-	105 (161)	665	220	Yes
Varied Sittella	V	-	105 (131)	490 (530)	220	Yes
Diamond Firetail	V	-	105 (203[2])	515[3]	220	No
Mammals						
Spotted-tailed Quoll	V	E	105 (195)	447 (457)	220	No
Brush-tailed Phascogale (good*)	V	-	52	157	220	Yes
Brush-tailed Phascogale (patchy*)	V	-	63	191	-	Yes
Common Planigale	V	-	105 (130)	490 (530)	220	No
Koala	V	-	105 (130)	478	220	Yes
Squirrel Glider (potential)	V	-	93	144	220	Yes

Common Name	Conservation Status[1]		Area Impacted (ha)	Area Conserved in Offset Area (ha)	Existing Conserved Area between Offset Area 2 and Offset area 3 (ha)	Recorded in Offset Area
	TSC Act	EPBC Act				
Squirrel Glider (predicted)	V	-	39	310	-	Yes
Long-nosed Potoroo	V	V	37	224 (234)	135	Yes
Grey-headed Flying Fox	V	V	105 (133)	490 (530)	220	Yes
Yellow-bellied Sheathtail-bat	V	-	105 (133)	490 (530)	220	No
Eastern Freetail-bat	V	-	105 (133)	490 (530)	220	Yes
Little Bentwing-bat	V	-	105 (133)	490 (530)	220	Yes
Eastern Bentwing-bat	V	-	105 (133)	490 (530)	220	Yes
Large-eared Pied Bat	V	V	105 (133)	490 (530)	220	Possible
Eastern False Pipistrelle	V	-	105 (133)	490 (530)	220	Possible
Southern Myotis	V	-	105 (133)	489	220	Yes
Greater Broad-nosed Bat	V	-	105 (133)	490 (530)	220	Possible
Eastern Cave Bat	V	-	105 (131)	243	204	Possible
New Holland Mouse (core*)	-	V	17	85	-	Yes
New Holland Mouse (patchy*)	-	V	102	217 (227)	220	Yes

[1] Threatened species status under the TSC Act and EPBC Act (current as at 16 February 2012).

V Vulnerable E Endangered

* Denotes quality of habitat

[2] +9.7 ha of predicted habitat

[3] +111 ha of predicted habitat

() values in brackets include the area of cleared land that the species may use

7.2.8 Strategic benefit of the offset areas

The shape of the proposed Offset areas takes into consideration the spatial arrangement of existing vegetation in the area and aims to link and expand on the size of the existing patches. Each Offset area has a reasonably good area to edge ratio, and will improve the area to edge ratio of vegetated areas for which they are adjacent to. The strategic benefit of each Offset area is outlines in Table 27.

Table 27: Strategic benefits of the Offset areas.

Area	Size (ha)	Description
Offset Area 1	40	• Known to contain threatened species such as the Grey-crowned Babbler (eastern subspecies) and adjoins habitat which has recorded the Squirrel Glider, Brush-tailed Phascogale, Varied Sittella, Flame Robin, and Eastern Bentwing-bat (Figures 4a, 4b and 4c). • Contains the same fauna habitat types that are present within the proposed surface disturbance area. • Contains 8 ha of Vegetation Type 8: Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands (HU526) which is 70% cleared in the CMA. • Contains cleared land that was likely to have contained Vegetation Type 8. • Adds to the overall size of fauna habitat in the area by expanding the area of vegetation on the opposite side of Bowens Road next to the crown reserve.

Area	Size (ha)	Description
Offset Area 2	70	• Adjoins a Voluntary Conservation Area that has records for threatened species such as the Brush-tailed Phascogale, Koala, Varied Sittella, Speckled Warbler, Eastern Freetail-bat, Eastern Bentwing-bat and Little Bentwing-bat (Figures 4a, 4b and 4c). • Contains similar habitat types present within the proposed surface disturbance area. • Contains 3.5 ha of Vegetation Type 8: Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands (HU526) which is 70% cleared in the CMA. • Contains cleared land that was likely to have contained Vegetation Type 8. • Adds to the overall amount of fauna habitat in the area by expanding the area of vegetation on the opposite side of Woods Road to the existing Voluntary Conservation Agreement area.
Offset Area 3	655	• Known to contain threatened species such as the Squirrel Glider, the Brush-tailed Phascogale, the New Holland Mouse, the Grey-headed Flying Fox, Eastern Bentwing-bat, Little Bentwing-bat, Eastern Freetail-bat, Southern Myotis, Grey-crowned Babbler (eastern subspecies), Scarlet Robin, Glossy Black-cockatoo, Varied Sittella and the Comb-crested Jacana (Figures 4a, 4b and 4c). • Provides connectivity between remnant native vegetation to the south-west of the study area and the large area of native vegetation in the east and south of the study area. • Contains similar habitat types present within the proposed surface disturbance area plus additional habitat types. • Contains 18.4 ha of Vegetation Type 8: Cabbage Gum open forest or woodland on flats of the North Coast and New England Tablelands (HU526) which is 70% cleared in the CMA. • Contains cleared land that was likely to have contained Vegetation Type 8.
Offset Area 4	170	• Known to contain a number of threatened species such as the New Holland Mouse, Koala, Yellow-bellied Glider, Long-nosed Potoroo, Grey-Crowned Babbler (eastern subspecies),, Varied Sittella, Masked Owl, Glossy Black-cockatoo, Eastern Bentwing-bat and Little Bentwing-bat (Figures 4a, 4b and 4c). • Contains a fauna habitat type that is also present within the proposed surface disturbance area plus one additional habitat type. • Contains potential habitat for Glossy Black-cockatoos.

7.2.9 Ecosystem resilience

FloraSearch (2012) suggested the vegetation on the agricultural parts of the Offset areas are in similar condition to that on the study area, so that when it is removed from agricultural production, the remnant woodland/forest can be expected to begin natural regeneration. There are some scattered trees (e.g. Red Ironbark [*Eucalyptus fibrosa*] and Spotted Gum [*Corymbia maculata*]) between vegetation patches which would provide a seed source for natural revegetation. Although the cleared lands are predominantly introduced grasses there are also some native species present (e.g. Kangaroo Grass [*Themeda triandra*]; *Lomandra* spp. and *Poa* spp.) (FloraSearch, 2012).

The remnant fauna habitat in the proposed Offset areas is in moderately good condition. The cleared lands are currently rated as poor condition, owing to the lack of understorey and ground cover features. In their current, state the cleared lands provide little value to threatened fauna, with the exception of the threatened Grey-crowned Babbler (eastern subspecies) which may use some of the scattered paddock trees.

While few parts of the Offset areas could be classed as old growth there are a small number of large and old trees present. The conservation of the Offset areas in perpetuity will, however, provide for a supply of old growth, hollow-bearing trees in the future, which will provide ongoing habitat for numerous threatened species in the area.

7.2.10 Existing infrastructure - roads, rail, power lines and houses

There are a number of existing infrastructure components that occur near the Offset areas:

- Bowens Road - occurs south of Offset area 1;
- Woods Road – occurs south of Offset area 2;
- The Bucketts Way – occurs through Offset area 3;
- The Glen Road - occurs through Offset area 3;
- North Coast Railway – occurs through Offset area 3;
- Powerline - occurs through Offset area 3; and
- Residences occur within Offset area 3.

The presence of the existing infrastructure within the Offset areas may negatively alter or influence environmental conditions in the areas, through the augmentation of indirect impacts. These may consist of, but are not restricted to:

- increased weed invasion;
- rubbish dumping;
- increased erosion through recreational use (e.g. mountain biking, dirt biking, etc.);
- illegal fire wood collection;
- barrier to movement of some species;
- increased fauna mortality through vehicle collision; and
- increased predation on local fauna from domestic dogs/cats.

These potential impacts would not preclude the area from being a suitable offset for the Project. Fencing would be installed to exclude vehicle and human entrance to areas around the existing roads, railway, powerlines and residences.

The proposed power line would span a section of the proposed Offset areas. Woodland/forest would not be allowed to regenerate within the power line corridor. In accordance with current power line clearance requirements, overstorey and mid-storey vegetation would be cleared, leaving ground cover vegetation only. These areas may still provide habitat for some native fauna species, including threatened species (e.g. the New Holland Mouse has been recorded within the grassland of the existing powerline easement).

7.3 Reconciliation of the proposed offset strategy against OEH offset principles

A reconciliation of the proposed offset proposal against the OEH Offset Principles is shown in Table 28 (OEH, 2011).

Table 28: Reconciliation of the proposed offset strategy against OEH offset principles.

OEH Offset Principles (OEH, 2011)	How the Proposed Offset Addresses the OEH Offset Principles
Impacts must be avoided first by using prevention and mitigation measures	Section 6 describes measures to avoid and mitigate Project impacts on fauna. The proposed offset strategy is proposed to address residual impacts.
All regulatory requirements must be met	SCPL is required to meet all statutory requirements. The proposed offset strategy is not proposed to substitute other licence/approval requirements.
Offsets must never reward ongoing poor performance.	The proposed offset strategy is proposed to address residual impacts associated with the Project only.
Offsets will complement other government programmes.	An arrangement would be made for long-term protection and management of the Offset areas within 12 months of Project approval (e.g. a voluntary conservation agreement pursuant to Section 69B of the NPW Act, as described in contemporary Project approval conditions pertaining to offsets). The proposed Offset areas (part of Offset area 2 and 3) expand on two existing areas conserved under voluntary conservation agreements (Figure 20). Also of note is that: • the habitat within Offset area 3 is linked through private properties to The Glen Nature Reserve; and • the proposed Offset areas are located within an OEH recognised climate change corridor (DECC, 2007).
Offsets must be underpinned by sound ecological principles.	The biodiversity offset is underpinned by sound ecological principles such as: • consideration of structure, function and compositional elements of biodiversity; • enhancement of biodiversity at a range of scales through a number of proposed management measures; • measures to protect the long-term viability and functionality of biodiversity (e.g. enhancing the existing habitat as well as securing and managing the land for conservation purposes); and • in the long-term the Offset areas will provide connectivity between valley floor habitats and the wooded range to the east- this link is poor at present.
Offsets should aim to result in a net improvement in biodiversity over time.	A net improvement in fauna abundance and diversity is possible because: • 435 ha of cleared land would be revegetated and 10 ha of existing planted trees would be retained, linking many disjunct smaller patches of vegetation and thus allowing fauna to move among remnants; • each vegetation type to be impacted is represented in the Offset areas; • additional fauna habitat types would be conserved to those that would be impacted, providing habitat for additional species; • the Offset areas (totalling 935 ha) would be conserved in perpetuity; and • measures to monitor and independently audit the biodiversity offset are provided.
Offsets must be enduring. They must offset the impact of the development for the period that the impact occurs.	The land tenure underlying the proposed Offset areas would be secured in perpetuity for flora and fauna conservation.
Offsets should be agreed prior to the impact occurring.	The offset strategy is proposed as part of the Project. The implementation of the biodiversity offset is likely to be a condition of Project Approval.
Offsets must be quantifiable. The impacts and benefits must be reliably estimated.	The fauna in both the proposed disturbance area and the Offset areas has been extensively surveyed by AMBS and EcoBiological. This report provides an assessment of both including: • area of the offset and area of impact; • fauna species present and their conservation status; • connectivity and condition of habitat; and • management actions and security for the offset site.

OEH Offset Principles (OEH, 2011)	How the Proposed Offset Addresses the OEH Offset Principles
Offsets must be targeted.	The biodiversity offsets contains habitat with a high conservation status, as demonstrated by the presence of numerous threatened fauna species in the Offset areas (see Table 25).They have been chosen to offset impacts on the basis of a like-for-like or better conservation outcome.
Offsets must be located appropriately.	The proposed Offset areas are located within the same CMA region as the Project area (i.e. the Hunter-Central Rivers CMA Region) and therefore has the capacity to benefit faunal biodiversity in the same region as the Project. The proposed Offset areas are suitably located because it is local to the area proposed to be disturbed and has a greater chance of maintaining and improving the biodiversity that would be impacted.
Offsets must be supplementary.	The implementation of the offset strategy is beyond existing requirements, in that the biodiversity is not subject to an existing conservation agreement.
Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.	Measures to monitor and independently audit the biodiversity offset are provided. The implementation of the biodiversity offset is likely to be a condition of Project Approval.

The EPBC Act and supporting guidelines (refer to Consultation Draft: EPBC Act Environmental Offsets Policy, 2011 [SEWPaC, 2011c]) contain a number of requirements for environmental offsets. Table 29 highlights the elements of the Project offset that address the EPBC Act offset principles.

Table 29: Environmental offset requirements.

Offset Requirements	Elements of the Project Offset that address these Requirements
Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environmental law and affected by the Project.	A conservation outcome that improves of maintains the viability environmental matters that are protect by national environmental law and affected by the Project because: • any nationally threatened fauna species which could be impacted by the Project has been recorded within part of the Offset area; • 435 ha of cleared land would be revegetated and 10 ha of existing planted trees would be retained, linking many disjunct smaller patches of vegetation and thus allowing fauna to move among remnants; • each vegetation type to be impacted is represented in the Offset areas; • additional fauna habitat types would be conserved to those that would be impacted, providing habitat for additional species; • the Offset areas (totalling 935 ha) would be conserved in perpetuity; and • measures to monitor and independently audit the biodiversity offset are provided.
Be efficient, effective, transparent, proportionate, scientifically robust and reasonable.	The fauna in both the proposed disturbance area and the Offset areas has been extensively surveyed by AMBS and EcoBiological. This report provides an assessment of both including: • area of the offset and area of impact; • fauna species present and their conservation status; • connectivity and condition of habitat; and • management actions and security for the offset site.

Offset Requirements	Elements of the Project Offset that address these Requirements
	Further, the biodiversity offset is underpinned by sound ecological principles such as: • consideration of structure, function and compositional elements of biodiversity through flora and fauna surveys; • enhancement of biodiversity at a range of scales through a number of proposed management measures; • measures to protect the long-term viability and functionality of biodiversity (e.g. enhancing the existing habitat as well as securing and managing the land for conservation purposes); and • in the long-term the Offset areas will provide connectivity between valley floor habitats and the wooded range to the east – this link is poor at present.
Be built around direct offsets but may include indirect offsets.	The biodiversity offsets contains habitat with a high conservation status, as demonstrated by the presence of numerous threatened fauna species in the Offset areas (see Table 25).They have been chosen to directly offset impacts on the basis of a like-for-like or better conservation outcome.
Be of a size and scale proportionate to the impacts being offset.	The Project would disturb approximately 105 ha of native vegetation and 195 ha of cleared land. The Offset areas would conserve and improve in perpetuity approximately 490 ha of native vegetation (composed of equivalent and/or additional fauna habitat types) and approximately 435 ha of cleared, some of which would be revegetated and 10 ha of existing planted trees would be retained.
Be in proportion to the level of statutory protection that applies to the affected species or community.	Nationally threatened species which are considered to have potential to be impacted by the Project, are all likely to benefit in the medium to long-term from the Offset proposal. All species that have been recorded in the study area that are listed as vulnerable under the EPBC Act would have known or potential habitat greater than the area which would be impacted, conserved and improved in the Offset area (Table 25). The Swift Parrot and the Regent Honeyeater (listed as endangered and critically endangered, respectively) are considered very unlikely to occur in the study area, and are likely to be only occasional vagrants. Nonetheless, potential foraging habitat for these species greater than the area which would be impacted would be conserved and improved in the Offset area (Table 25). Further, in relation to all species, the revegetation program is likely to create additional areas of potential habitat.
Effectively manage the risks of the offset not succeeding.	Measures to monitor and independently audit the biodiversity offset are provided, which would provide for ongoing adaptive management in the event unlikely event that the offset is not succeeding. The implementation of the biodiversity offset is likely to be a condition of Project Approval.
Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	An arrangement would be made for long-term protection and management of the Offset areas within 12 months of Project approval (e.g. a voluntary conservation agreement pursuant to Section 69B of the NPW Act, as described in contemporary Project approval conditions pertaining to offsets). Measures to monitor and independently audit the biodiversity offset are provided. The implementation of the biodiversity offset is likely to be a condition of Project Approval.

7.4 Ecological gains of the proposed offset

It is considered that the Project meets the standard in the requirements of the Director-General of the NSW Department of Planning and Infrastructure that fauna biodiversity in the region would be maintained and improved in the long-term. The Offset areas contain numerous threatened species and a very similar array of natural habitat types to those on the study area, which are also in similar condition. The Offset areas have a number of features that ensure they meet the 'maintain or improve' test. These include:

- The addition of the Offset areas as new protected areas enhances nature conservation over the region.
- Offset area 3 is bordered to the east and south-east by a very large block of largely undisturbed natural vegetation. Consequently, the offset is not isolated in the landscape and its high connectivity helps to ensure its long-term viability.
- The revegetation of offsets is designed to provide connectivity between isolated woodland remnants via corridors. This will facilitate movement of animals between remnants and the large block of forest to the east and south of the study area, thereby re-establishing genetic exchange across the landscape.
- Numerous threatened species are known to inhabit the Offset areas or conservation areas that directly adjoin the offsets. These include the: Koala, Squirrel Glider, Brush-tailed Phascogale, New Holland Mouse, Yellow-bellied Glider, Long-nosed Potoroo, Grey-crowned Babbler (eastern subspecies), Varied Sittella, Comb-crested Jacana, Masked Owl, Eastern Bentwing-bat, Little Bentwing-bat, Eastern Freetail-bat and the Southern Myotis. Therefore, habitat for these species will be protected in the region in perpetuity.
- Each habitat type proposed to be cleared by the Project is represented in the Offset areas.
- The vegetation on the agricultural parts of the Offset areas is in similar condition to that on the study area. Therefore, when this land is removed from agricultural production, the remnant woodlands can be expected to begin natural regeneration and thus provide habitat for fauna.
- Cleared paddock areas would be planted strategically with appropriate tree and shrub species that will provide habitat for fauna to recolonise.
- The offset supports samples of all native vegetation types within the Project disturbance areas and has a greater diversity of vegetation types than occur on the Project area. Therefore, additional habitat will be available for animal species that occur and could potentially occur in the area.

8 Conclusion

The Project is the extension of an existing mine. It would involve the extension of an existing open pit, the construction of two additional open pits, construction of new waste and stockpile areas, construction of surface water diversions, re-alignment of a two roads and a power line, and construction of ancillary infrastructure. The aims of this study were to identify terrestrial fauna that are known or likely to occur in the Project area, on the basis of desktop reviews and field surveys performed over a number of years by several identities, and to assess the impacts of the Project on those fauna. Potential impacts from the Project would include loss and fragmentation of threatened fauna habitat, including foraging, roosting and breeding habitat, removal of dead wood and trees, and loss of individuals. A number of proposed impact avoidance and mitigation measures were assessed and details are provided regarding the value and management of proposed Offset areas, which would be managed for conservation purposes and conserved in perpetuity.

Desktop reviews and fauna surveys revealed that 289 vertebrate fauna species have been recorded in the Project area and its surrounds. Database searches indicate that there are 65 animal species that are listed as threatened on the TSC Act and/or the EPBC Act that have been reported or predicted to occur within a 20 km radius of the Project. A total of 28 species of fauna listed under the TSC Act and/or EPBC Act have been recorded within Project area or surrounds, plus three possible additional microbats. Thirteen exotic species have also been recorded in the area. All of these exotic species were considered to be uncommon, with the exception of the Rabbit.

An assessment of fauna habitat within the Project area and surrounds identified ten broad habitats including: rainforest, riparian forest, dry sclerophyll forest, wet sclerophyll forest, grassy woodland, artificial wetlands, acacia regeneration, derived grasslands/shrub regrowth, plantings and cleared land. The habitat condition throughout the study area was highly variable, ranging from poor to good. The density of hollow bearing trees within the study area was mostly less than 10 per ha, however, some areas had densities of 15-30 per ha. Only two small caves were detected, both outside the Project area, and unlikely to provide important roosting sites for microbats.

Potential Koala habitat was identified, but surveys using SAT did not detect Koalas within the Project area or immediate surrounds. Koalas have, however, been recorded in proposed Offset areas, in The Glen Nature Reserve, and in the Voluntary Conservation Area to the south-west of the Project area.

It was considered that 33 species of threatened fauna listed under the TSC Act and/or EPBC Act are likely to be impacted to some extent by the Project. These potential impacts range in type and severity, from loss of minor areas of potential foraging habitat for some species to the direct loss of known habitat for others. Assessments of significance were performed for all species considered likely to be affected by the Project. The conclusion of these assessments was the, while the Project is likely to affect a range of threatened species, the impacts are not likely to be significant for most of those species. The species considered to have the greatest level of impact as a result of the project was the Squirrel Glider. Impacts on this species were considered to have the potential to be significant in the short-term, due to habitat loss and isolation; however, in the long-term, the establishment of the Offset areas has the potential to considerably improve the status of this species in the locality.

Potential impacts associated with the Project have been or would be minimised through a variety of impact avoidance and mitigation measures. These measures include refinement of the mine design to reduce the overall footprint of the Project, timing and staging of land clearing, salvage and relocation of habitat features and installation of next boxes where appropriate. Species-specific mitigation measures have been proposed for Squirrel Gliders (e.g. installation of nest boxes and glider poles, radio-tracking, and revegetation), Glossy Black-cockatoos (e.g. planting Allocasuarina feed trees) and the New Holland Mouse (e.g. ecological burns, revegetation and pre-clearance trapping programme).

An arrangement would be made within 12 months of the Project being approved so that the Offset areas are conserved and managed in perpetuity. These proposed Offset areas occur in close proximity to the Project area and protection would be achieved through, for example, a voluntary conservation agreement pursuant to Section 69B of the NPW Act, as described in contemporary Project approval conditions pertaining to offsets. The proposed Offset areas contain all broad habitat types that would be lost as a result of the Project. The area of habitat in the offsets is greater than that which would be cleared, and a number of management measures would also be implemented to enhance flora and fauna values of the Offset areas. These measures would include revegetation of cleared land to increase the amount and connectivity of fauna habitat in the area; exclusion of grazing by livestock; weed control to encourage natural regeneration of native vegetation; management of exotic animals to benefit native wildlife; bushfire management; and controlling vehicular access.

It is considered that the Project meets the standard in the requirements of the Director-General of the NSW Department of Planning and Infrastructure for the Project because fauna biodiversity in the region would be maintained and improved in the medium to long-term. The Offset areas contain numerous threatened species and have a number of features so they meet the ‘maintain or improve’ test. For example, the offsets would represent new protected areas in the region and they would conserve in perpetuity habitat for threatened species. The offsets would also have high connectivity with existing fauna habitat, which would help to maintain their long-term viability. The offsets would facilitate movement of some animals between remnant habitat, some of which are fragmented or isolated in their current state, thereby maintaining or re-establishing the potential for genetic exchange across the landscape.

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Appendix A: Fauna species list

Scientific Name	Common Name	Conservation Status[1]		Reference													
		TSC Act	EPBC Act	AMBS (2011)[2]	AMBS (2012)[3]	Kerle (2011)[4]	EcoBiological (2011a)[5]	EcoBiological (2011b)[6]	EcoBiological (2011c)[7]	SCPL(1994)[8]	Murray (1994)[9]	Hoye and Finney (1994)[10]	AGC Woodward-Clyde (1994)[11]	Mount King Ecological Surveys (2001)[12]	Richards (2001)[13]	Hoye (1998)[14]
Amphibians																	
MYOBATRACHIDAE																	
Crinia signifera	Common Eastern Froglet	–	–	●	●	–	●	–	–	–	●	–	–	●	–	–	
Limnodynastes dumerilli	Eastern Banjo Frog	–	–	–	–	–	–	–	–	–	–	–	–	●	–	–	
Limnodynastes peronii	Brown-striped Frog	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–	
Limnodynastes tasmaniensis	Spotted Grass Frog	–	–	–	●	–	●	–	–	–	–	–	–	●	–	–	
Mixophyes fasciolatus	Great Barred Frog	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–	
Pseudophryne bibronii	Brown Toadlet	–	–	–	–	–	–	–	–	–	–	–	–	●	–	–	
Pseudophryne coriacea	Red-backed Toadlet	–	–	–	●	–	●	–	–	●	–	–	–	–	–	–	
Uperoleia fusca	Dusky Toadlet	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–	
Uperoleia laevigata	Smooth Toadlet	–	–	–	●	–	●	–	–	–	–	–	–	●	–	–	
Uperoleia tyleri	Tyler's Toadlet	–	–	–	–	–	–	–	–	–	–	–	–	●	–	–	
Uperoleia sp.[#]	–	–	–	–	–	–	–	–	–	–	●	–	–	–	–	–	
HYLIDAE							–										
Litoria barringtonensis	Mountain Stream Frog	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–	
Litoria caerulea	Green Tree Frog	–	–	–	–	–	–	–	–	–	–	–	–	●	–	–	
Litoria dentate	Bleating Tree Frog	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–	
Litoria fallax	Eastern Dwarf Tree Frog	–	–	–	●	–	●	–	–	●	–	–	–	●	–	–	
Litoria freycineti	Freycinet's Frog	–	–	–	–	–	–	–	–	–	–	–	–	●	–	–	
Litoria latopalmata	Broad-palmed Frog	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–	
Litoria peronii	Peron's Tree Frog	–	–	–	●	–	●	–	–	●	–	–	–	●	–	–	
Litoria tyleri	Tyler's Tree Frog	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–	

Scientific Name	Common Name	Conservation Status[1]		Reference												
		TSC Act	EPBC Act	AMBS (2011)[2]	AMBS (2012)[3]	Kerle (2011)[4]	EcoBiological (2011a)[5]	EcoBiological (2011b)[6]	EcoBiological (2011c)[7]	SCPL(1994) [8]	Murray (1994)[9]	Hoye and Finney (1994)[10]	AGC Woodward-Clyde (1994)[11]	Mount King Ecological Surveys (2001)[12]	Richards (2001)[13]	Hoye (1998)[14]
Litoria verreauxii	Verreaux's Tree Frog	–	–	●	●	–	–	–	–	–	●	–	–	–	–	–
Litoria wilcoxii	Rocky River Frog	–	–	–	●	–	●	–	–	●	–	–	–	●	–	–
Reptiles																
CHELIDAE																
Chelodina longicollis	Snake-necked Turtle	–	–	–	●	–	●	–	–	●	–	–	–	●	–	–
SCINCIDAE																
Calyptotis ruficauda	Red-tailed Calyptotis	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Cryptoblepharus virgatus	Cream-striped Shinning-skink	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
Ctenotus robustus	Robust Ctenotus	–	–	–	–	–	●	–	–	●	–	–	–	–	–	–
Ctenotus taeniolatus	Copper-tailed Skink	–	–	–	–	–	–	–	–	●	–	–	–	–	–	–
Cyclodomorphus casuarinae	Tasmanian She-oak Skink	–	–	–	–	–	–	–	–	●	–	–	–	–	–	–
Egernia major	Land Mullet	–	–	●	–	–	–	–	–	–	–	–	–	–	–	–
Egernia striolata	Tree skink	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Egernia whitii	White's Skink	–	–	–	–	–	–	–	–	●	–	–	–	–	–	–
Eulamprus heatwolei	Yellow-bellied Water-skink	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
Eulamprus tenuis	Barred-sided Skink	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Eulamprus quoyii	Eastern Water Skink	–	–	–	●	–	–	–	–	●	–	–	–	–	–	–
Lampropholis Caligula	Montane Sunskink	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
Lampropholis delicate	Dark-flecked Garden Sunskink	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–
Lampropholis guichenoti	Pale-flecked Garden Sunskink	–	–	–	–	–	●	–	–	–	–	–	–	●	–	–
Oedura robusta	Robust Velvet Gecko	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Pygopus lepidopodus	Common Scaly-foot	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Saltuarius moritzi	Leaf-tailed Gecko	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Tiliqua scincoides	Eastern Blue-tongue	–	–	–	–	–	–	–	–	●	–	–	–	–	–	–
AGAMIDAE																
Amphibolurus muricatus	Jacky Lizard	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–

Scientific Name	Common Name	Conservation Status[1]		Reference												
		TSC Act	EPBC Act	AMBS (2011)[2]	AMBS (2012)[3]	Kerle (2011)[4]	EcoBiological (2011a)[5]	EcoBiological (2011b)[6]	EcoBiological (2011c)[7]	SCPL(1994) [8]	Murray (1994)[9]	Hoye and Finney (1994)[10]	AGC Woodward-Clyde (1994)[11]	Mount King Ecological Surveys (2001)[12]	Richards (2001)[13]	Hoye (1998)[14]
Physignathus lesueurii	Eastern Water Dragon	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–
Pogona barbata	Bearded Dragon	–	–	–	●	–	●	–	–	●	–	–	–	●	–	–
VARANIDAE																
Varanus varius	Lace Monitor	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–
BOIDAE																
Morelia spilota spilota	Diamond Python	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
COLUBRIDAE																
Dendrelaphis punctulata	Common Tree Snake	–	–	–	–	–	–	–	–	●	–	–	–	–	–	–
ELAPIDAE																
Cacophis krefftii	Dwarf-crowned Snake	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Furina diadema	Red-naped Snake	–	–	–	–	–	–	–	–	●	–	–	–	–	–	–
Hemiaspis signata	Black-bellied Swamp Snake	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Pseudechis porphyriacus	Red-bellied Black Snake	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–
Pseudonaja textilis	Eastern Brown Snake	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Rhinoplocephalus nigrescens	Small-eyed Snake	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
Birds																
ANSERANATIDAE																
Anseranas semipalmata	Magpie Goose	V	–	–	–	–	●	–	–	–	–	–	–	–	–	–
ANATIDAE																
Cygnus atratus	Black Swan	–	–	●	–	–	–	–	–	–	–	–	–	–	–	–
Chenonetta jubata	Australian Wood Duck	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Anas rhynchotis	Australasian Shoveler	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
Anas superciliosa	Pacific Black Duck	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–
Anas gracilis	Grey Teal	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–
Anas castanea	Chestnut Teal	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
Aythya australis	Hardhead	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–

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Biziura lobata	Musk Duck	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
PODICIPEDIDAE																
Tachybaptus novaehollandiae	Australasian Grebe	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–
Podiceps cristatus	Great Crested Grebe	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
THRESKIORNITHIDAE																
Threskiornis spinicollis	Straw-necked Ibis	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
ARDEIDAE																
Nycticorax caledonicus	Nankeen Night Heron	–	–	–	–	–	–	–	–	–	–	–	–	●	–	–
Ardea ibis	Cattle Egret	–	M	–	●	–	●	–	–	–	–	–	–	●	–	–
Ardea intermedia	Intermediate Egret	–	–	–	●	–	●	–	–	–	–	–	–	●	–	–
Ardea pacifica	White-necked Heron	–	–	–	●	–	●	–	–	–	–	–	–	●	–	–
Ardea alba	Great Egret	–	M	–	●	–	●	–	–	–	–	–	–	–	–	–
Egretta novaehollandiae	White-faced Heron	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
PELECANIDAE																
Pelecanus conspicillatus	Australian Pelican	–		●	–	–	–	–	–	–	–	–	–	–	–	–
PHASIANIDAE																
Coturnix chinensis	King Quail				●											
Coturnix ypsilophora	Brown Quail				●											
PHALACROCORACIDAE																
Phalacrocorax melanoleucos	Little Pied Cormorant	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
Phalacrocorax sulcirostris	Little Black Cormorant	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
Phalacrocorax varius	Pied Cormorant	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
Phalacrocorax carbo	Great Cormorant	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
ANHINGIDAE																
Anhinga melanogaster	Darter	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
FALCONIDAE																

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Falco cenchroides	Australian Kestrel	–	–	●	–	–	●	–	–	–	–	–	●	●	–	–
Falco longipennis	Australian Hobby	–	–	●	●	–	–	–	–	–	–	–	–	–	–	–
Falco berigora	Brown Falcon	–	–	●		–	–	–	–	–	–	–	–	●	–	–
ACCIPITRIDAE																
Aviceda subcristata	Pacific Baza	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–
Elanus axillaris	Black-shouldered Kite	–	–	–	●	–	●	–	–	–	–	–	–	●	–	–
Haliaeetus leucogaster	White-bellied Sea-Eagle	–	M	●	–	–	●	–	–	–	–	–	–	–	–	–
Accipiter cirrocephalus	Collared Sparrowhawk	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Accipiter fasciatus	Brown Goshawk	–	–	–	●	–	–	–	–	–	–	–	●	–	–	–
Aquila audax	Wedge-tailed Eagle	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–
Hieraaetus morphnoides	Little Eagle	V	–	●	–	–	–	–	–	–	–	–	–	–	–	–
RALLIDAE																
Gallirallus philippensis	Buff-banded Rail	–	–	●	●	–	–	–	–	–	–	–	–	–	–	–
Porphyrio porphyrio	Purple Swamphen	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Gallinula tenebrosa	Dusky Moorhen	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–
Fulica atra	Eurasian Coot	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–
JACANIDAE																
Irediparra gallinacean	Comb-crested Jacana	V	–	–	●	–	–	–	–	–	–	–	–	–	–	–
TURNICIDAE																
Turnix varius	Painted Button-quail	–	–	●	●	–	–	–	–	–	–	–	●	–	–	–
RECURVIROSTRIDAE																
Himantopus himantopus	Black-winged Stilt	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
CHARADIIDAE																
Vanellus miles	Masked Lapwing	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Charadrius bicinctus	Double-banded Plover	–	M	–	–	–	●	–	–	–	–	–	–	–	–	–
Elseyornis melanops	Black-fronted Dotterel	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–

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SCOLOPACIDAE																	
Gallinago hardwickii	Latham's Snipe	–	M	–	–	–	●	–	–	–	–	–	–	–	–	–	–
COLUMBIDAE																	
*Columba livia**	Rock Dove*	–	–	–	–	–	–	–	–	–	–	–	–	●	–	–	–
Columba leucomela	White-headed Pigeon	–	–	●	–	–	●	–	–	–	–	–	–	–	–	–	–
*Streptopelia chinensis**	Spotted Turtle-Dove*	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–	–
Macropygia amboinensis	Brown Cuckoo-Dove	–	–	●	●	–	–	–	–	–	–	–	●	–	–	–	–
Phaps chalcoptera	Common Bronzewing	–	–	●	●	–	–	–	–	–	–	–	–	–	–	–	–
Phaps elegans	Brush Bronzewing	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–	–
Ocyphaps lophotes	Crested Pigeon	–	–	●	–	–	●	–	–	–	–	–	●	●	–	–	–
Leucosarcia melanoleuca	Wonga Pigeon	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–	–
Geopelia placida	Peaceful Dove	–	–	–	–	–	–	–	–	–	–	–	●	–	–	–	–
Geopelia humeralis	Bar-shouldered Dove	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–	–
PSITTACIDAE																	
Cacatua galerita	Sulphur-crested Cockatoo	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–	–
Calyptorhynchus lathami	Glossy Black-cockatoo	V	–	●	●	–	●	–	–	–	–	–	●	–	–	–	–
Calyptorhynchus funereus	Yellow-tailed Black-cockatoo	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–	–
Cacatua roseicapilla	Galah	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–	–
Trichoglossus haematodus	Rainbow Lorikeet	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–	–
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–	–
Glossopsitta concinna	Musk Lorikeet	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–	–
Glossopsitta pusilla	Little Lorikeet	V	–	–	●	–	–	–	–	–	–	–	●	–	–	–	–
Platycercus elegans	Crimson Rosella	–	–	●	●	–	●	–	–	–	–	–	–	●	–	–	–
Platycercus eximius	Eastern Rosella	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–	–
Alisterus scapularis	Australian King-Parrot	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–	–
CUCULIDAE																	

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Cuculus pallidus	Pallid Cuckoo	–	–	–	–	–	–	–	–	–	–	–	●	–	–	–
Cacomantis flabelliformis	Fan-tailed Cuckoo	–	–	●	–	–	–	–	–	–	–	–	–	–	–	–
Chalcites basalis	Horsfield's Bronze-Cuckoo	–	–	●	●	–	–	–	–	–	–	–	–	–	–	–
Chalcites lucidus	Shining Bronze-Cuckoo	–	–	–	●	–	–	–	–	–	–	–	–	–	–	
Chrysococcyx lucidus	Shining Bronze-Cuckoo	–	–	–	–	–	–	–	–	–	–	–	●	–	–	–
Scythrops novaehollandiae	Channel-billed Cuckoo	–	–	●	●	–	–	–	–	–	–	–	●	–	–	–
CENTROPODIDAE																
Centropus phasianinus	Pheasant Coucal	–	–	●	●	–	●	–	–	–	–	–	–	●	–	–
TYTONIDAE																
Tyto novaehollandiae	Masked Owl	V	–	–	●	–	●	–	–	–	–	–	–	–	–	–
Tyto tenebricosa	Sooty Owl	V	–	–	●	–	–	–	–	–	–	–	–	–	–	–
STRIGIDAE																
Niinox novaeseelandiae	Southern Boobook	–	–	●	●	–	–	–	–	–	–	–	–	–	–	–
PODARGIDAE																
Podargus strigoides	Tawny Frogmouth	–	–	–	●	–	–	–	–	–	–	–	●	●	–	–
CAPRIMULGIDAE																
Eurostopodus mystacalis	White-throated Nightjar	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–
AEGOTHELIDAE																
Aegotheles cristatus	Australian Owlet-nightjar	–	–	●	●	–	–	–	–	–	–	–	–	–	–	–
APODIDAE																
Apus pacificus	Fork-tailed Swift	–	M	–	–	–	●	–	–	–	–	–	–	–	–	–
CORACIIDAE																
Eurystomus orientalis	Dollarbird	–	–	–	●	–	●	–	–	–	–	–	–	●	–	–
ALCEDINIDAE																
Dacelo novaeguineae	Laughing Kookaburra	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Todiramphus sanctus	Sacred Kingfisher	–	–	–	●	–	●	–	–	–	–	–	●	–	–	–

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Alcedo azurea	Azure Kingfisher	–	–	–	–	–	–	–	–	–	–	–	–	●	–	–
MEROPIDAE																
Merops ornatus	Rainbow Bee-eater	–	M	–	●	–	●	–	–	–	–	–	●	–	–	–
PITTIDAE																
Pitta versicolour	Noisy Pitta	–		●	●	–	–	–	–	–	–	–	–	–	–	–
CLIMACTERIDAE																
Cormobates leucophaeus	White-throated Treecreeper	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	–	–	–	–	–	–	–	–	–	–	●	–	–	–
MALURIDAE																
Malurus lamberti	Variegated Fairy-wren	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Malurus cyaneus	Superb Fairy-wren	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Malurus melanocephalus	Red-backed Fairy-wren	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–
Stipiturus malachurus	Southern Emu-wren	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–
PARDALOTIDAE																
Pardalotus punctatus	Spotted Pardalote	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Pardalotus striatus	Striated Pardalote	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
ACANTHIZIDAE																
Pyrrholaemus saggitatus	Speckled Warbler	V	–	–	●	–	–	–	–	–	–	–	●	–	–	–
Sericornis citreogularis	Yellow-throated Scrubwren	–	–	●	●	–	–	–	–	–	–	–	●	–	–	–
Sericornis frontalis	White-browed Scrubwren	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Sericornis magnirostra	Large-billed Scrubwren	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Smircrornis brevirostris	Weebill	–	–	–	●	–	–	–	–	–	–	–	–	●	–	–
Gerygone albogularis	White-throated Gerygone	–	–	●	–	–	–	–	–	–	–	–	–	–		–
Gerygone mouki	Brown Gerygone	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Gerygone olivacea	White-throated Gerygone	–	–	–	●	–	●	–	–	–	–	–	●	–	–	–

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Acanthiza pusilla	Brown Thornbill	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Acanthiza reguloides	Buff-rumped Thornbill	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Acanthiza nana	Yellow Thornbill	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Acanthiza lineate	Striated Thornbill	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
MELIPHAGIDAE																
Lichenostomus chrysops	Yellow-faced Honeyeater	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Lichenostomus leucotis	White-eared Honeyeater	–	–	●	●	–	–	–	–	–	–	–	–	●	–	–
Lichenostomus melanops	Yellow-tufted Honeyeater	–	–	–	–	–	–	–	–	–	–	–	–	●	–	–
Lichenostomus fuscus	Fuscous Honeyeater	–	–	–	●	–	●	–	–	–	–	–	●	–	–	–
Lichenostomus penicillatus	White-plumed Honeyeater	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Meliphaga lewinii	Lewin's Honeyeater	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Manorina melanophrys	Bell Miner	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–
Manorina melanocephala	Noisy Miner	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Entomyzon cyanotis	Blue-faced Honeyeater	–	–	●	●	–	–	–	–	–	–	–	–	–	–	–
Melithreptus brevirostris	Brown-headed Honeyeater	–	–	–	●	–	●	–	–	–	–	–	●	–	–	–
Melithreptus lunatus	White-naped Honeyeater	–	–	–	●	–	●	–	–	–	–	–	●	–	–	–
Philemon citreogularis	Little Friarbird	–	–	–	–	–	–	–	–	–	–	–	●	–	–	–
Philemon corniculatus	Noisy Friarbird	–	–	–	●	–	●	–	–	–	–	–	●	●	–	–
Anthochaera chrysoptera	Little Wattlebird	–	–	–		–	–	–	–	–	–	–	–	●	–	–
Anthochaera carnunculata	Red Wattlebird	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Acanthorhynchus tenuirostris	Eastern Spinebill	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Myzomela sanguinolenta	Scarlet Honeyeater	–	–	–	●	–	●	–	–	–	–	–	●	●	–	–
PETROICIDAE																
Eopsaltria australis	Eastern Yellow Robin	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Melanodryas cucullata cucullata	Hooded Robin (south-eastern	V	–	–		–	–	–	–	–	–	–	●	–	–	–

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	form)																
Microeca fascinans	Jacky Winter	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–	
Petroica boodang	Scarlet Robin	V	–	–	●	–	–	–	–	–	–	–	–	–	–	–	
Petroica phoenicea	Flame Robin	V	–	–	●	–	–	–	–	–	–	–	–	–	–		
Petroica rosea	Rose Robin	–	–	●	●	–	–	–	–	–	–	–	–	–	–	–	
ORTHONYCHIDAE																	
Orthonyx temminckii	Australian Logrunner	–	–	●	●	–	–	–	–	–	–	–	–	–	–	–	
POMATOSTOMIDAE																	
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	–	●	●	–	●	–	–	–	–	–	●	–	–	–	
EUPETIDAE																	
Psophodes olivaceus	Eastern Whipbird	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–	
NEOSITTIDAE																	
Daphoenositta chrysoptera	Varied Sittella	V	–	●	●	–	●	–	–	–	–	–	●	–	–	–	
PACHYCEPHALIDAE																	
Falcunculus frontatus	Crested Shrike-tit	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–	
Pachycephala pectoralis	Golden Whistler	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–	
Pachycephala rufiventris	Rufous Whistler	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–	
Colluricincla harmonica	Grey Shrike-thrush	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–	
Falcunculus frontatus	Eastern Shrike-tit	–	–			–	–	–	–	–	–	–	●	–	–	–	
DICRURIDAE																	
Rhipidura rufifrons	Rufous Fantail	–	M	●		–	–	–	–	–	–	–	●	–	–	–	
Rhipidura albiscapa	Grey Fantail	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–	
Rhipidura leucophrys	Willie Wagtail	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–	
Dicrurus bracteatus	Spangled Drongo	–		●		–	–	–	–	–	–	–	–	–	–	–	
Monarcha melanopsis	Black-faced Monarch	–	M	–	●	–	●	–	–	–	–	–	●	●	–	–	

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Symposiachrus trivirgatus	Spectacled Monarch	–	M	–	●	–	–	–	–	–	–	–	–	–	–	–
Grallina cyanoleuca	Magpie-lark	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Myiagra cyanoleuca	Satin Flycatcher	–	M	–	●	–	–	–	–	–	–	–	–	–	–	
Myiagra rubecula	Leaden Flycatcher	–	–	–	●	–	●	–	–	–	–	–	●	●	–	–
ARTAMIDAE																
Cracticus torquatus	Grey Butcherbird	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Cracticus nigrogularis	Pied Butcherbird	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Gymnorhina tibicen	Australian Magpie	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Strepera graculina	Pied Currawong	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
Artamus cyanopterus	Dusky Woodswallow	–	–		●	–	–	–	–	–	–	–	●	–	–	–
CAMPEPHAGIDAE																
Coracina tenuirostris	Cicadabird	–	–		●	–	●	–	–	–	–	–	–	–	–	–
Coracina novaehollandiae	Black-faced Cuckoo-shrike	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Coracina papuensis	White-bellied Cuckoo-shrike	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Lalage sueurii	White-winged Triller	–	–		●	–	–	–	–	–	–	–	●	–	–	–
ORIOLIDAE																
Oriolus saggitatus	Olive-backed Oriole	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
CORVIDAE																
Corvus mellori	Little Raven	–	–			–	–	–	–	–	–	–	–	●	–	–
Corvus coronoides	Australian Raven	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
CORCORACIDAE																
Corcorax melanorhamphos	White-winged Chough	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
PTILONORHYNCHIDAE																
Ailuroedus crassirostris	Green Catbird	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Ptilonorhynchus violaceus	Satin Bowerbird	–	–	●	●	–	–	–	–	–	–	–	–	–	–	–
STURNIDAE																

Scientific Name	Common Name	Conservation Status[1]		Reference												
		TSC Act	EPBC Act	AMBS (2011)[2]	AMBS (2012)[3]	Kerle (2011)[4]	EcoBiological (2011a)[5]	EcoBiological (2011b)[6]	EcoBiological (2011c)[7]	SCPL(1994) [8]	Murray (1994)[9]	Hoye and Finney (1994)[10]	AGC Woodward-Clyde (1994)[11]	Mount King Ecological Surveys (2001)[12]	Richards (2001)[13]	Hoye (1998)[14]
*Sturnus vulgaris**	Common Starling*	–	–			–	●	–	–	–	–	–	●	●	–	–
*Acridotheres tristis**	Common Myna*	–	–	●		–	●	–	–	–	–	–	–	–	–	–
HIRUNDINIDAE																
Hirundo neoxena	Welcome Swallow	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Petrochelidon ariel	Fairy Martin	–	–			–	●	–	–	–	–	–	–	●	–	–
Hirundo nigricans	Tree Martin	–	–		●	–	●	–	–	–	–	–	●	–	–	–
ZOSTEROPIDAE																
Zosterops lateralis	Silvereye	–	–	●	●	–	●	–	–	–	–	–	●	–	–	–
SYLVIIDAE																
Acrocephalus australis	Australian Reed-Warbler	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
Megalurus timoriensis	Tawny Grassbird	–	–	●	●	–	–	–	–	–	–	–	–	–	–	–
Megalurus gramineus	Little Grassbird	–	–	–	–	–	●	–	–	–	–	–	–	●	–	–
Cincloramphus mathewesi	Rufous Songlark	–	–	–	–	–	–	–	–	–	–	–	●	–	–	–
Cisticola exilis	Golden-headed Cisticola	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
DICAEIDAE																
Dicaeum hirundinaceum	Mistletoebird	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
MENURIDAE																
Menura novaehollandiae	Superb Lyrebird	–	–	●	–	–	–	–	–	–	–	–	●	–	–	–
MOTACILLIDAE																
Anthus australis	Australian Pipit	–	–	●	–	–	–	–	–	–	–	–	●	–	–	–
MEGAPODIIDAE																
Alectura lathami	Australian Brush-turkey	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
ESTRILDIDAE																
Stagonopleura guttata	Diamond Firetail	V	–	–	–	–	–	–	–	–	–	–	●	–	–	–
Neochmia temporalis	Red-browed Finch	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–
Taeniopygia bichenovii	Double-barred Finch	–	–	●	●	–	●	–	–	–	–	–	●	●	–	–

Scientific Name	Common Name	Conservation Status[1]		Reference													
		TSC Act	EPBC Act	AMBS (2011)[2]	AMBS (2012)[3]	Kerle (2011)[4]	EcoBiological (2011a)[5]	EcoBiological (2011b)[6]	EcoBiological (2011c)[7]	SCPL(1994) [8]	Murray (1994)[9]	Hoye and Finney (1994)[10]	AGC Woodward-Clyde (1994)[11]	Mount King Ecological Surveys (2001)[12]	Richards (2001)[13]	Hoye (1998)[14]
Mammals																	
TACHYGLOSSIDAE																	
Tachyglossus aculeatus	Short-beaked Echidna	–	–	–	●	–	●	–	–	–	–	–	–	●	–	–	
DASYURIDAE																	
Antechinus flavipes	Yellow-footed Antechinus	–	–	–	–	●	–	–	●	–	–	–	–	–	–	–	
Antechinus stuartii	Brown Antechinus	–	–	●	●	●	●	–	–	–	–	–	–	●	–	–	
Phascogale tapoatafa	Brush-tailed Phascogale	V	–	●	●	●	●	●	–	–	–	–	–	–	–	–	
PERAMELIDAE																	
Isoodon macrourus	Northern Brown Bandicoot	–	–	–	●	–	●	–	–	–	–	–	–	●[15]	–	–	
Perameles nasuta	Long-nosed Bandicoot	–	–	–	●	–	●	–	–	–	–	–	–	●[15]	–	–	
PHASCOLARCTIDAE																	
Phascolarctos cinereus	Koala	V	–	–	●	–	–	●	–	–	–	–	–	–	–	–	
PETAURIDAE																	
Petaurus australis	Yellow-bellied Glider	V	–	–	●	–	–	●	–	–	–	–	–	–	–	–	
Petaurus breviceps	Sugar Glider	–	–	●	●	–	●	●	–	–	–	–	–	–	–	–	
Petaurus norfolcensis	Squirrel Glider	V	–	–	●	–	●	●	–	–	–	●	–	–	–	–	
PSEUDOCHERIRIDAE																	
Pseudocheirus peregrinus	Common Ringtail Possum	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–	
PHALANGERIDAE																	
Trichosurus caninus	Short-eared Brushtail Possum	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–	
Trichosurus vulpecular	Common Brushtail Possum	–	–	–	●	–	●	●	–	●	–	–	–	●	–	–	
MACROPODIDAE																	
Macropus giganteus	Eastern Grey Kangaroo	–	–	●	●	–	●	–	–	–	–	–	–	–	–	–	
Macropus rufogriseus	Red-necked Wallaby	–	–	●	●	–	●	–	–	●	–	–	–	●	–	–	
Macropus robustus	Euro	–	–	–	–	–	●	–	–	●	–	–	–	–	–	–	
Thylogale thetis	Red-necked Pademelon	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–	

Scientific Name	Common Name	Conservation Status[1]		Reference												
		TSC Act	EPBC Act	AMBS (2011)[2]	AMBS (2012)[3]	Kerle (2011)[4]	EcoBiological (2011a)[5]	EcoBiological (2011b)[6]	EcoBiological (2011c)[7]	SCPL(1994) [8]	Murray (1994)[9]	Hoye and Finney (1994)[10]	AGC Woodward-Clyde (1994)[11]	Mount King Ecological Surveys (2001)[12]	Richards (2001)[13]	Hoye (1998)[14]
Wallabia bicolour	Swamp Wallaby	–	–	●	–	–	–	–	–	●	–	–	–	●	–	–
POTOROIDAE																
Potorous tridactylus	Long-nosed Potoroo	V	V	–	●	–	–	–	–	–	–	–	–	–	–	–
PTEROPODIDAE																
Pteropus poliocephalus	Grey-headed Flying Fox	V	V	–	●	–	–	–	–	–	–	–	–	–	–	–
RHINOLOPHIDAE																
Rhinolophys megaphyllus	Eastern Horseshoe Bat	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–
EMBALLONURIDAE																
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	–	–		–	–	–	–	–	–	–	–	–	●	–
MOLOSSIADE																
Mormopterus norfolkensis	Eastern Freetail-bat	V	–		●	–	●	–	–	–	–	–	–	–	–	–
Mormopterus sp. 2	–	–	–		●	–	●	–	–	–	–	–	–	–	–	–
Mormopterus sp. 4	–	–	–		●	–	–	–	–	–	–	–	–	–	–	–
Tadarida australis	White-striped Freetail-bat	–	–			–	●	–	–	–	–	–	–	–	●	●
VESPERTILIONIDAE										–						
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Miniopterus australis	Little Bentwing-bat	V	–	–	●	–	●	–	–	–	–	–	–	–	–	–
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	–	–	●	–	●	–	–	–	–	●	–	–	–	●
Mormopterus sp. 1[16]	–	–	–	–		–	–	–	–	–	–	–	–	–	–	●
Nyctophilus geoffroyi	Lesser Long-eared Bat	–	–	–	●	–	–	–	–	–	–	●	–	–	–	●
Nyctophilus gouldi	Gould's Long-eared Bat	–	–	–	●	–	●	–	–	–	–	–	–	–	–	●
Nyctophilus sp.~	Unidentified Long-eared Bat	–	–	–		–	●	–	–	–	–	–	–	–	–	–
Chalinolobus gouldii	Gould's Wattled Bat	–	–	–	●	–	●	–	–	–	–	●	–	–	●	●
Chalinolobus morio	Chocolate Wattled Bat	–	–	–	●	–	●	–	–	–	–	●	–	–	●	●
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	–	●	–	–	–	–	–	–	–	–	–	–	–
Myotis macropus	Southern Myotis	V	–	–	●	–	–	–	–	–	–	–	–	–	–	●

Scientific Name	Common Name	Conservation Status[1]		Reference													
		TSC Act	EPBC Act	AMBS (2011)[2]	AMBS (2012)[3]	Kerle (2011)[4]	EcoBiological (2011a)[5]	EcoBiological (2011b)[6]	EcoBiological (2011c)[7]	SCPL(1994)[8]	Murray (1994)[9]	Hoye and Finney (1994)[10]	AGC Woodward-Clyde (1994)[11]	Mount King Ecological Surveys (2001)[12]	Richards (2001)[13]	Hoye (1998)[14]
Scoteanax rueppellii	Greater Broad-nosed Bat	V	–	–	●	–	–	–	–	–	–	–	–	–	–	●
Scotorepens orion	Eastern Broad-nosed Bat	–	–	–	●	–	–	–	–	–	–	–	–	–	–	●
Vespedalus darlingtoni	Large Forest Bat	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Vespadelus pumilis	Eastern Forest Bat	–	–	–	●	–	●	–	–	–	–	–	–	–	–	–
Vespadelus troughtoni	Eastern Cave Bat	V	–	–	●	–	–	–	–	–	–	–	–	–	–	–
Vespadelus vulturnus	Little Forest Bat	–	–	–	●	–	●	–	–	–	–	●	–	–	●	●
MURIDAE																
Pseudomys novaehollandiae	New Holland Mouse	–	V	●	●	●	●	–	●	–	–	–	–	–	–	–
Hydromus chysogaster	Water Rat	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
*Mus musculus**	House Mouse*	–	–	●	●	●	●	–	●	●	–	–	–	–	–	–
Rattus fuscipes	Bush Rat	–	–	●	●	●	●	–	●	●	–	–	–	–	–	–
Rattus lutreolus	Swamp Rat	–	–	●	●	●	–	–	–	–	–	–	–	–	–	–
*Rattus rattus**	Black Rat*	–	–	●	●	●	–	–	●	–	–	–	–	–	–	–
CANIDAE																
*Canis lupus familiaris**	Domestic Dog*	–	–	–	●	–	–	–	–	●	–	–	–	●	–	–
*Vulpes vulpes **	Red Fox*	–	–	●	●	–	●	–	–	–	–	–	–	●	–	–
FELIDAE																
*Felis catus**	Cat*	–	–	–	●	–	●	–	–	●	–	–	–	●	–	–
LEPORIDAE																
*Lepus capensis **	Brown Hare*	–	–	–	–	–	●	–	–	–	–	–	–	–	–	–
*Lepus europeaus**	European Hare*	–	–	–	●	–	–	–	–	–	–	–	–	–	–	–
*Oryctolagus cuniculus **	Rabbit*	–	–	–	●	–	●	–	–	●	–	–	–	●	–	–
BOVIDAE																
*Bos taurus**	European Cattle*	–	–	–	–	–	–	–	–	●	–	–	–	●	–	–

Nomenclature consistent with CSIRO (2006) *CSIRO List of Australian Vertebrates - A Reference with Conservation Status.*

[1] Threatened species conservation status under the NSW *Threatened Species Conservation Act, 1995* and/or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (current as at 16 February 2012).

V = Vulnerable E = Endangered M = Migratory

[2] Australian Museum Business Services (2011) *Gloucester Valley Terrestrial Fauna Survey*.

[3] Australian Museum Business Services (2012) *Stratford Surrounds Terrestrial Fauna Survey*.

[4] Kerle, A. (2011) *Stratford Coal Mine New Holland Mouse (Pseudomys novaehollandiae) Targeted Survey Programme*.

[5] EcoBiological (2011a) *Fauna Survey Report: Stratford Coal Mine, Gloucester, New South Wales.*

[6] EcoBiological (2011b) *Stratford Coal Mine Arboreal Mammal Targeted Survey Programme.*

[7] EcoBiological (2011c) *Stratford Coal Mine New Holland Mouse Targeted Survey Programme.*

[8] Stratford Coal Pty Ltd (1994) *Terrestrial Fauna.* Appendix 8.2 of Stratford Coal Pty Ltd (1994) *Stratford Coal Project Environmental Impact Statement.*

[9] Murray, M. (1994) *Survey of Frog Species at proposed Mine Stratford, Near* Gloucester. Attachment A8.2-A of Appendix 8.2 in Stratford Coal (1994) *Stratford Coal Project Environmental Impact Statement*.

[10] Hoye, G.A. and Finney, D. (1994) *Report on a Survey of the Bat Fauna of an Area Proposed for Open Cut Coal Mining Near Stratford, New South Wales.* Attachment A8.2B of Appendix 8.2 of Stratford Coal (1994) *Stratford Coal Project Environmental Impact Statement.*

[11] AGC Woodward-Clyde (1994) *Avifauna.* Attachment A8.3 of Appendix 8.2 of Stratford Coal (1994) *Stratford Coal Project Environmental Impact Statement.*

[12] Mount King Ecological Surveys (2001) *Bowens Road North Project, Stratford Fauna Survey and Assessment.* Appendix FA of Stratford Coal (2001) *Bowens Road North Project Environmental Impact Statement.*

[13] Richards, G.C. (2001) *An Assessment of the Bat Fauna at the proposed Bowens Road North Project, via Stratford, New South Wales*. Appendix FC of Stratford Coal (2001) *Bowens Road North Project Environmental Impact Statement.*

[14] Hoye, G.A. (1998) *1998 Summer Survey of Bats at the Stratford Open Cut Coal Mine, Stratford, New South Wales.* In Richards, G.C. (2001) *An Assessment of the Bat Fauna at the proposed Bowens Road North Project, via Stratford, New South Wales.* Appendix FC of Stratford Coal (2001) *Bowens Road North Project Environmental Impact Statement.*

[15] Either the Long-nosed Bandicoot or the Northern Brown Bandicoot were recorded - unable to distinguish between the two species during the survey.

[16] As per Parnaby (1992).

[#] This species is most likely either *Uperoleia fusca, U. laevigata* or *U. tyleri*.

[~] This species is most likely either *Nyctophilus geoffroyi* or *N. gouldi*.

Appendix B: Database search results

Scientific Name	Common Name	Conservation Status[1]		Database records from locality?	Survey records from Project area or surrounds?	Potential to occur in the study area	Potential impact from the Project?
		TSC Act	EPBC Act				
Amphibians							
MYOBATRACHIDAE							
Mixophyes balbus	Stuttering Frog	E	V	Yes	No	Marginal potential habitat occurs. No potential habitat within the Project area, and has not been recorded despite previous searches, unlikely to occur. The area of marginal habitat unlikely to be impacted by the Project.	Very unlikely.
Mixophyes iteratus	Giant Barred Frog	E	E	Yes	No	Marginal potential habitat occurs. No potential habitat within the Project area, and has not been recorded despite previous searches, unlikely to occur. The area of marginal habitat unlikely to be impacted by the Project.	Very unlikely.
HYLIDAE							
Litoria aurea	Green and Golden Bell Frog	E	V	No	No	Potential habitat marginal and would not be impacted by the Project. Not recorded during any previous surveys and no records exist from the locality. Considered unlikely to occur in the Project area.	Very unlikely.
Litoria booroolongensis	Booroolong Frog	E	E	Yes	No	No potential habitat observed in the Project area or surrounds and has not been recorded. Unlikely to occur.	Very unlikely.
Litoria brevipalmata	Green-thighed Frog	V	-	Yes	No	Potential habitat is limited. There are few records from the locality and has not been recorded in the study area. Considered unlikely to occur in the Project area.	Very unlikely.
Litoria daviesae	Davies' Tree Frog	V	-	Yes	No	Only known to occur above 400 metre (m) altitude, study area is less than 300 m. Unlikely to occur.	Very unlikely.
Reptiles							
ELAPIDAE							
Hoplocephalus bungaroides	Broad-headed Snake	E	V	No	No	No potential habitat occurs in the study area, and no records exist from the locality. Unlikely to occur.	Very unlikely.

Scientific Name	Common Name	Conservation Status[1]		Database records from locality?	Survey records from Project area or surrounds?	Potential to occur in the study area	Potential impact from the Project?
		TSC Act	EPBC Act				
Hoplocephalus stephensii	Stephens' Banded Snake	V	-	Yes	No	Not recorded in the Project area, but can be difficult to detect. Marginal potential habitat occurs east of the Project area, but is patchy throughout, and located in areas unlikely to be impacted by the Project.	Negligible.
Birds							
ANSERANATIDAE							
Anseranas semipalmata	Magpie Goose	V	-	No	Yes	Potential habitat is limited and considered very unlikely to occur in the Project area. No waterbodies are likely to be impacted by the Project.	Negligible.
CICONIIDAE							
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Yes	No	Potential habitat is limited and considered very unlikely to occur in the Project area. No waterbodies are likely to be impacted by the Project.	Negligible.
ACCIPITRIDAE							
Circus assimilis	Spotted Harrier	V	-	Yes	No	Potential habitat is limited and considered very unlikely to occur in the Project area. Has not been recorded despite previous surveys, and very few records exist from the locality.	Very unlikely.
Hieraaetus morphnoides	Little Eagle	V	-	Yes	No	Potential foraging habitat occurs widely throughout the region, but there are few records from the locality. The species is only likely to occur on occasion and unlikely to rely on the habitats that would be impacted.	Some habitat loss. A significance test was carried out for this species.
BURHINIDAE							
Burhinus grallarius	Bush Stone-curlew	E	-	Yes	No	Potential habitat is limited and considered very unlikely to occur in the Project area. There are few records from the locality, and the species has not been recorded in the study area despite previous surveys.	Very unlikely.

Scientific Name	Common Name	Conservation Status[1]		Database records from locality?	Survey records from Project area or surrounds?	Potential to occur in the study area	Potential impact from the Project?
		TSC Act	EPBC Act				
ROSTRATULIDAE							
Rostratula australis	Australian Painted Snipe	E	V	No	No	Potential habitat is limited and considered unlikely to occur in the Project area. There are no records of the species from the locality, and no waterbodies are likely to be impacted by the Project.	Very unlikely.
COLUMBIDAE							
Ptilinopus magnificus	Wompoo Fruit-Dove	V	-	Yes	No	Potential habitat is very limited and there are no records of the species in the study area despite previous surveys. Considered very unlikely to occur in the Project area.	Very unlikely.
Ptilinopus regina	Rose-crowned Fruit-Dove	V	-	Yes	No	Potential habitat is very limited and there are no records of the species in the study area despite previous surveys. Considered very unlikely to occur in the Project area.	Very unlikely.
Ptilinopus superbus	Superb Fruit-Dove	V	-	Yes	No	Potential habitat is very limited and there are no records for the species in the study area despite previous surveys. Considered very unlikely to occur in the Project area.	Very unlikely.
PSITTACIDAE							
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-	Yes	Yes	Known foraging habitat and potential nesting resources exist in the study area. The species has been recorded foraging in locations which are likely to be impacted by the Project.	Likely. A significance test was carried out for this species.
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Yes	No	Potential habitat occurs throughout the Project area. The species has not been recorded despite previous surveys and there are very few records from the locality. Unlikely to occur. The habitat resources that would be impacted are unlikely to be essential for a local population of the species.	Some habitat loss. A significance test was carried out for this species.
Cacatua leadbeateri	Major Mitchell's Cockatoo	V	-	Yes	No	Potential habitat for the species is extremely limited. There are very few records from the locality, and none from the study area despite previous surveys. Considered very unlikely to occur in the Project area.	Very unlikely.

Scientific Name	Common Name	Conservation Status[1]		Database records from locality?	Survey records from Project area or surrounds?	Potential to occur in the study area	Potential impact from the Project?
		TSC Act	EPBC Act				
Glossopsitta pusilla	Little Lorikeet	V	-	Yes	Yes	Potential foraging habitat exists throughout most of the Project area and the species has been recorded during previous surveys. The species is likely to utilise the habitat resources that would be impacted on occasion, but they are unlikely to be essential for the species in the locality.	Some habitat loss. A significance test was carried out for this species.
Neophema pulchella	Turquoise Parrot	V	-	Yes	No	Potential habitat for the species in the Project area is limited and there are very few records from the locality. The species has not been recorded in the study area despite previous surveys. Considered very unlikely to occur in the Project area.	Very unlikely.
Lathamus discolor	Swift Parrot	E	E	Yes	No	Potential winter foraging habitat exists throughout the Project area. There are very few records of the species from the locality and none from the Project area despite previous surveys. Could occur on occasion.	Some habitat loss. A significance test was carried out for this species.
TYTONIDAE							
Tyto tenebricosa	Sooty Owl	V	-	Yes	Yes	Some potential foraging habitat occurs. The species has not been recorded within the Project area, but could potentially occur. The potential habitat that does occur is unlikely to be essential for a local population.	Some habitat loss. A significance test was carried out for this species.
Tyto novaehollandiae	Masked Owl	V	-	Yes	Yes	Potential foraging habitat occurs and the species has been recorded during previous surveys in the Project area. The habitat that would be impacted is unlikely to be essential for the species in the locality.	Some habitat loss. A significance test was carried out for this species.
STRIGIDAE							
Ninox strenua	Powerful Owl	V	-	Yes	No	Potential foraging habitat exists, but the species has not been recorded despite previous surveys. The habitat that would be impacted is unlikely to be essential for the species in the locality. Could occur in the Project area but is unlikely.	Some habitat loss. A significance test was carried out for this species.

Scientific Name	Common Name	Conservation Status[1]		Database records from locality?	Survey records from Project area or surrounds?	Potential to occur in the study area	Potential impact from the Project?
		TSC Act	EPBC Act				
Ninox connivens	Barking Owl	V	-	Yes	No	Potential foraging habitat exists, but the species has not been recorded despite previous surveys. The habitat that would be impacted is unlikely to be essential for the species in the locality. The species is considered unlikely to occur.	Some habitat loss. A significance test was carried out for this species.
ATRICHORNITHIDAE							
Atrichornis rufescens	Rufous Scrub-bird	V	-	Yes	No	No potential habitat for this species was observed in the Project area, and there are no records despite previous surveys. Very unlikely to occur.	Very unlikely.
CLIMACTERIDAE							
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	Yes	Yes	Potential habitat occurs within the Project area, but the species was not recorded during any recent surveys (last record is from 1994). The species is considered unlikely to occur.	Some habitat loss. A significance test was carried out for this species.
ACANTHIZIDAE							
Pyrrholaemus saggitatus	Speckled Warbler	V	-	Yes	Yes	Potential habitat occurs within the Project area, and the species was recorded during recent surveys. Some potential habitat is likely to be impacted by the Project.	Likely. A significance test was carried out for this species.
MELIPHAGIDAE							
Anthochaera phrygia	Regent Honeyeater	CE	E	No	No	Potential foraging habitat occurs, but there are no records of the species in the Project area or the locality. The habitat that would be impacted is unlikely to be essential for the species in the locality.	Unlikely; however, a significance test was carried out due to its Critically Endangered status on the TSC Act.
Epthianura albifrons	White-fronted Chat	V	-	Yes	No	Potential habitat is limited in the study area and there are very few records from the locality. Very unlikely to occur in the Project area, and no waterbodies are likely to be impacted by the Project.	Very unlikely.

Scientific Name	Common Name	Conservation Status[1]		Database records from locality?	Survey records from Project area or surrounds?	Potential to occur in the study area	Potential impact from the Project?
		TSC Act	EPBC Act				
PETROICIDAE							
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Yes	Yes	Potential habitat is limited within the Project area and the species was not recorded during any recent surveys (last record is from 1994). The species is considered unlikely to occur in the Project area.	Some habitat loss. A significance test was carried out for this species.
Petroica phoenicea	Flame Robin	V	-	Yes	Yes	Potential habitat occurs for the species throughout most of the Project area and surrounds and the species was recorded during recent surveys. Some potential habitat is likely to be impacted by the Project.	Likely. A significance test was carried out for this species.
Petroica boodang	Scarlet Robin	V	-	Yes	Yes	Potential habitat occurs for the species throughout most of the lowland areas of Project area and the species was recorded during recent surveys. Some potential habitat is likely to be impacted by the Project.	Likely. A significance test was carried out for this species.
POMATOSTOMIDAE							
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	Yes	Yes	Potential habitat occurs for the species throughout most of the lowland areas of Project area and the species was recorded during recent surveys. Some potential habitat is likely to be impacted by the Project.	Likely. A significance test was carried out for this species.
NEOSITTIDAE							
Daphoenositta chrysoptera	Varied Sittella	V	-	Yes	Yes	Potential habitat occurs for the species throughout most of the Project area and the species was recorded during recent surveys. Some potential habitat is likely to be impacted by the Project.	Likely. A significance test was carried out for this species.
PACHYCEPHALIDE							
Pachycephala olivacea	Olive Whistler	V	-	Yes	No	No potential habitat for this species was observed in the Project area and there are no records despite previous surveys. Very unlikely to occur.	Very unlikely.

Scientific Name	Common Name	Conservation Status[1]		Database records from locality?	Survey records from Project area or surrounds?	Potential to occur in the study area	Potential impact from the Project?
		TSC Act	EPBC Act				
ESTRILIDIDAE							
Stagonopleura guttata	Diamond Firetail	V	-	No	Yes	Marginal potential habitat occurs throughout the Project area. There are very few records from the locality, and was not recorded during any recent surveys (last record is from 1994). This species is only likely to occur on occasion, and the habitat that would be impacted is unlikely to be essential for the species in the locality.	Some habitat loss. A significance test was carried out for this species.
JACANIDAE							
Irediparra gallinacea	Comb-crested Jacana	V	-	No	Yes	Potential habitat is limited in the Project area, nonetheless the species was recorded during recent surveys. The habitat in which the species was recorded is unlikely to be impacted by the Project, and no other waterbodies are likely to be impacted.	Negligible.
Mammals							
DASYURIDAE							
Dasyurus maculatus maculatus (SE mainland population)	Spotted-tailed Quoll	V	E	Yes	No	Marginal potential habitat occurs throughout most of the Project area. There are records from the locality but none from the Project area or surrounds despite previous surveys. The habitat that would be impacted is unlikely to be essential for the species in the locality.	Some habitat loss. A significance test was carried out for this species.
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	Yes	Yes	Habitat occurs throughout most of the Project area, particularly the lowland woodlands. Has been recorded during recent surveys. Some potential habitat is likely to be impacted by the Project.	Likely. A significance test was carried out for this species.
Planigale maculata	Common Planigale	V	-	Yes	No	Potential habitat for the species is limited, but there is some potential for the species to occur. There are few records from the locality. The habitats that will be disturbed are unlikely to be important for a local population.	Some habitat loss. A significance test was carried out for this species.

Scientific Name	Common Name	Conservation Status[1]		Database records from locality?	Survey records from Project area or surrounds?	Potential to occur in the study area	Potential impact from the Project?
		TSC Act	EPBC Act				
PHASCOLARCTIDAE							
Phascolarctos cinereus	Koala	V	-	Yes	Yes	Potential habitat of varying quality occurs throughout most of Project area and surrounds, and the species was recorded during the recent surveys. The habitat that would be impacted is unlikely to be essential for the species in the locality.	Some habitat loss. A significance test was carried out for this species.
BURRAMYIDAE							
Cercartetus nanus	Eastern Pygmy-possum	V	-	Yes	No	Potential habitat for the species is extremely limited within the Project area and is considered unlikely to occur. The species has not been recorded in the study area and there are very few records from the locality. Considered very unlikely to occur in the Project area.	Very unlikely.
PETAURIDAE							
Petaurus australis	Yellow-bellied Glider	V	-	Yes	Yes	Potential habitat is limited within the Project area and the species has not been recorded. The species was recorded during recent surveys outside the Project area, where more suitable habitat occurs within the Offset area and the Glen Nature Reserve. Considered unlikely to occur in the Project area.	Negligible.
Petaurus norfolcensis	Squirrel Glider	V	-	Yes	Yes	Potential habitat occurs throughout the lowland valley areas of the Project area, and the species was recorded during recent surveys. Some potential habitat is likely to be impacted by the Project.	Likely. A significance test was carried out for this species.
POTOROIDAE							
Aepyprymnus rufescens	Rufous Bettong	V	-	Yes	No	Potential habitat is limited within the Project area, and there are very few records of the species from the locality. The species was not recorded despite previous surveys, and is considered very unlikely to occur in the Project area.	Very unlikely.

Scientific Name	Common Name	Conservation Status[1]		Database records from locality?	Survey records from Project area or surrounds?	Potential to occur in the study area	Potential impact from the Project?
		TSC Act	EPBC Act				
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE mainland)	V	V	Yes	Yes	Potential habitat is patchy throughout the Project area and surrounds and there are recent records for the species. Known habitat for the species has potential to be impacted by the Project.	Likely. A significance test was carried out for this species.
MACROPODIDAE							
Macropus parma	Parma Wallaby	V	-	Yes	No	Potential habitat is limited within the Project area, and there are very few records of the species from the locality. The species was not recorded despite previous surveys, and is considered very unlikely to occur in the Project area.	Very unlikely.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Yes	No	No potential habitat for this species was observed in the Project area and there are no records despite previous surveys. Very unlikely to occur.	Very unlikely.
Thylogale stigmatica	Red-legged Pademelon	V	-	Yes	No	Potential habitat is limited within the Project area, and there are very few records of the species from the locality. The species was not recorded despite previous surveys and is considered very unlikely to occur in the Project area.	Very unlikely.
PTEROPODIDAE							
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Yes	Yes	Potential foraging habitat occurs throughout most of the Project area and the species was recorded during recent surveys. Some potential habitat is likely to be impacted by the Project.	Some habitat loss. A significance test was carried out for this species.
EMBALLONURIDAE							
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	No	Yes	Potential foraging habitat occurs but the species has only been recorded once. Considered unlikely to occur. The habitat that would be disturbed is unlikely to be important for a local population.	Some habitat loss. A significance test was carried out for this species.

Scientific Name	Common Name	Conservation Status[1]		Database records from locality?	Survey records from Project area or surrounds?	Potential to occur in the study area	Potential impact from the Project?
		TSC Act	EPBC Act				
MOLOSSIDAE							
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Yes	Yes	Potential foraging and roosting habitat occurs throughout most of the Project area. There are records for the species in the locality and from previous surveys in the Project area. Some potential habitat is likely to be impacted by the Project.	Some habitat loss. A significance test was carried out for this species.
VESPERTILIONIDAE							
Kerivoula papuensis	Golden-tipped Bat	V	-	Yes	No	No potential habitat for the species was observed in the Project area. The species has not been recorded in the study area despite previous surveys, and is considered very unlikely to occur in the Project area	Negligible.
Miniopterus australis	Little Bentwing-bat	V	-	Yes	Yes	Potential foraging habitat occurs throughout most of the Project area. There are records for the species in the locality and from previous surveys. Some potential habitat is likely to be impacted by the Project.	Some habitat loss. A significance test was carried out for this species.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Yes	Yes	Potential foraging habitat occurs throughout most of the Project area. There are records for the species in the locality and from previous surveys. Some potential habitat is likely to be impacted by the Project.	Some habitat loss. A significance test was carried out for this species.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Yes	Yes*	Potential foraging habitat occurs throughout most of the Project area. There are records for the species in the locality and possible records from previous surveys. Some potential habitat is likely to be impacted by the Project.	Some habitat loss. A significance test was carried out for this species.
Myotis macropus	Southern Myotis	V	-	Yes	Yes	Potential foraging and roosting habitat occurs within the Project area. There are records for the species in the locality and from previous surveys. Some potential roosting habitat could be impacted by the Project.	Some habitat loss. A significance test was carried out for this species.
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Yes	Yes	Potential foraging and roosting habitat occurs throughout most of the Project area. There are records for the species in the locality and from previous surveys. Some potential habitat is likely to be impacted by the Project.	Some habitat loss. A significance test was carried out for this species.

Scientific Name	Common Name	Conservation Status[1]		Database records from locality?	Survey records from Project area or surrounds?	Potential to occur in the study area	Potential impact from the Project?
		TSC Act	EPBC Act				
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	-	Yes*	Potential foraging and roosting habitat is limited within Project area. There are no records for the species in the locality, but possible records from recent surveys. Some potential habitat may be impacted by the Project.	Some habitat loss. A significance test was carried out for this species.
Vespadelus troughtoni	Eastern Cave Bat	V	-	Yes	Yes*	Potential foraging habitat occurs throughout most of the Project area. There are records for the species in the locality and possible records from previous surveys. Some potential habitat could be impacted by the Project.	Some habitat loss. A significance test was carried out for this species.
MURIDAE							
Pseudomys novaehollandiae	New Holland Mouse	-	V	Yes	Yes	Potential habitat is patchy throughout the Project area. The species has been recorded during recent surveys and it is likely some habitat will be impacted by the Project.	Likely. A significance test was carried out for this species.
Pseudomys oralis	Hastings River Mouse	E	E	No	No	No potential habitat was observed in the Project area. There are no records for the species in the study area or the locality. It is considered very unlikely to occur.	Very unlikely.

[1] Threatened species conservation status under the NSW *Threatened Species Conservation Act, 1995* and/or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (current as at 16 February 2012).

Key: * = possible identification; V = vulnerable species; E = endangered species; CE = critically endangered species.

Appendix C: Seven Part Tests

'Assessments of significance' using the New South Wales (NSW) *Threatened Species Conservation Act, 1995* (TSC Act) 'Seven Part Test' criteria have been undertaken for threatened species considered likely to occur and/or be potentially impacted by the Project. These assessments are presented below.

Little Eagle (Hieraaetus morphnoides)

The Little Eagle is listed as vulnerable in NSW under Schedule 2 of the TSC Act. The Little Eagle occurs as a single population throughout NSW. It is distributed throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment (Marchant and Higgins, 1993). It occurs in habitats that have abundant prey within open eucalypt forest, woodland or open woodland. The species also uses Sheoak or acacia woodlands and riparian woodlands of interior NSW (Marchant and Higgins, 1993). Little Eagles nest in tall living trees within a remnant patch. They build a large stick nest in winter and eggs are laid in early spring, with young fledging in early summer. Generation length has been estimated as 10 years. Little Eagles eat other birds, reptiles and mammals, occasionally taking large insects and carrion (Marchant and Higgins, 1993; Aumann, 2001). Formerly, this species was heavily dependent on rabbits, but following the spread of rabbit calicivirus disease, and consequent decline in rabbit numbers in the arid and semi-arid zones, the Little Eagle is increasingly dependent on native prey. Most of its former native mammalian prey species in inland NSW are, however, extinct (terrestrial mammals of rabbit size or smaller e.g. large rodents, juvenile hare-wallabies and wallabies) (van Dyck and Strahan, 2008).

In the 1990s, the Little Eagle was estimated to occur globally in the tens of thousands to as many as 100 000 birds (NSW Scientific Committee, 2010a). While accurate figures are not available, the species is now thought to have declined greatly. In NSW, evidence from localised and broadscale surveys suggest that the species has undergone a moderate reduction in population size in recent decades. For example, there has been a long-term decline in reporting rate of about 50% in south-eastern NSW since the 1970s, with an accelerating trend since the 1990s. While reductions in Little Eagle numbers have coincided with the calicivirus induced reduction in rabbits, there may be multiple factors involved in their decline. Other species of raptors that eat rabbits showed no consistent decrease in their survey rate between 1986-1990 and 1996-2000, whereas observations of some other raptors that are not rabbit predators decreased over this period (NSW Scientific Committee, 2010a). The Little Eagle is a resident, territorial species that is long-lived with low breeding productivity, and formerly had a low and stable density, its recent decline may be a long-term process that tracks habitat quality and overall prey biomass rather than temporary fluctuations in climate or prey availability.

Land clearing and degradation of foraging and breeding habitat are thought to be the main threats to the Little Eagle. Over 50% of forest and woodland has been cleared in NSW and important habitat on the NSW tablelands and western slopes, which contained relatively high eagle breeding densities until the 1980s, are mostly cleared and moderately to highly stressed. Direct human threats to habitat are most evident around expanding provincial cities, where urbanisation and rural-residential expansion are displacing breeding pairs. Loss of breeding sites may bring the Little Eagle into increasing interspecific competition with the larger, dominant Wedge-tailed Eagle (*Aquila audax*). Secondary poisoning from pindone used to control rabbits is listed as a possible threat (NSW Scientific Committee, 2010a).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Little Eagle has not been recorded in the Project area but has been recorded on a single occasion in the wider Gloucester Valley (Figure C-1). The Project would remove approximately 105 hectares (ha) of potential foraging habitat of native vegetation for this species (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) (Figure C-2). A further 90 ha of cleared land within the Project area is also likely to provide foraging habitat for the species. It is also possible that some of the potential habitat could be used for breeding as this species nests in tall trees within remnant patches. However, this is considered unlikely because there is an absence of sightings of the species near the Project area.

This level of clearing is unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction, because there is substantial habitat in the surrounding area outside of the Project area. Furthermore, post-mining landforms would be rehabilitated and revegetated, and approximately 530 ha of potential habitat for this species (including 490 of native vegetation and 40 ha of cleared land) would be conserved and enhanced in the Offset areas. Additional potential habitat would be created through revegetation of cleared land in offsets (up to 435 ha) and post-mining landforms (Section 7).

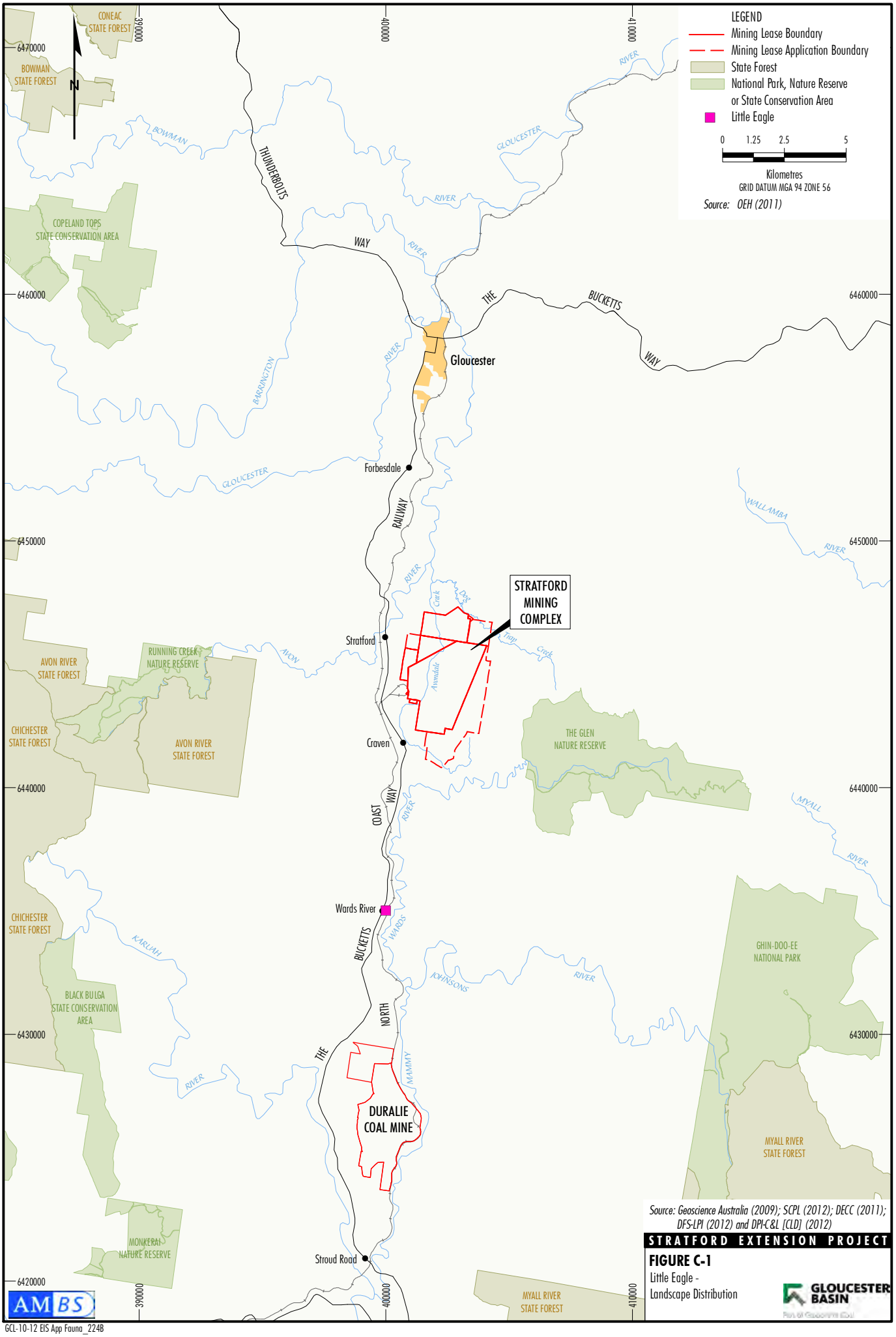
(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-1

Little Eagle - Landscape Distribution

GLOUCESTER BASIN

AMBS

GCL-10-12 EIS App Fauna_224B

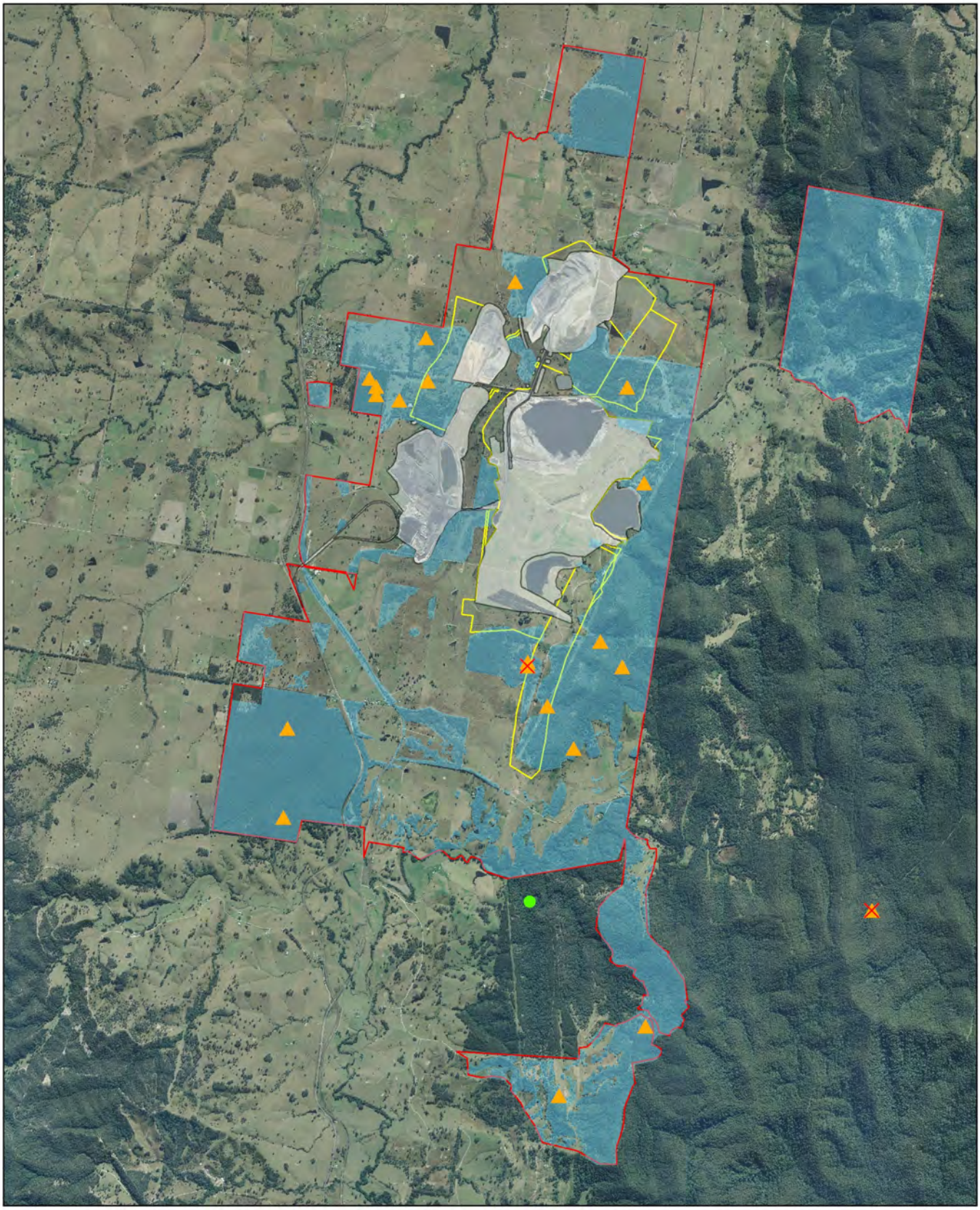


Figure C-2: Little Eagle, Gang-gang Cockatoo, Little Lorikeet and Varied Sittella - Potential Habitat

(i) Approximately 105 ha of potential foraging habitat would be removed as a result of the Project (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest). A further 90 ha of cleared land, which also provides foraging habitat would also be removed. It is also possible that some of the potential habitat could be used for breeding as this species nests in tall trees within remnant patches. Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) Potential habitat would become further fragmented and isolated, however the impacts from this are likely to be minor considering the highly mobile and wide ranging behaviour of the species;

(iii) The potential habitat to be removed is not likely to be important for the survival of the species in the locality considering that it has not been recorded in the Project area, there is substantial habitat in the surrounding area and 530 ha of potential habitat (490 ha of native vegetation and 40 ha of cleared land) would be conserved and enhanced in the Offset areas.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for the Little Eagle has been declared by the Minister for the Environment and none has been identified in the Gloucester Local Environment Plan (LEP).

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan has been prepared for the Little Eagle. The NSW Office of Environment and Heritage (OEH) (2012a) suggests a number of recovery actions for this species including:

- protecting known populations and habitats from clearing;
- rehabilitating known and potential habitat; and
- retaining and protecting nesting and foraging habitat.

While the removal of approximately 195 ha of potential habitat (105 ha of native vegetation and 90 ha of cleared land) is not consistent with these actions, substantial potential habitat exists in the surrounding area. In addition, post-mining landforms would be rehabilitated and revegetated, and potential habitat (490 ha of native vegetation and 40 ha of cleared land) would be conserved and improved in the offset area, which is consistent with the suggested recovery actions.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

'Clearing of native vegetation' is listed as a Key Threatening Process in NSW under the TSC Act. While the Project would result in the clearing of 105 ha of native vegetation that represents potential habitat for this species, substantial habitat exists in the surrounding area and 530 ha of potential habitat would be conserved and improved in the Offset areas.

Conclusion

It is anticipated that the Project would potentially impact on the Little Eagle due to the removal of potential foraging habitat for this species. Overall, the Project is unlikely to have a significant impact on the Little Eagle such that a local viable population would be placed at risk of extinction given:

- the species has not been recorded in the Project area and has only been reported once in the wider area;

- a relatively small amount of potential habitat would be cleared (105 ha primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and a further 90 ha of cleared land that provides potential foraging habitat) (Section 7), compared to the amount of potential habitat in region and the surrounding area; and
- any potential habitat that would be fragmented or isolated is unlikely to have more than a negligible impact for this highly mobile and wide-ranging species.

Further to the above, post-mining landforms would be rehabilitated and revegetated, and a considerable amount of potential habitat would be conserved and enhanced in the proposed Offset areas (490 ha of native vegetation composed of equivalent and/or additional vegetation types and 40 ha of cleared land) (Section 7). Additional potential habitat would be created through revegetation of cleared land in offsets (up to 435 ha) and post-mining landforms (Section 7).

Glossy Black-cockatoo (Calyptorhynchus lathami)

The Glossy Black-cockatoo is listed as vulnerable under Schedule 2 of the TSC Act. It occurs in a wide coastal band from central Queensland to the Victorian border (NSW National Parks and Wildlife Service [NPWS], 1999a). In NSW, the species' distribution is patchy and localised, reflecting the distribution of its moist and dry sclerophyll forest habitat. This species is locally nomadic, with small family parties (seldom more than ten individuals) roaming in search of feeding areas. It prefers woodland dominated by *Allocasuarina* spp. or open sclerophyll forest or woodlands with a middle stratum of Allocasuarina, but also occurs in bushland remnants in agricultural and urban areas (Higgins, 1999).

Glossy Black-cockatoos are considered ecological specialists, feeding almost exclusively on the seeds of Forest Oak (*Allocasuarina torulosa*), *A. stricta* and Black She-oak (*A. littoralis*), although they also occasionally eat the seeds of Swamp Oak (*Casuarina glauca*) and Shrub She-oak (*A. distyla*). In eastern NSW, Black She-oak *A. littoralis* is the main dietary component (Chapman, 1999). Glossy Black-cockatoos are also highly selective about which trees they feed from. Clout (1989) recorded feeding signs beneath only 24% of the 1672 cone-bearing trees examined near Eden in NSW. Mature, sparse trees between 2-10 metres (m) tall are favoured for foraging (Higgins, 1999), with birds showing a preference for trees with large seeds and with high seed mass, cone mass ratios and high seed mass per cone values (Pepper, 2000). Although trees are selected on the basis of the number of cones, feeding activity is unevenly distributed between trees, with birds settling for sustained feeding (> 4 hours) in some trees and remaining for only a few minutes in others (Clout, 1989). They also select only the young russet cones (rather than older grey cones) which may reflect a preference for softer cones or the higher protein content of the seeds (Clout, 1989).

The Glossy Black-cockatoo must forage for many hours every day to obtain sufficient food and habitat that is apparently suitable will not always provide adequate food to support the cockatoos, particularly during the breeding season (Garnett and Crowley, 2000). Breeding birds forage for about 80% of daylight hours, consuming seeds from up to 140 cones during this period. Non-breeding birds forage for about half the daylight hours and eat half as many cones (Chapman, 1999).

Glossy Black-cockatoos require large hollows in the trunk or limbs of living or dead eucalypt trees for nesting. They prefer deep (40-120 centimetres [cm]) nest hollows with wide entrances (approximately 21 cm) located 10-28 m above the ground (Higgins, 1999). Hollows of sufficient size for nesting generally do not form in eucalypt trees less than 150-200 years old (Mackowski, 1984).

Glossy Black-cockatoos form strong pair bonds and are thought to pair for life (Chapman, 1999). Adults breed during the autumn and winter (OEH, 2012a), mainly between February and April, but as early as January and as late as August if earlier nesting attempts fail (Chapman, 1999). Incubation of eggs lasts for about 30 days and chicks fledge around 90 days after hatching. Only one young is raised per season.

Little is known of the movements of Glossy Black-cockatoos. They are variously described as being mainly sedentary, resident, or locally nomadic. They are, however, capable of travelling large distances to locate suitable foraging habitat. Permanent groups of up to ten individuals are formed. Roosting is usually communal in the canopy of live leafy trees (Higgins, 1999) and groups may form aggregations at food and water sources.

This species is threatened by a number of processes including reduction of suitable habitat through clearing for development, loss of tree hollows, excessively frequent fire which reduces the abundance and recovery of She-oaks, and illegal bird smuggling and egg-collecting (OEH, 2012a).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

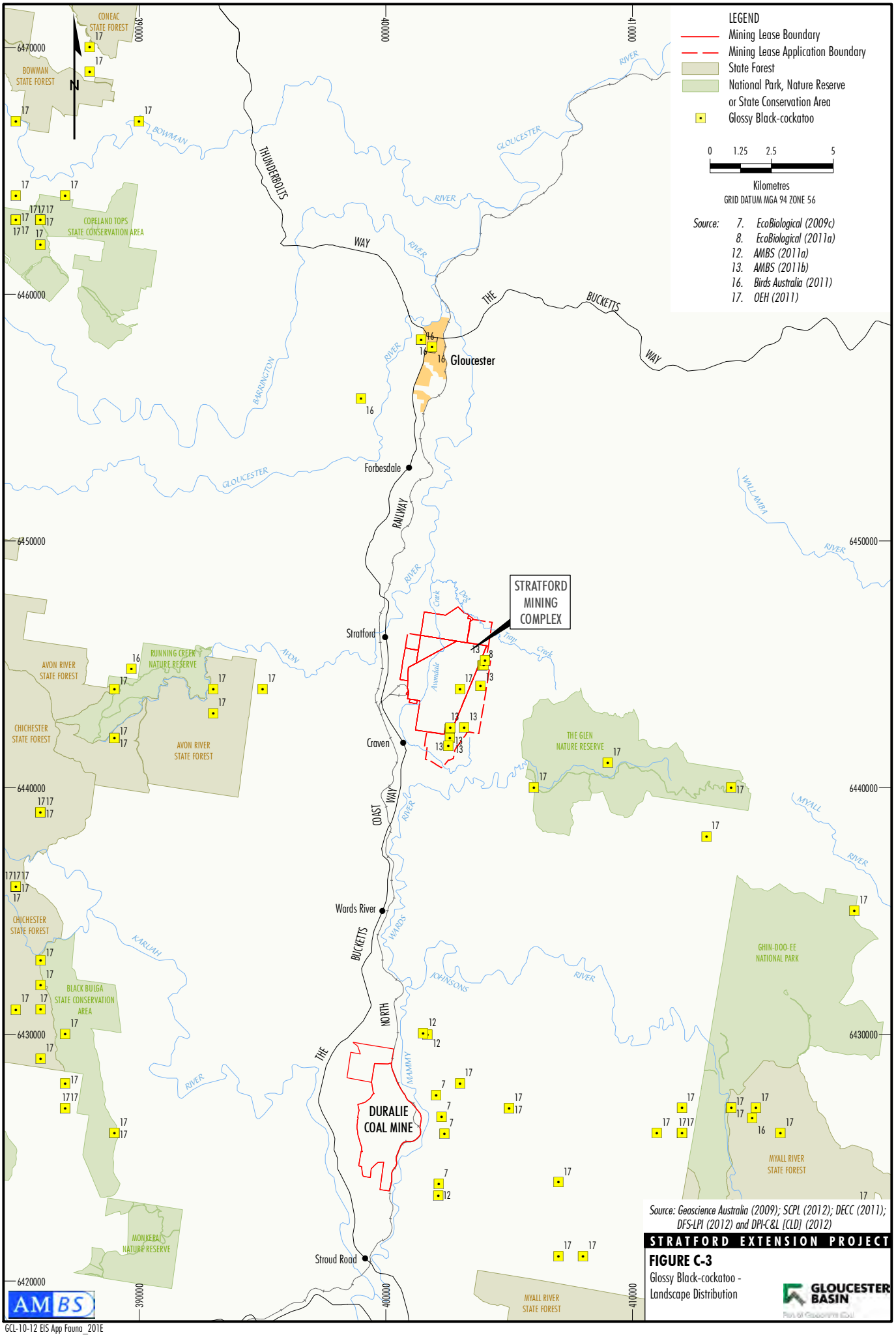
There is known and potential foraging habitat for the Glossy Black-cockatoo in the Project area and in nearby locations. Observations of feeding animals and/or signs of feeding (chewed cones) have been recorded within three general locations: in the vicinity of the Stratford East Open Cut, east of the Avon North Open Cut, and within Offset area 4 (Figure 4a). The Project would result in the loss of known foraging habitat for this species in one of these foraging areas.

Given the potential mobility of this species, for the purpose of this assessment, the local population is considered to comprise of individuals known or likely to occur in the Project area, as well as any individuals occurring in the adjoining areas, in particular along the western side of the range to the east of the Project area and potentially other parts of the offset area. The Glossy Black-cockatoo has also been recorded in a number of locations in the wider Gloucester Valley (Figure C-3), including in the Glen Nature Reserve (OEH, 2012b, Bionet search for Glossy Black-cockatoo in The Glen Nature Reserve).

As described above, the diet of Glossy Black-cockatoos is primarily restricted to the seeds of Allocasuarina/Casuarina (Higgins, 1999) and the species is highly selective about which trees they feed from. Potential foraging habitat (areas containing Forest Oak [*Allocasuarina torulosa*]) occurs in a band along the western side of the range, the majority of which is located to the east of the Project area, but some of which is also located within the Project area (Figure C-4). Potential foraging habitat is also located to the south of the Project area (Figure C-4). Evidence of Glossy Black-cockatoo feeding has been observed in parts of these areas.

In 2011, FloraSearch mapped the extent of Forest Oak on the eastern side of the range by walking the perimeter of the Forest Oak patches (Figure C-5). During the mapping, FloraSearch also recorded the location of feeding trees, evidenced by chewed cones beneath the trees. FloraSearch did not attempt to locate all feeding trees. The trees that were recorded were mostly on the perimeter of the patches. Feeding trees were recorded in two ways. In the southern area, FloraSearch noted feeding trees while only walking the perimeter of the patch. Feeding trees to the west of the power line and in the northern parts of the area were located by targeted searches for evidence of feeding. This approach would not have located all feeding trees within an area, but would have found more than the perimeter survey in the south. FloraSearch noted that the evidence of feeding varied from very little to extensive. One patch of trees to the east of the main dam had seven trees within a small area that were extensively browsed. This patch was isolated from others.

Some foraging habitat for the Glossy Black-cockatoo (Forest Oak [*Allocasuarina torulosa*]) occurs within the extent of the proposed Stratford East Open Cut and would be removed for the Project. Glossy Black-cockatoos have been sighted feeding on the trees that would be removed. The habitat that would be removed may also contain potential nesting hollows for the Glossy Black-cockatoo. The average density of tree hollows in the Project area is less than 10 hollows per hectare, except in two small patches where the tree hollow density is greater than 20 per ha (Figure 9). However, there are a limited number of hollow-bearing trees in the area that are large enough to accommodate this species. There is no evidence of this species breeding in the Project area and given the pattern of past land clearance (Figures 7a to 7e), more suitable breeding habitat is likely to occur in the older remnant vegetation to the east of the Project area (Figure 2).



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-3

Glossy Black-cockatoo - Landscape Distribution

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GLOUCESTER BASIN

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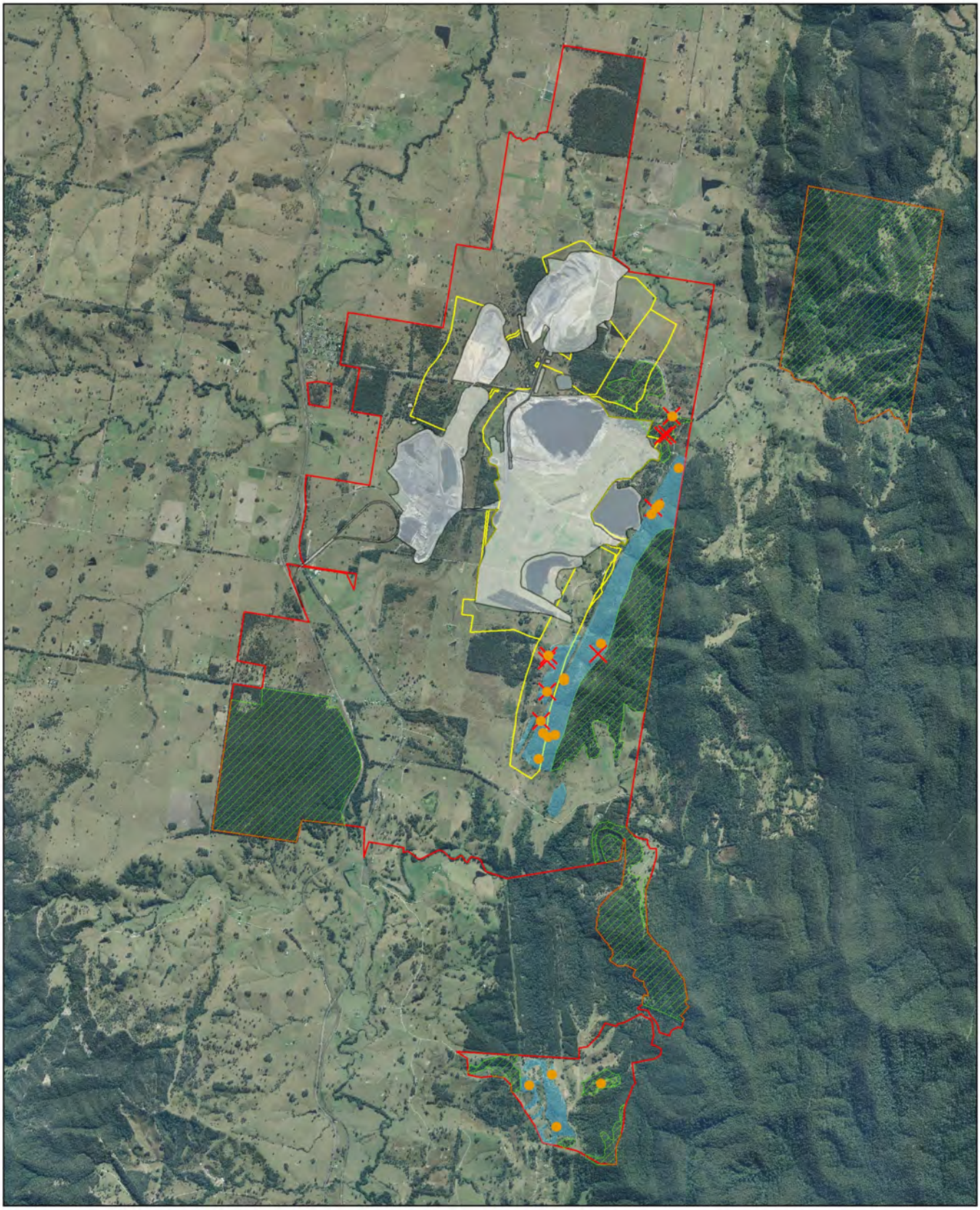


Figure C-4: Glossy Black-cockatoo - Potential Habitat

0 0.5 1 2 Kilometres

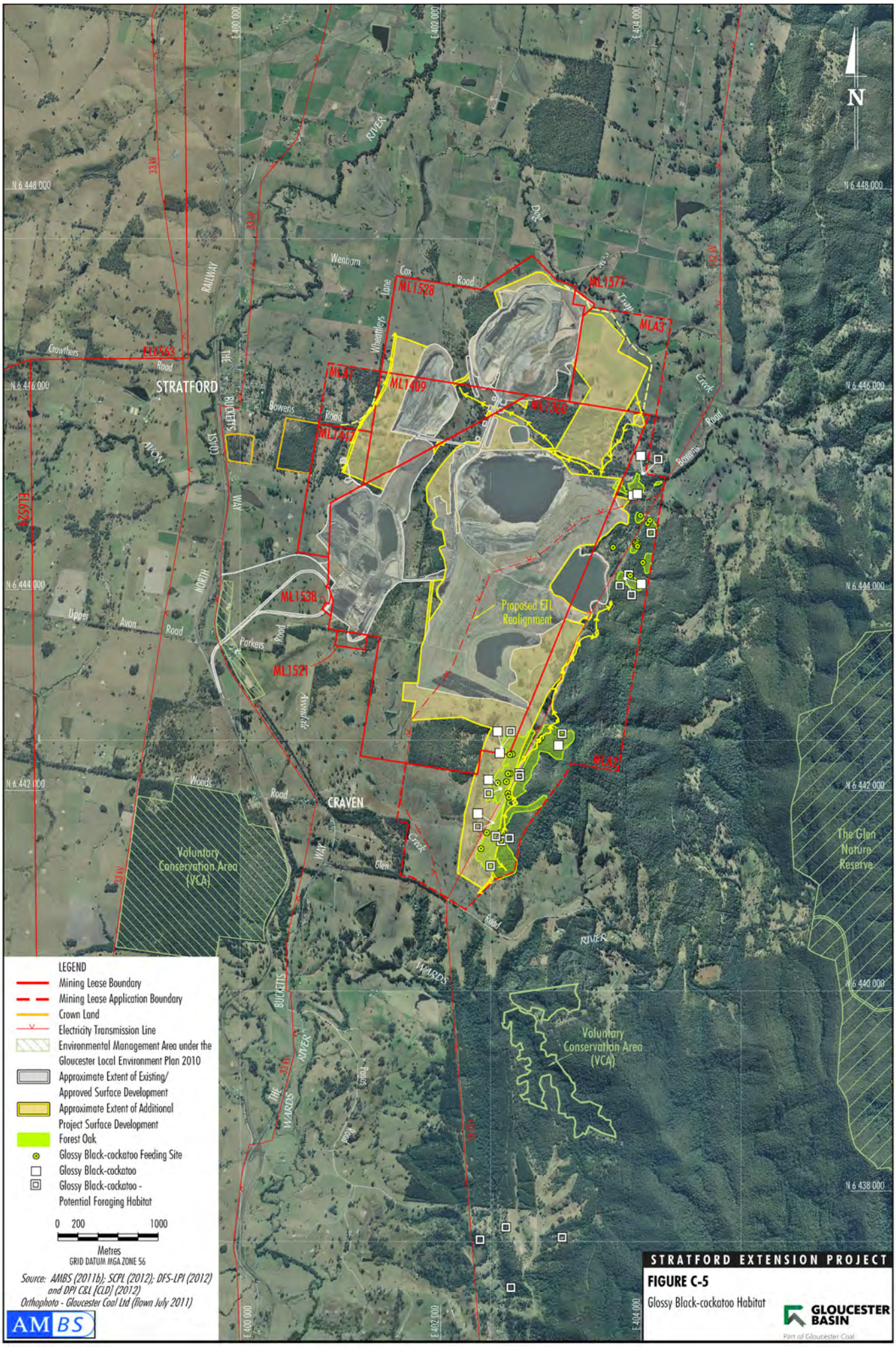
Notes: Glossy Black-cockatoo potential foraging habitat as indicated by the abundance of Allocasuarina spp. Areas unmapped inside the study area are considered unlikely foraging habitat where there is a low probability that the species would occur.

Legend

- Allocasuarina spp. abundance high
- Allocasuarina spp. abundance low
- Glossy Black-cockatoo
- Glossy Black-cockatoo (foraging signs)
- Study Area
- Approximate Extent of Existing/Approved Surface Development
- Approximate Extent of Additional Project Surface Development

N

AMBS



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The Project would remove or modify a substantial proportion of the known foraging habitat (wet sclerophyll forest and dry sclerophyll forest) for this species in the Project area and surrounds. It is possible, therefore, that the Project would have an adverse effect on the life cycle of the local population of Glossy Black-cockatoos in the short-term. However, the Project is unlikely to place a viable local population at risk of extinction, because there are much larger areas of known foraging habitat that would be retained (Figure C-4) and there is evidence of the species feeding at a number of locations outside the Project area, many of which are in the Offset area. Glossy Black-cockatoos are considered likely to persist in the local area given that breeding hollows in the surrounding areas are unlikely to be impacted, there are numerous records of the species in the wider Gloucester Valley (Figure C-3), and substantial areas of foraging habitat would remain (including approximately 63 ha of high quality habitat and a further 166 ha of low quality habitat).

In the medium to long-term, additional potential habitat would be attained through revegetation of Offset areas and post-mine landforms. Tube stock of Forest Oak (*Allocasuarina torulosa*) (and other feed tree species where appropriate) would be planted as a mid-storey species in suitable locations on the lower slopes in the study area (Figure 18).

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would result in the removal or modification of approximately 25 ha of habitat with high Allocasuarina abundance and 14 ha of habitat with low Allocasuarina abundance. This constitutes approximately 18% of the total area of habitat with high Allocasuarina abundance and 6% of total area of habitat with low Allocasuarina abundance. This removal is primarily due to the proposed Stratford East Open Cut (Figure C-4). Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) The Project would increase fragmentation of potential habitat, but the impact from this is only likely to be minor given the highly mobile nature of the species .

(iii) The foraging habitat that is to be removed constitutes a substantial portion of the known Glossy Black-cockatoo foraging habitat in the locality. The habitat that would be removed is likely to be important for the population in the immediate vicinity from time to time, but there are larger areas of good quality habitat available outside of the Project area (i.e. at least 116 ha of habitat with high abundance of *Allocasuarina* spp.). There is evidence of the species occurring in several other localities in the study area, including in proposed Offset areas where 63 ha of habitat with high *Allocasuarina* spp. abundance and approximately 166 ha of habitat with low *Allocasuarina* spp. abundance would be conserved. These Offset areas would be protected in perpetuity and revegetation including planting of *Allocasuarina* spp. tubestock would be undertaken in strategic locations throughout.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for the Glossy Black-cockatoo has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Glossy Black-cockatoo (OEH, 2012a). Suggestions for the recovery of this species include retaining and protecting areas of Casuarina/Allocasuarina forest and woodland, re-establishing corridors that link areas of remnant vegetation, and protecting existing and future hollow-bearing trees (OEH, 2012a). The Project involves the removal of approximately 25 ha of high abundance Allocasuarina habitat and 14 ha of low abundance Allocasuarina habitat for the Glossy Black-cockatoo, which constitutes a substantial proportion of known Glossy Black-cockatoo habitat in the study area. While the removal of this vegetation is inconsistent with the above suggested recovery actions, there is known habitat for the species that would be conserved and enhanced in the proposed Offset areas (63 ha of high abundance Allocasuarina habitat and 166 ha of low abundance habitat). Moreover, revegetation in Offset areas and Biodiversity Enhancement Area with additional feed trees for this species and use of *Allocasuarina* spp. in the rehabilitation of the post-mine landforms is consistent with these suggested actions.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Glossy Black-cockatoo include the clearing of native vegetation, the removal of hollow-bearing and dead trees, and excessively frequent fire (OEH, 2012a).

The Project would result in the clearing of native vegetation, resulting in a loss of approximately 25 ha of high abundance Allocasuarina habitat and 14 ha of low abundance habitat, and while Glossy Black-cockatoos have not been recorded breeding in the area, potential nesting habitat such as hollow bearing trees would also be removed. Some of the habitat that would be lost is known Glossy Black-cockatoo habitat and constitutes a substantial proportion of the potential foraging habitat in the Project area. Thus the clearing of vegetation as a result of the Project is likely in the short-term to increase the impact of a key threatening process on this species but is unlikely to do so in the medium to long-term due to the proposed Offset, and the rehabilitated and revegetation of post-mining landforms.

Conclusion

The Project would impact the Glossy-black Cockatoo through removal of known foraging habitat and some potential breeding habitat. Approximately 18% of the area of potential habitat with high abundance of *Allocasuarina* spp. in the study area would be removed. However, the Project is unlikely to have a significant impact on the Glossy-black Cockatoo because:

- from a regional perspective, only a small amount of potential and/or known foraging habitat would be removed (approximately 25 ha of native vegetation with high abundance of *Allocasuarina* spp. and 14 ha with low abundance) (Section 7);
- known foraging habitat consisting of stands of *Allocasuarina* spp. would be conserved in the Offset areas (63 ha with high abundance of *Allocasuarina* spp. and 166 ha with low abundance) (Section 7);
- additional areas of known foraging habitat also exist in nearby locations outside the Project and Offset areas;
- potential breeding habitat would be conserved in the Offset areas, given the presence of hollows, known foraging habitat and observational records for the species;
- the impacts of habitat fragmentation from the Project are only likely to be minor for this highly mobile and wide-ranging species; and
- the species occurs throughout the Gloucester Valley, including in the Offset areas and in the Glen Nature Reserve.

Further to the above, revegetation programmes within the area, including plantings of stands of *Allocasuarina* spp., would be undertaken in parts of the Offset areas (Section 7) and some of the post-mining landforms would also be rehabilitated and revegetated with *Allocasuarina* spp.

Gang-gang Cockatoo (Callocephalon fimbriatum)

The Gang-gang Cockatoo is listed as vulnerable in NSW under Schedule 2 of the TSC Act. The distribution of the Gang-gang Cockatoo extends from southern Victoria through south and central eastern NSW. In NSW, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee (OEH, 2012a).

The Gang-gang Cockatoo is found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, it may occur at lower altitudes in drier more open eucalypt forests and woodlands, and is often found in urban areas. It may also occur in sub-alpine Snow Gum (*Eucalyptus pauciflora*) woodland and occasionally in temperate rainforests. In these habitats it moves to lower altitudes in winter, preferring more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. The Gang-gang Cockatoo favours large continuous areas of forest rather than smaller remnants (Lindenmayer *et al*., 2002) and they prefer old growth attributes for nesting and roosting (OEH, 2012a). They feed mainly on the seeds of tree and shrubs, including eucalypts, wattles and introduced hawthorns, but also may consume insects, larvae and fruit.

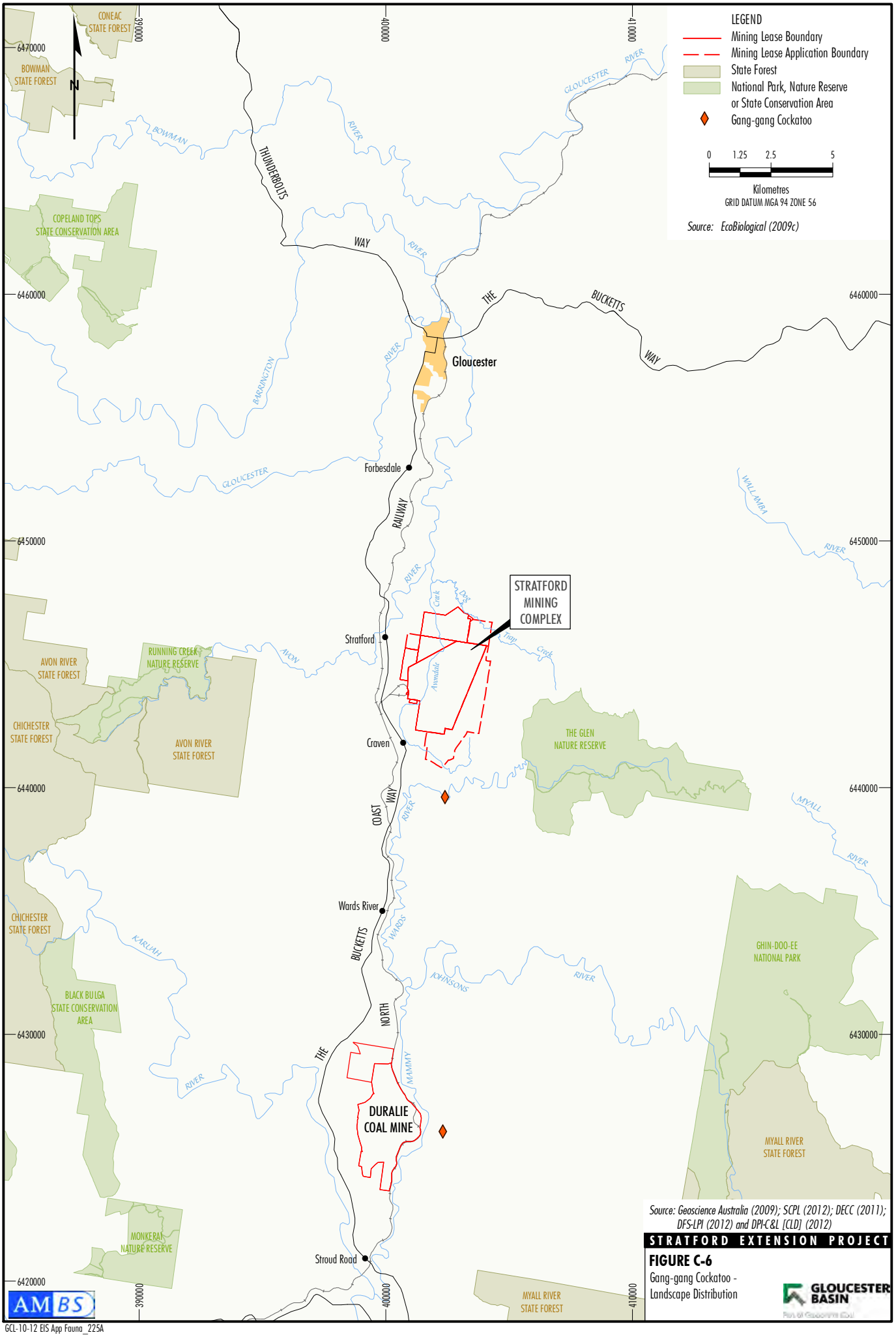
(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Gang-gang Cockatoo has been recorded on two occasions in the wider Gloucester Valley (Figures 4a and C-6). Potential foraging habitat for this species occurs within the Stratford Mining Complex (Figure C-2).

The Project would result in the removal of approximately 105 ha of potential foraging habitat of native vegetation (i.e. dry sclerophyll forest, grassy woodland and wet sclerophyll forest) and a further 26 ha of cleared land that could be utilised by the Gang-gang Cockatoo. This impact is only expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding area, and the area of potential habitat conserved and enhanced in the proposed Offset areas (490 ha of native vegetation and a further 40 ha of cleared land that could be utilised by these species). Additionally, following revegetation of Offset areas a further 435 ha of native vegetation will be potentially available for this species, as well as revegetated areas of the post-mining landforms. A local population of this species is unlikely to exist in the Stratford Mining Complex; rather this species is either seasonally nomadic and may inhabit the area during the non-breeding winter. Given this, the Project would not be likely to place either species at risk of local extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-6

Gang-gang Cockatoo - Landscape Distribution

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(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would result in the removal of approximately 105 ha of potential foraging habitat in native vegetation (i.e. dry sclerophyll forest, grassy woodland and wet sclerophyll forest) and a further 26 ha of cleared land that could be utilised by this species. Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.
(ii) Removal of vegetation as a result of the Project cause fragmentation or isolation of habitat, but the impact from this is only likely to be minor given the highly mobile and wide-ranging nature of the species.
(iii) The proposed loss of 105 ha of native vegetation and 26 ha of cleared land that this species could utilise is only minimal when compared to the large areas of higher quality habitat in the region and surrounding area. Furthermore, 490 ha of native vegetation and 40 ha of cleared land that this species could utilise would be conserved and improved in the offset area. Additional habitat (up to 435 ha) would also be created in the proposed Offset areas through the revegetation programme. Therefore, this species is not expected to be reliant upon habitat in the Stratford Mining Complex for its long-term survival.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for the Gang-gang Cockatoo has been declared by the Minister for the Environment or any relevant LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Gang-gang Cockatoo. OEH (2012a) lists a number of recovery strategies for this species. Recovery strategies of relevance to this Project includes: the planning of bushfire mitigation and sympathetic planting of known feed tree species.

The Project would involve the removal of approximately 105 ha of potential foraging habitat for the species. However, the offset would both protect foraging habitat and ensure additional areas become available in the long-term through revegetation programmes. Further, the Project would also include bushfire management. Therefore, the proposed action is not inconsistent with these recovery strategies.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Clearing of native vegetation is a key threatening processes of relevance to the Gang-gang Cockatoo (OEH, 2012a). The Project would result in the clearing of 105 ha of native vegetation, and therefore cause a small loss of foraging habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the region, adjacent area, the potential to conserve and enhance habitat for this species in the proposed Offset areas (490 ha) and the additional habitat that would be created through revegetation of Offset areas (up to 435 ha). Further, post-mining landforms would be rehabilitated and revegetated.

Conclusion

It is anticipated that the Project would potentially impact on the Gang-gang Cockatoo due to the removal of potential foraging habitat for this species. Overall, the Project is unlikely to have a significant impact on the Gang-gang Cockatoo such that a local viable population would be placed at risk of extinction given:

- the Gang-gang Cockatoo has not been recorded within the Stratford Mining Complex, and few records exist from the wider locality;
- from a regional perspective, the Project would only remove a small area of potential foraging habitat (105 ha primarily composed of dry sclerophyll forest, grassy woodland and wet sclerophyll forest, and a further 26 ha of cleared land);
- the impacts of habitat fragmentation from the Project are only likely to be minor for this highly mobile and wide-ranging species; and
- there is likely to be substantial habitat for this species in the surrounding areas.

Further to the above, potential habitat for the species would be conserved and improved in the region in the long-term due to the proposed Offset areas, including conservation of 490 ha of wet sclerophyll forest, grassy woodland and dry sclerophyll forest composed of equivalent and/or additional vegetation types, and 40 ha of cleared land (Section 7). Additional potential habitat would be created through revegetation of cleared land in Offset areas (up to 435 ha), and post-mining landforms would be rehabilitated and revegetated.

Little Lorikeet (Glossopsitta pusilla)

The Little Lorikeet is listed as vulnerable is NSW under Schedule 2 of the TSC Act. The distribution of the Little Lorikeet extends from North Queensland along the east coast of Australia to Adelaide (NSW Scientific Committee, 2009), and within NSW can occur westward as far as Dubbo and Albury (OEH, 2012a). The species mostly occurs in dry, open eucalypt forests and woodlands (NSW Scientific Committee, 2009). They are considered to be nomadic, with movements apparently related to food availability (NSW Scientific Committee, 2009). They are gregarious, travelling and foraging in small flocks, which are often mixed with other species of lorikeet (OEH, 2012a). They feed primarily on nectar and pollen, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes, and sometimes fruits (NSW Scientific Committee, 2009). Nesting occurs in small tree hollows (OEH, 2012a).

Threats to the Little Lorikeet include clearing of woodlands and the subsequent decrease in food availability, leading to reduced survival and breeding success. The loss of hollow-bearing trees, which are required for breeding, is also a threat to this species.

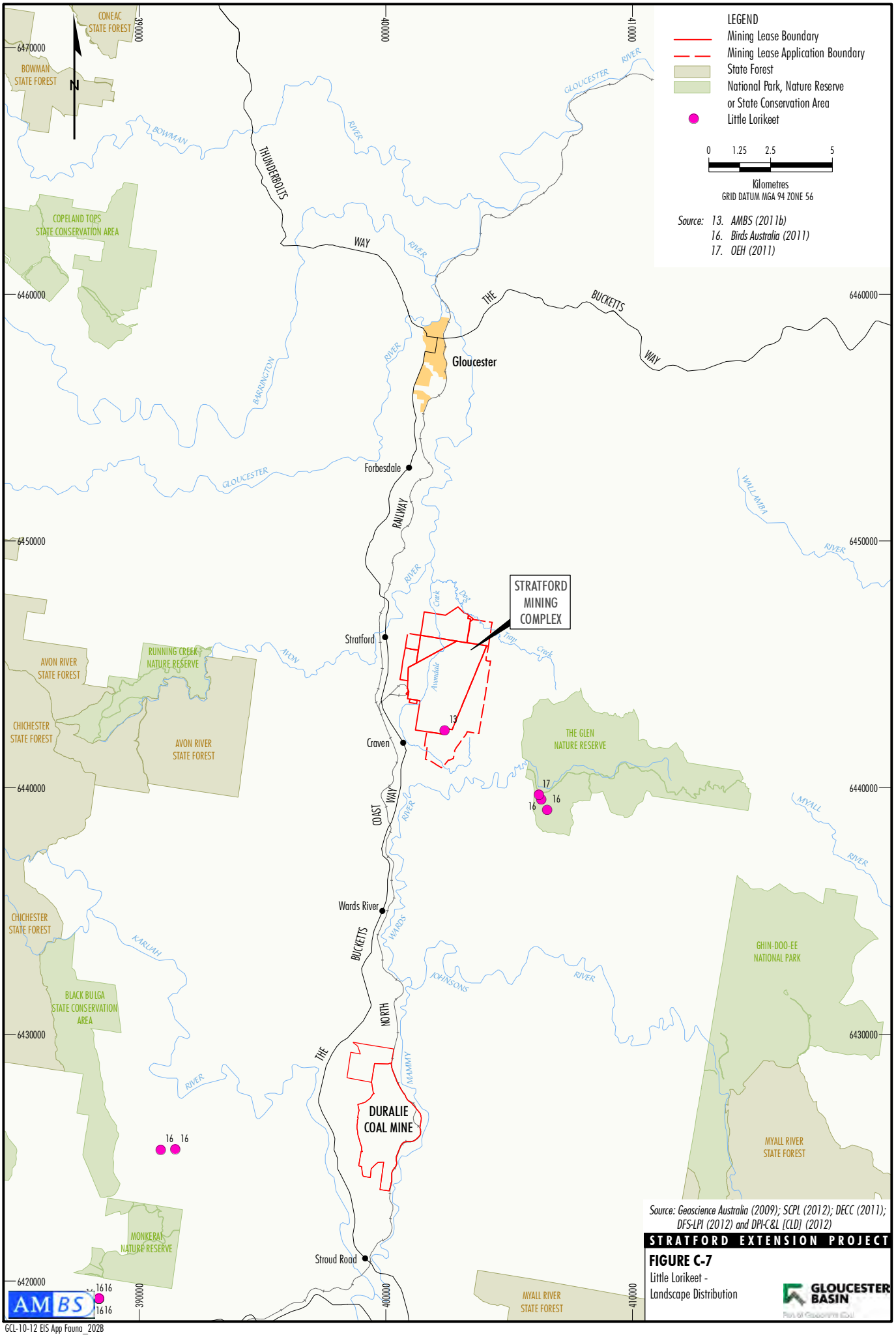
(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Little Lorikeet has been recorded within the Stratford Mining Complex, and potential habitat would be removed as a result of the Project (Figure 4a). The species has also been recorded in the wider area (Figure C-7). The Project would result in the removal of approximately 105 ha of potential native vegetation foraging habitat (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 26 ha of cleared land that could be utilised by this species (Figure C-2). The habitat that would be removed also contains potential nesting hollows for the Little Lorikeet. The density of tree hollows within the Project area is mostly less than 10 per hectare, except in two small patches where tree hollow density is greater than 20 per hectare (Figure 9). A portion of this habitat represents potential nesting or refuge habitat for this species.

Considering the amount of suitable foraging and breeding habitat that is available in the surrounding area, the amount of habitat that would be preserved in the Offset areas (490 ha of native vegetation including wet sclerophyll forest, grassy woodland, dry sclerophyll forest and 40 ha of cleared land that could be utilised by this species), and the revegetation programmes, it is unlikely that the proposed action would have an adverse effect on the life cycle of this highly mobile and wide-ranging species such that a viable local population is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-7

Little Lorikeet - Landscape Distribution

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(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would result in the removal of approximately 105 ha of potential foraging habitat in native vegetation, a further 26 ha of cleared land that could be utilised by this species, and the removal of hollow-bearing trees. The density of tree hollows within the Project area is mostly less than 10 per hectare, except in two small patches where the tree hollow density is greater than 20 per hectare (Figure 9). A portion of this habitat represents potential nesting or refuge habitat for this species. Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) The Project would increase fragmentation of potential habitat, but the impact from this is only likely to be minor given the highly mobile nature of the species.

(iii) Only a relatively small amount of potential habitat would be cleared (approximately 105 ha of native vegetation and 26 ha of cleared land that this species could utilise) and considerable suitable habitat occurs in the surrounding area. In addition, approximately 490 ha of suitable habitat in native vegetation and a further 40 ha of cleared land that could be utilised by this species would be conserved and improved in the Offset areas and up to 435 ha of cleared land would be potentially created through revegetation. Further, post-mining landforms would be rehabilitated and revegetated. Therefore, it is considered that the habitat to be removed is unlikely to adversely impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No “critical habitat” for the Little Lorikeet has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan has been prepared for the species. OEH (2012a) makes a number of suggestions for the recovery of this species including, retaining large, hollow-bearing trees, ensuring recruitment of trees into the mature age class to allow future hollow formation, protecting large flowering Eucalyptus trees throughout the habitats frequented by this species. Considering only a small amount of potential habitat would be cleared, and that the offset would both protect large flowering trees and ensure trees are able to mature into hollow-bearing trees, the action proposed is not inconsistent with these suggested recovery actions.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes that are relevant to this species include clearing of native vegetation and the loss of hollow-bearing trees. The Project would result in 105 ha of native vegetation being cleared and the loss of potential nesting-hollows. The density of tree hollows within the Project area is mostly less than 10 per hectare, except in two small patches where the tree hollow density is greater than 20 per hectare (Figure 9). A portion of this habitat represents potential nesting or refuge habitat for this species.

In the short-term there is likely to be a relatively small increase in a key threatening process. However it is unlikely that these processes would have a significant adverse impact on this species considering the availability of large areas of potential habitat in the region and the surrounding area, the native vegetation that would be conserved in the Offset areas (490 ha), and the amount of additional habitat that would be potentially created through revegetation of Offset areas (up to 435 ha) and post-mining landforms.

Conclusion

It is anticipated that the Project would potentially impact the Little Lorikeet due to the removal of potential foraging and breeding habitat for the species. In the short-term there is likely to be a relatively small increase in a key threatening process (clearing and loss of hollows). However, the Project is not likely to have a significant adverse impact on this species such that a local viable population would be placed at risk of extinction given:

- the Little Lorikeet has only rarely been recorded in the area (one occasion Figure 4a);
- only a relative small amount of potential habitat would be cleared (105 ha of potential foraging habitat in native vegetation [i.e. primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest]) and a further 26 ha of cleared land that could be utilised by this species (Section 7);
- the impacts of habitat fragmentation from the Project are only likely to be minor for this highly mobile and wide-ranging species; and
- there is substantial extant areas of habitat for this species in the region and in the surrounding area, including in the Glen Nature Reserve where this species is known to occur.

Further to the above, potential habitat in the Offset areas would be conserved and improved (approximately 490 ha of wet sclerophyll forest, grassy woodlands and dry sclerophyll forest composed of equivalent and/or additional vegetation types and 40 ha of cleared land that this species could utilise) (Section 7). Additional potential habitat would be created through revegetation of cleared land in offsets (up to 435 ha) and post-mining landforms (Section 7).

Swift Parrot (Lathamus discolour)

The Swift Parrot is listed as an endangered species under both Schedule 2 of the TSC Act and nationally on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Swift Parrot population is estimated to number less than 2,500 mature individuals. Within the parrot's breeding range the area of occupancy is less than 500 square kilometres (km^2) and the population has a severely fragmented distribution. A continuing decline in the number of mature individuals and in habitat extent and quality is projected unless action is taken to address the threats to the species (Swift Parrot Recovery Team, 2001).

The Swift Parrot breeds only in Tasmania and migrates to mainland Australia in autumn. Birds disperse widely across south-eastern Australia. Until recently it was believed that in NSW, Swift Parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region. However, evidence is gathering that the forests on the coastal plains from southern to northern NSW are also extremely important (Swift Parrot Recovery Team, 2001). NSW coastal areas provide important drought-refuge habitats for a large proportion of the population (Saunders and Heinsohn 2008). The abundance of Swift Parrots on mainland Australia fluctuates significantly between years and regions (Kennedy and Tzaros, 2005; Saunders and Heinsohn, 2008). During winter it is semi-nomadic, foraging for lerps and nectar and pollen in winter-flowering eucalypts such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*) (OEH, 2012a). Commonly used lerp-infested trees include Grey Box (*E. microcarpa*), Grey Box (*E. moluccana*) and Blackbutt (*E. pilularis*). The fruits and seeds of native and exotic plants are eaten in suburban environments. Landscapes containing winter foraging habitat include scattered trees, remnant vegetation and continuous forests within which foraging sites are used repeatedly, highlighting their likely importance for conservation (Saunders and Heinsohn, 2008).

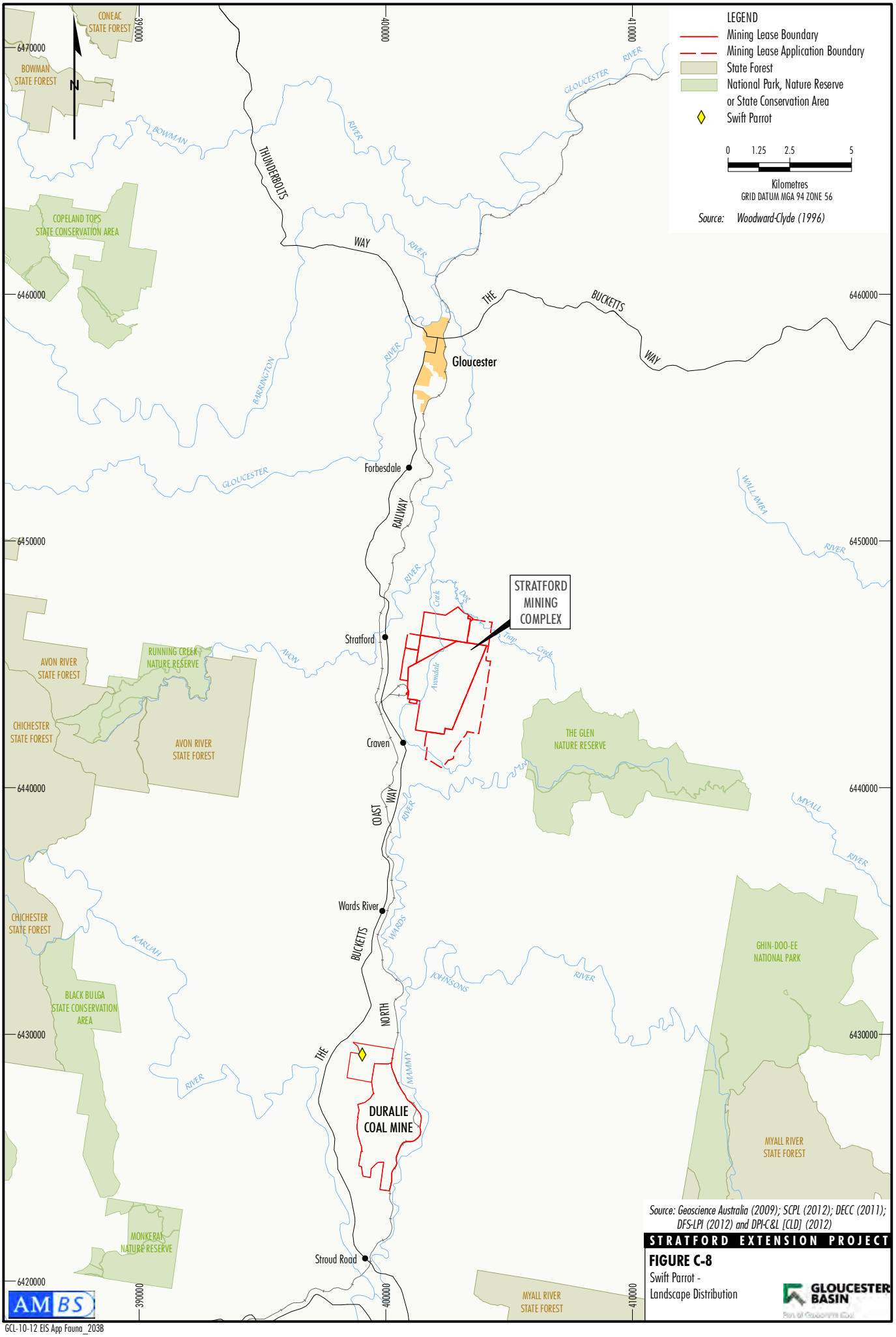
Swift Parrots return to Tasmania in early august with most of the population arriving by mid-September.

The Swift Parrot is threatened by a number of factors on the mainland, including loss of habitat through clearing for agriculture, and urban and industrial development (OEH 2012a). Collisions with wire netting fences, windows and cars, during the breeding season and winter migration also pose a threat.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Swift Parrot has not been recorded in the Project area or immediate surrounds but there is a previous recording of this species approximately 15 km away (Figure C-8). Potential foraging habitat for this species occurs within the Project area and wider Gloucester Valley (Figure C-9).

The Project would result in the removal of approximately 105 ha of potential foraging habitat of native vegetation and a further 28 ha of cleared land that could be utilised by the Swift Parrot (i.e. dry sclerophyll forest, grassy woodland and wet sclerophyll forest).



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-8

Swift Parrot - Landscape Distribution

GLOUCESTER BASIN

AMBS

GCL-10-12 EIS App Fauna_203B

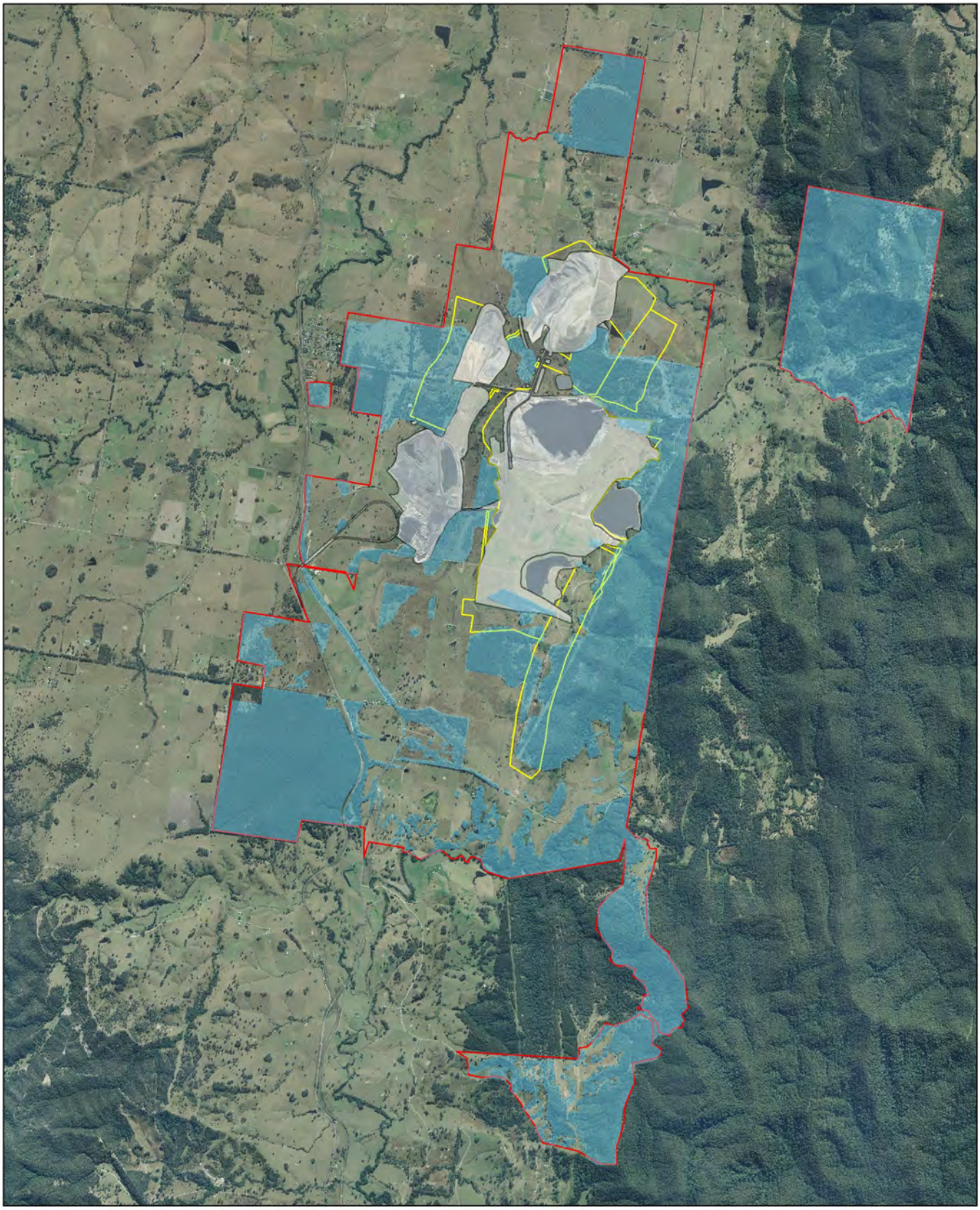


Figure C-9: Swift Parrot - Potential Habitat

0 0.5 1 2 Kilometres

Legend

- Potential Habitat
- Approximate Extent of Existing/Approved Surface Development
- Approximate Extent of Additional Project Surface Development
- Study Area

Notes: areas unmapped inside the study area are considered unlikely habitat where there is a low probability that the species would occur.

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AMBS

This impact is only expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding area, the area of potential habitat conserved and enhanced in the proposed Offset areas (490 ha of native vegetation and a further 40 ha of cleared land that could be utilised by these species).

Additionally, following revegetation of Offset areas up to 435 ha of native vegetation will be available for this species. A local population of this species would not be resident in the locality; rather the species is nomadic and may inhabit the area between March and October when flowering feed trees are present. Swift Parrots are known to breed elsewhere; breeding in Tasmania. Given this, the Project would not be likely to place this species at risk of local extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would result in the removal of approximately 105 ha of potential foraging habitat in native vegetation (i.e. dry sclerophyll forest, grassy woodland and wet sclerophyll forest) and a further 28 ha of cleared land that could be utilised by the species. Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) The Project would increase fragmentation of potential foraging habitat, but the impact from this is only likely to be minor given the highly mobile nature of the species.

(iii) The proposed loss of 105 ha of native vegetation and 28 ha of cleared land that this species could utilise is only minimal when compared to the large areas of higher quality habitat in the region and surrounding area. Furthermore, 490 ha of native vegetation and 40 ha of cleared land that the species could utilise would be conserved and improved in the offset area. Additional habitat (up to 435 ha) would also be created in the proposed Offset areas and rehabilitated mine land. Therefore, this species is not expected to be reliant upon habitat in the Stratford Mining Complex for its long-term survival.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for the Swift Parrot has been declared by the Minister for the Environment or any relevant LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A Swift Parrot Recovery Plan has been prepared by the National Heritage Trust in 2001 (Swift Parrot Recovery Team, 2001). The specific objectives of relevance to the Project include the implementation of management strategies to protect and improve priority habitats and the protection and management the habitat of swift parrots at a landscape scale.

The Project would involve the removal of approximately 105 ha of potential foraging habitat for the species. However, the offset would both protect flowering feed trees and ensure new feed trees become available in the long-term through revegetation programmes. Therefore the proposed action is not inconsistent with these recovery strategies.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Clearing of native vegetation is a key threatening process of relevance to the Swift Parrot (Swift Parrot Recovery Team, 2001; OEH, 2012a).

The Project would result in the clearing of 105 ha of native vegetation, and therefore cause a small loss of foraging habitat from a regional perspective. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the region, adjacent area, the potential to conserve and enhance habitat for this species in the proposed Offset areas (490 ha) and the additional habitat that would be created through revegetation of offset areas (up to 435 ha).

Conclusion

It is anticipated that the Project would potentially impact on the Swift Parrot due to the removal of potential foraging habitat for this species. Overall, the Project is unlikely to have a significant impact on the Swift Parrot such that a local viable population would be placed at risk of extinction given:

- the Swift Parrot has only rarely been recorded in the general wider locality (one occasion);
- from a regional perspective, the Project would only remove a small area of potential foraging habitat (105 ha primarily composed of dry sclerophyll forest, grassy woodland and wet sclerophyll forest, and a further 28 ha of cleared land) (Section 7); and
- the impacts of habitat fragmentation from the Project are only likely to be minor for this highly mobile and wide-ranging species.

Further to the above, potential habitat for the species would be conserved and improved in the region in the long-term due to the proposed Offset areas, including conservation of 490 ha of wet sclerophyll forest, grassy woodland and dry sclerophyll forest composed of equivalent and/or additional vegetation types, and 40 ha of cleared land (Section 7). Additional potential habitat would be created through revegetation of cleared land in Offset areas (up to 435 ha) and rehabilitated post-mining landforms (Section 7).

Forest Owls: Powerful Owl (Ninox strenua), Barking Owl (Ninox connivens), Masked Owl (Tyto novaehollandiae) and Sooty Owl (Tyto tenebricosa)

These large forest owls are considered together as they have a similar ecology and habitat requirements. Separate species profiles have been compiled for each species but a combined 7 part test has been prepared for these four owl species.

Powerful Owl (*Ninox strenua*)
The Powerful Owl is listed as vulnerable in NSW under Schedule 2 of the TSC Act.

The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria (OEH, 2012a). In NSW, it is widely distributed throughout the eastern forests from the coast inland to the tablelands. Records are most concentrated on the coast and tablelands and are sparse and mostly historical inland (on the western slopes of the Great Dividing Range) (NSW Department of environment and Conservation [DEC], 2006). There is no seasonal variation in distribution.

The habitat of the Powerful Owl includes a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine (*Syncarpia glomulifera*), Black She-oak (*Allocasuarina littoralis*), Blackwood (*Acacia melanoxylon*), Rough-barked Apple (*Angorphora floribunda*), Cherry Ballart (*Exocarpus cupressiformis*) and a number of eucalypt species. The main prey items of the Powerful Owl are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider. There may be marked regional differences in the prey taken by Powerful Owls. For example in southern NSW, Ringtail Possum make up the bulk of prey in the lowland or coastal habitat. At higher elevations, such as the tableland forests, the Greater Glider may constitute almost all of the prey for a pair of Powerful Owls. Birds comprise about 10% of the diet, with flying foxes important in some areas. As most prey species require hollows and a shrub layer, these are important habitat components for the owl.

The Powerful Owl itself requires hollow-bearing trees for breeding. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. During the breeding season, the male Powerful Owl roosts in a "grove" of up to 20-30 trees, situated within 100-200 m of the nest tree where the female shelters. Pairs of Powerful Owls are believed to have high fidelity to a small number of hollow-bearing nest trees (OEH, 2012a) and will defend a large home range of 1380-4470 ha (Soderquist and Gibbsons, 2007). Powerful Owls are monogamous and mate for life. Nesting occurs from late autumn to mid-winter, but is slightly earlier in north-eastern NSW (late summer to mid-autumn).

Barking Owl (*Ninox connivens*)
The Barking Owl is listed as vulnerable in NSW under Schedule 2 of the TSC Act.

This owl species is found throughout continental Australia except for the central arid regions (OEH, 2012a). Although common in parts of northern Australia, the Barking Owl has declined greatly in southern Australia and now occurs in a wide but sparse distribution in NSW. Core populations exist on the western slopes and plains (especially the Pilliga) and in some northeast coastal and escarpment forests. Sometimes the owls extend their home range into urban areas, hunting birds in garden trees and insects attracted to streetlights.

Barking Owls inhabit woodland and open forest, including fragmented remnants and partly cleared farmland. Is flexible in its habitat use and hunting can extend in to closed forest and more open areas. Sometimes it is able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils. It roosts in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance. Barking Owls preferentially hunt small arboreal mammals such as Squirrel Gliders and Ringtail Possums, but when loss of tree hollows decreases these prey populations it becomes more reliant on birds, invertebrates and terrestrial mammals such as rodents and rabbits. It can also catch bats and moths on the wing, but typically hunts by sallying from a tall perch.

Barking Owls requires very large permanent territories in most habitats due to sparse prey densities. Monogamous pairs hunt over as much as 6,000 ha, with 2,000 ha being more typical in NSW habitats. For nest hollows large, old living eucalypts are preferred though dead trees are also used. Nest sites are used repeatedly over years by a pair, but they may switch sites if disturbed. Nesting occurs during mid-winter and spring.

Masked Owl (*Tyto novaehollandiae*)
The Masked Owl is listed as vulnerable in NSW under Schedule 2 of the TSC Act.

This medium sized owl occurs in a broad coastal band around most of mainland Australia and throughout Tasmania (OEH, 2012a). For the most part it occurs less than 300 km from the coast but overall records for this species fall within approximately 90% of NSW, with only the most arid north-western corner being excluded. There is no seasonal variation in its distribution.

Masked Owls live in dry eucalypt forests and woodlands from sea level to 1,100 m. They prefer forest habitats, but they often hunt along the edges of forests, including along roadsides. This species predominantly eats tree-dwelling and ground mammals. Rats are a popular prey item but they also eat possums, birds, reptiles and insects.

Masked Owls are territorial and pairs have a large home-range of 500 to 1,000 ha. They roost and breed in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.

Sooty Owl (*Tyto tenebricosa*)
The Sooty Owl is listed as vulnerable in NSW under Schedule 2 of the TSC Act.

It occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands (OEH, 2012a). Northern and southern NSW populations are disjunct separated by the Hunter Valley (Debus, 1994). Otherwise, there are no isolated populations (DEC, 2006). There is no seasonal variation in its distribution. The Sooty Owl occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests (OEH, 2012a), where they occupy large home-ranges of 990-3,025 ha (Bilney *et al*., 2011). It roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (*Pseudocheirus peregrinus*) or Sugar Glider (*Petaurus breviceps*). The diet of the Sooty Owl is likely to have changed significantly since European Settlement. A comparison of its current diet analysis and a comparison with its prehistoric and historic diet from bone deposits found in cave roosts showed that before European Settlement a large percentage of the diet consisted of terrestrial mammals and that the range of terrestrial mammal species preyed upon included at least 8 more species than its current diet (Bilney *et al*., 2006). Sooty Owls require very large tree hollows for nesting.

Significant habitat for large forest owls (information taken from the Recovery Plan for Large Forest Owls [DEC, 2006]).

Forest Owls respond to geomorphology, moisture regime, vegetation structure and consequent site productivity rather than specific floristics. The owls appear to prefer mid to late successional, mixed-age or multi-aged forest greater than 60 years old, although Powerful and Sooty Owls show no adverse relationship with management history and can forage in forest greater than 20 years old. By contrast, the Masked Owl prefers unlogged or lightly logged forest with high densities of old hollow trees and avoids young regrowth. Tree hollows used by many of the owls main prey species form in trees greater than 120 years old; those of a size used by owls for nesting and roosting form in trees greater than 150 and probably greater than 200 years old. Depending on forest productivity, several major prey species (the gliders and large possums) are each likely to require at least 1-2 hollow trees per hectare, and up to 10-20+ den trees per hectare in the best habitat. However, the most important prey species for the Powerful Owl and the Sooty Owl in many areas, the Common Ringtail Possum, does not require tree hollows provided there is a tall, dense shrub layer present in which it can build a drey among the foliage.

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

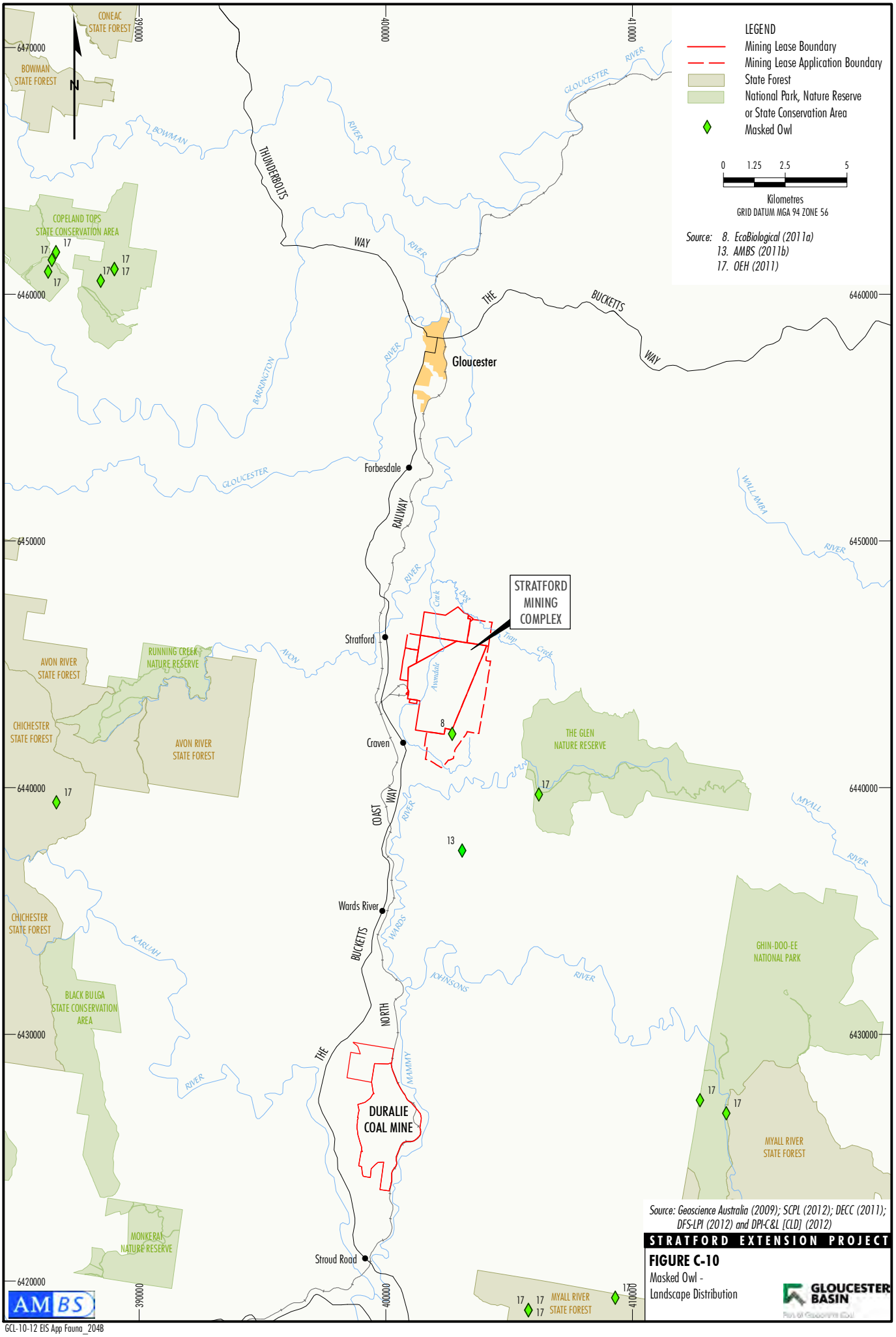
The only threatened owl to be recorded near the Project area is the Masked Owl (Figures 4a and C-10). The Sooty Owl was also recorded in the ranges east of the Project area (Figures 4a and C-11). The other owls (Powerful Owl and Barking Owl) have been recorded in the wider landscape (Figures C-12 and C-13). Potentially suitable foraging habitat for these species exists however in the Stratford Mining Complex (Figure C-14). Breeding habitat for any of the owl species is rare in the Stratford Mining Complex.

The Project would result in the removal of a relatively small amount of foraging habitat for the various owl species (105 ha of wet sclerophyll forest, grassy woodland, dry sclerophyll forest and 90 ha of cleared land that each species could utilise). The habitat that would be removed may also contain potential nesting hollows for the forest owls. The density of tree hollows within the Project area is mostly less than 10 per hectare, except in two small patches where the tree hollow density is greater than 20 per hectare (Figure 9). A portion of this habitat may represent potential nesting habitat for the owl species.

This impact of the Project on the Forest Owls (including the Masked Owl) is only expected to be minimal, when considering the large areas of potential habitat available in the region and the surrounding area, the amount of potential habitat that would be conserved and improved in the Offset areas (490 ha native vegetation native vegetation and 231 ha of cleared land that these species could utilise). Further, the Masked Owl has been recorded in Offset area 4 (Figure 4a). Additional areas of habitat would also be created through the revegetation programme. It is not considered that the Project would place a viable local population of either of the owl species at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

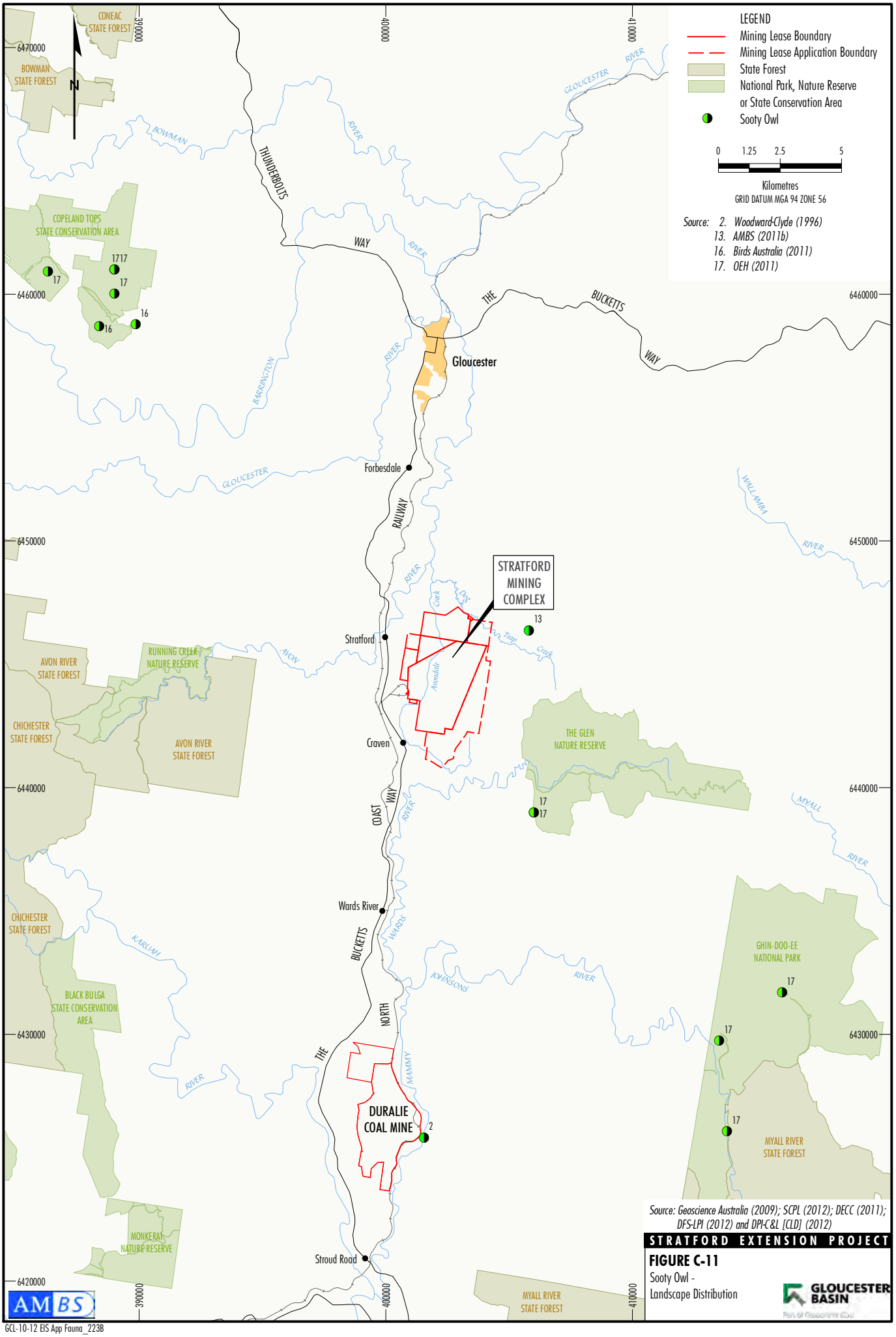
FIGURE C-10

Masked Owl - Landscape Distribution

AMBS

GLOUCESTER BASIN

GCL-10-12 EIS App Fauna_204B



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

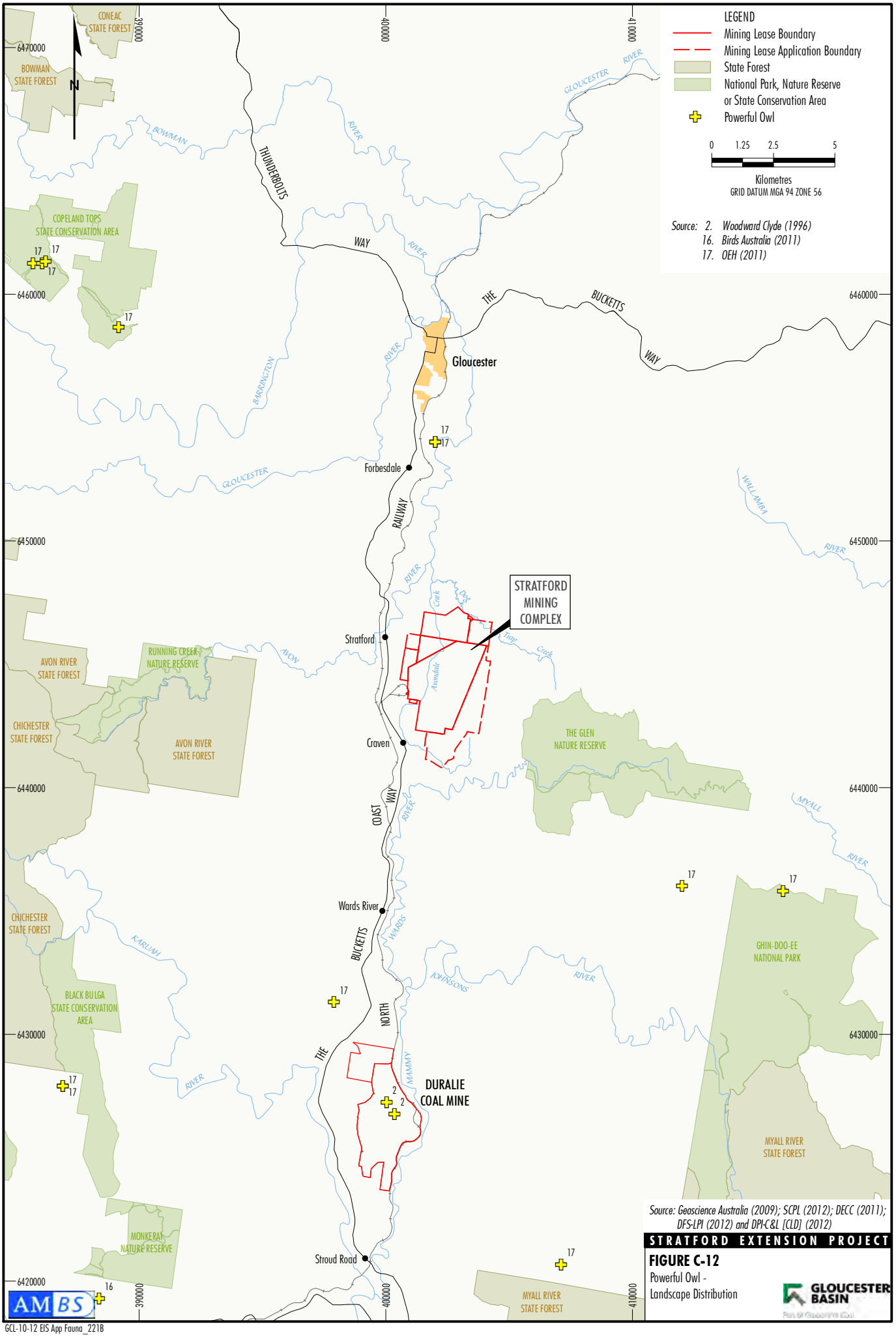
FIGURE C-11

Sooty Owl - Landscape Distribution

AMBS

GLOUCESTER BASIN

GCL-10-12 EIS App Fauna_223B



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

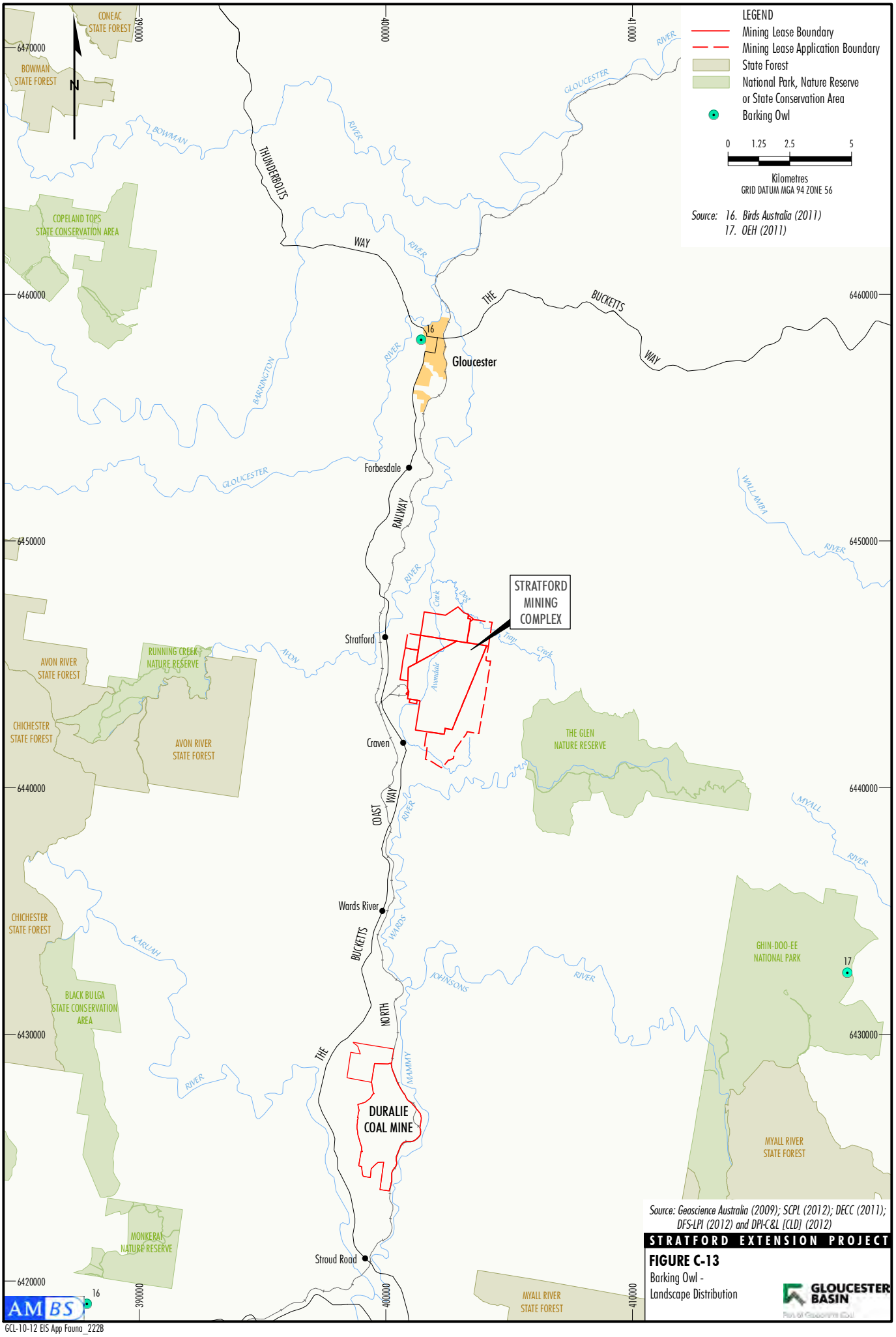
FIGURE C-12

Powerful Owl - Landscape Distribution

AMBS

GLOUCESTER BASIN

GCL-10-12 EIS App Fauna_221B



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-13

Barking Owl - Landscape Distribution

GLOUCESTER BASIN

AMBS

GCL-10-12 EIS App Fauna_222B

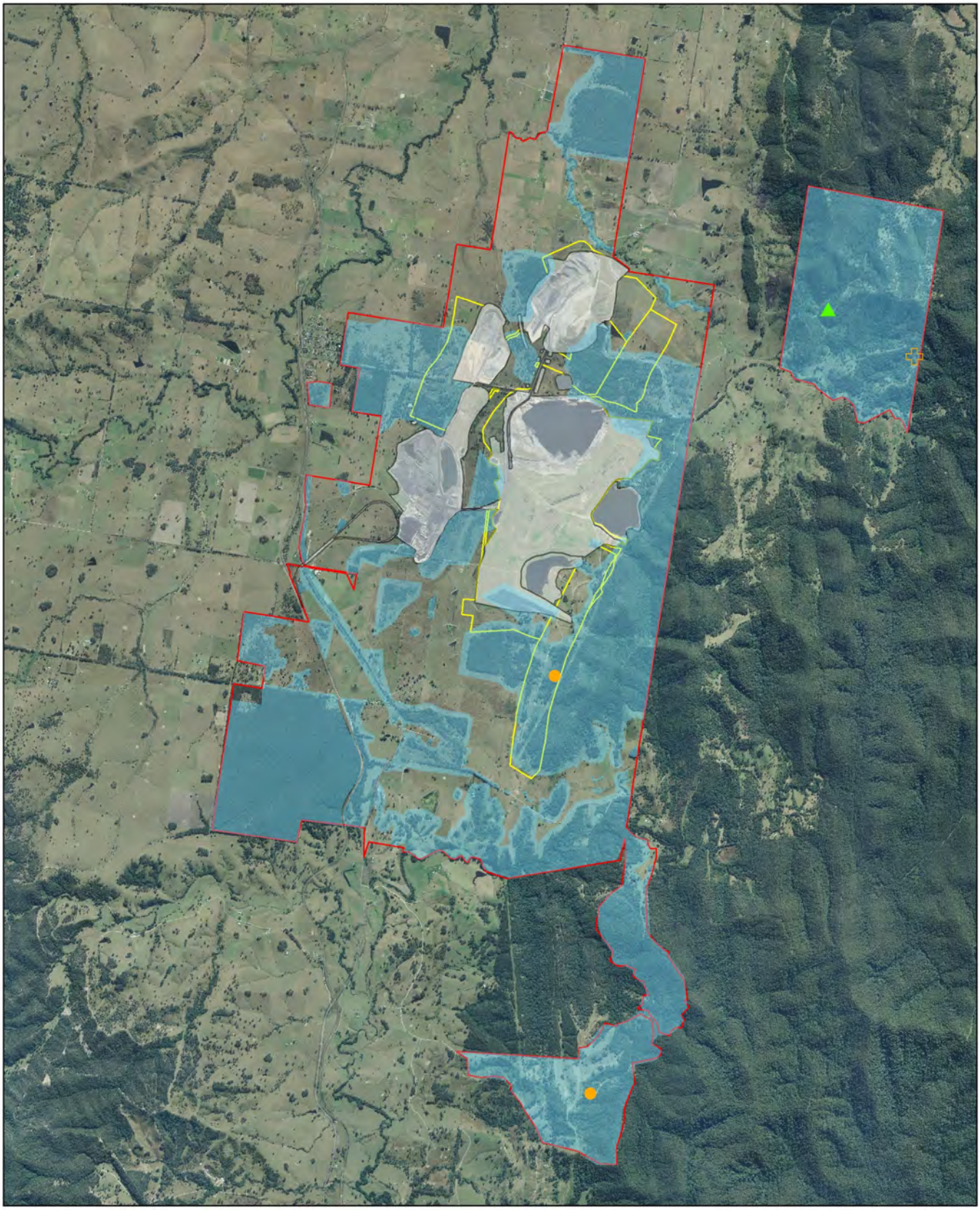


Figure C-14: Forest Owls - Potential Habitat

Areas of cleared land not mapped could also be used as foraging habitat.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would result in the removal of potential foraging habitat of the owl species (105 ha of wet sclerophyll forest, grassy woodland, dry sclerophyll forest and 90 ha of cleared land that each species could utilise). Breeding habitat (trees with hollows >20 cm) is scarce in the Stratford Mining Complex. Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) The habitat cleared as a result of the Stratford East Open Cut and the Avon North Open Cut would result in further fragmentation of forest owl habitat. Given their large home ranges and highly mobile nature, this fragmentation however is unlikely to lead to the isolation of habitat patches for these owl species.

(iii) Considering that only a relatively small amount of potential habitat would be cleared (105 ha for all owl species), considerable suitable habitat occurs in the region and surrounding area, and the low density of tree hollows in the Project area, the habitat is unlikely to be important for a population in the locality. Further, suitable habitat would be conserved and improved in the Offset areas (490 ha of native vegetation and a further 231 ha of cleared land that these species could potentially utilise) and up to 435 ha of cleared land would be revegetated, it is considered that the habitat to be removed is unlikely to adversely impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No “critical habitat” for either of the owl species has been declared by the Minister for the Environment or in the Gloucester LEP or relevant SEPP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A recovery plan for the large forest owls was produced by the DEC (2006). The recovery plan includes the Powerful Owl, Masked Owl and Sooty Owl. A separate draft recovery plan exists for the Barking Owl (NPWS, 2003). Objectives or actions relevant to the Project included in the recovery plans ensuring that impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment processes, minimizing further loss and fragmentation of habitat by protection and to undertake threat abatement and mitigation.

OEH (2012a) makes a number of suggestions for the recovery of these species including protecting woodland and open forest remnants, especially those containing hollow-bearing trees and native vegetation important for the survival of potential prey species, retaining standing dead trees and large fallen logs but also younger recruitment trees to replace older trees in the long-term.

While habitat loss and fragmentation are inconsistent with these actions, only a small amount of habitat would be cleared and substantial potential habitat exists in the surrounding area. Further, additional mitigation measures include the offset, which would ensure potential habitat is protected in perpetuity, and additional areas would be revegetated (up to 435 ha) some of which may provide potential habitat in the future. Post-mining landforms would also be rehabilitated and revegetated. The Offset areas would both protect large trees and ensure young trees are able to mature into hollow-bearing trees. Given the above, the action proposed is not inconsistent with these objectives and suggested recovery actions.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the owl species include the clearing of native vegetation (habitat for owls and their prey species) and loss of hollow bearing trees (OEH, 2012a).

The Project would result in the clearing of 105 ha of native vegetation of foraging habitat that may support prey species, and a further 90 ha of cleared land that these species could utilise. The Project would also result in the removal of dead wood and dead trees that may contain potential nesting hollows for the owls. The density of tree hollows within the Project area is mostly less than 10 hollows per hectare, except in two small patches where tree hollows occur at a density of greater than 20 hollows per hectare (Figure 9). A portion of this habitat represents potential nesting habitat for this species.

In the short-term there is likely to be a relatively small increase in a key threatening process. However, It is unlikely that these processes would have a significant adverse impact on these species considering the large amount of potential habitat in the surrounding area, the potential habitat that would be conserved in the Offset areas (490 ha of native vegetation and a further 231 ha of cleared land that these species could utilise) and the amount of additional habitat that would potentially be created through revegetation of Offset areas (up to 435 ha) and post-mining landforms.

Conclusion

It is anticipated that the Project would potentially impact these large forest owls due to the removal of potential foraging and breeding habitat for these species. In the short-term there is likely to be a relatively small increase in a key threatening process (clearing and loss of hollows). Similarly, the Project would remove potential foraging and breeding habitat for prey species. Overall, the Project is unlikely to have a significant impact on these species such that a local viable population would be placed at risk of extinction considering that:

- the Masked Owl and Sooty Owl have only been rarely recorded in the Project area or surrounds;
- the Powerful Owl and Barking Owl have not been previously recorded in the Project area or surrounds;
- from a regional perspective, the Project would only remove a relatively small area of potential foraging and breeding habitat for these species, consisting of the following (Section 7):
  - Masked Owl: 105 ha primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and 90 ha of cleared land that this species could utilise; and
  - Powerful Owl: 105 ha primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and 90 ha of cleared land that this species could utilise;
  - Barking Owl: 105 ha primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and 90 ha of cleared land that this species could utilise;
  - Sooty Owl: 105 ha of native vegetation potential foraging habitat, and 90 ha of cleared land that this species could utilise. Most likely roosting habitat within the Project Area is composed of 0.1 ha of wet sclerophyll forest;
- there is substantial habitat for these species in the surrounding area; and
- the impacts of habitat fragmentation from the Project are only likely to be minor for these highly mobile and wide-ranging species.

Further to the above, potential habitat in the Offset areas would be conserved and improved (490 ha of native vegetation composed of equivalent and/or additional vegetation types and 231 ha of cleared land that these species could utilise) (Section 7). Potential habitat would be created through revegetation of cleared land in offsets (up to 435 ha) and post-mining landforms (Section 7).

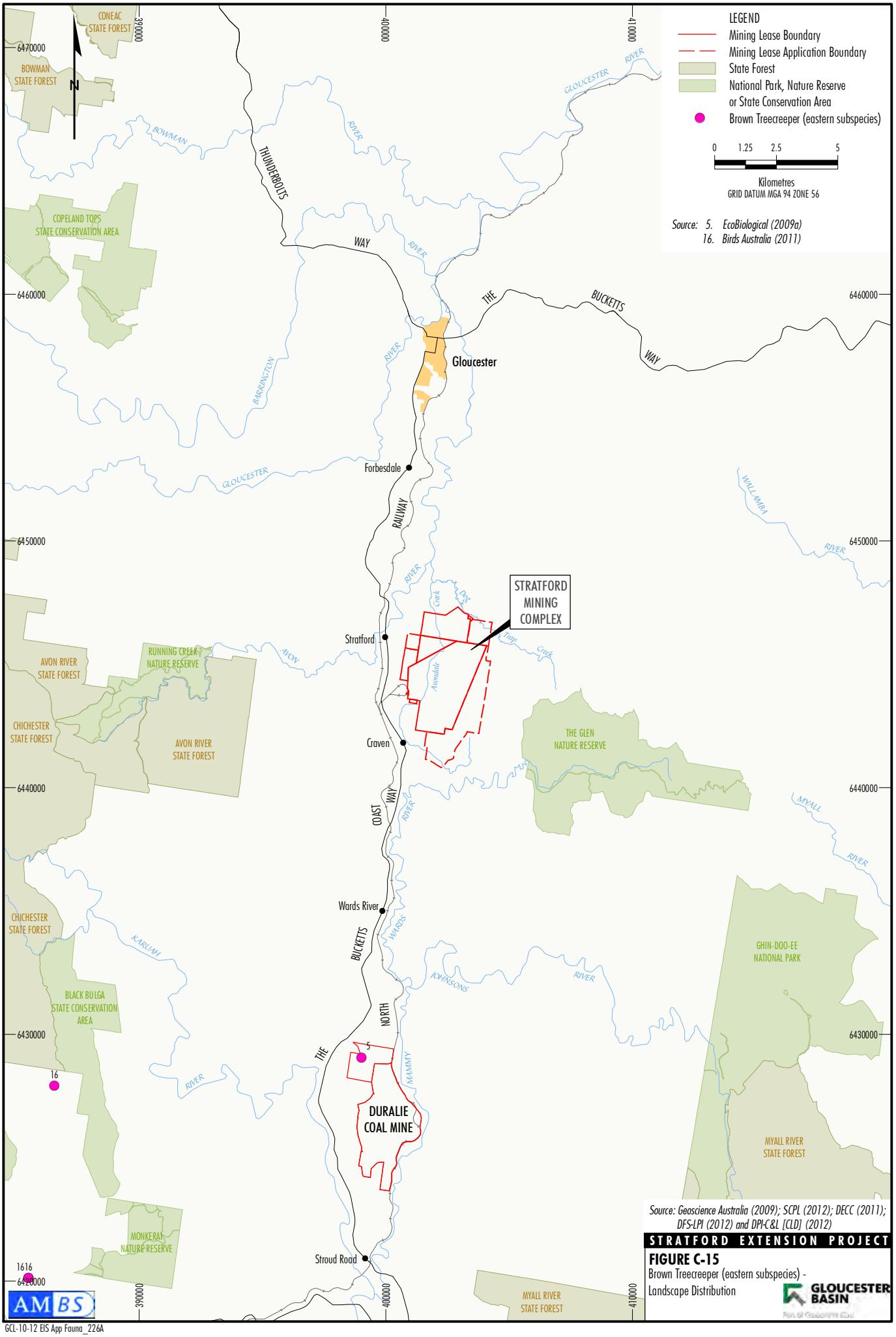
Brown Treecreeper (Climacteris picumnus victoriae), and Hooded Robin (south-eastern form) (Melanodryas cucullata cucullata)

These species are considered together due to similar habitat requirements. There are separate sections to introduce the species, but the impact assessment is combined for the two species.

Brown Treecreeper *(Climacteris picumnus victoriae)*
The Brown Treecreeper is listed as vulnerable in NSW under Schedule 1 of the TSC Act. The eastern subspecies of the Brown Treecreeper (*Climacteris picumnus victoriae*) is distributed through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys (NSW Scientific Committee, 2001a). It is found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range (OEH, 2012a). It mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey (OEH, 2012a). It is sedentary and nests in tree hollows within permanent territories, breeding in pairs or co-operatively in territories which range in size from 1.1 to 10.7 ha (mean = 4.4 ha) (Noske, 1991). Each group is composed of a breeding pair with retained male offspring and, rarely, retained female offspring (OEH, 2012a). Birds forage on tree trunks and on the ground amongst leaf litter and on fallen logs for ants, beetles and larvae (Noske, 1979).

This species is threatened by a number of processes including loss of woodland, forest and Mallee habitats as a result of agriculture, forestry, mining and residential development (OEH, 2012a). Fragmentation of woodland and forest remnants is a major threat (Ford *et al*., 2009), since the species appears to be unable to maintain viable populations in remnants less than 200 ha, and its abundance decreases as remnant size decreases (Barrett *et al*., 1994). Furthermore, fragmentation leads to a skewed sex ratio in Brown Treecreeper populations because female birds are unable to disperse to isolated remnants, increasing the chance of local extinctions (Walters *et al*., 1999). It also leads to increased competition with aggressive honeyeater species and increased levels of nest predation (Major *et al*., 1998). Other threats include degradation of habitat, particularly the loss of tree hollows and fallen timber from firewood collection and overgrazing, as well as a lack of regeneration of eucalypt overstorey in woodland due to overgrazing and too-frequent fires (OEH, 2012a). The loss of ground litter from compaction and overgrazing also leads to a decrease in diversity of ground-dwelling invertebrates (Bromham *et al*., 1999) decreasing the availability of food for the birds (OEH, 2012a).

Potential habitat for the species occurs throughout the lowland areas of the Stratford Mining Complex, but the species has not been recorded in the Stratford Mining Complex during recent surveys and few records exist from the locality (Figures C-15 and C-16). It appears unlikely that there is a resident population of this species within the Stratford Mining Complex. Areas of suitable habitat for this species occur within the Offset areas.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-15

Brown Treecreeper (eastern subspecies) - Landscape Distribution

GLOUCESTER BASIN

AMBS

GCL-10-12 EIS App Fauna_226A

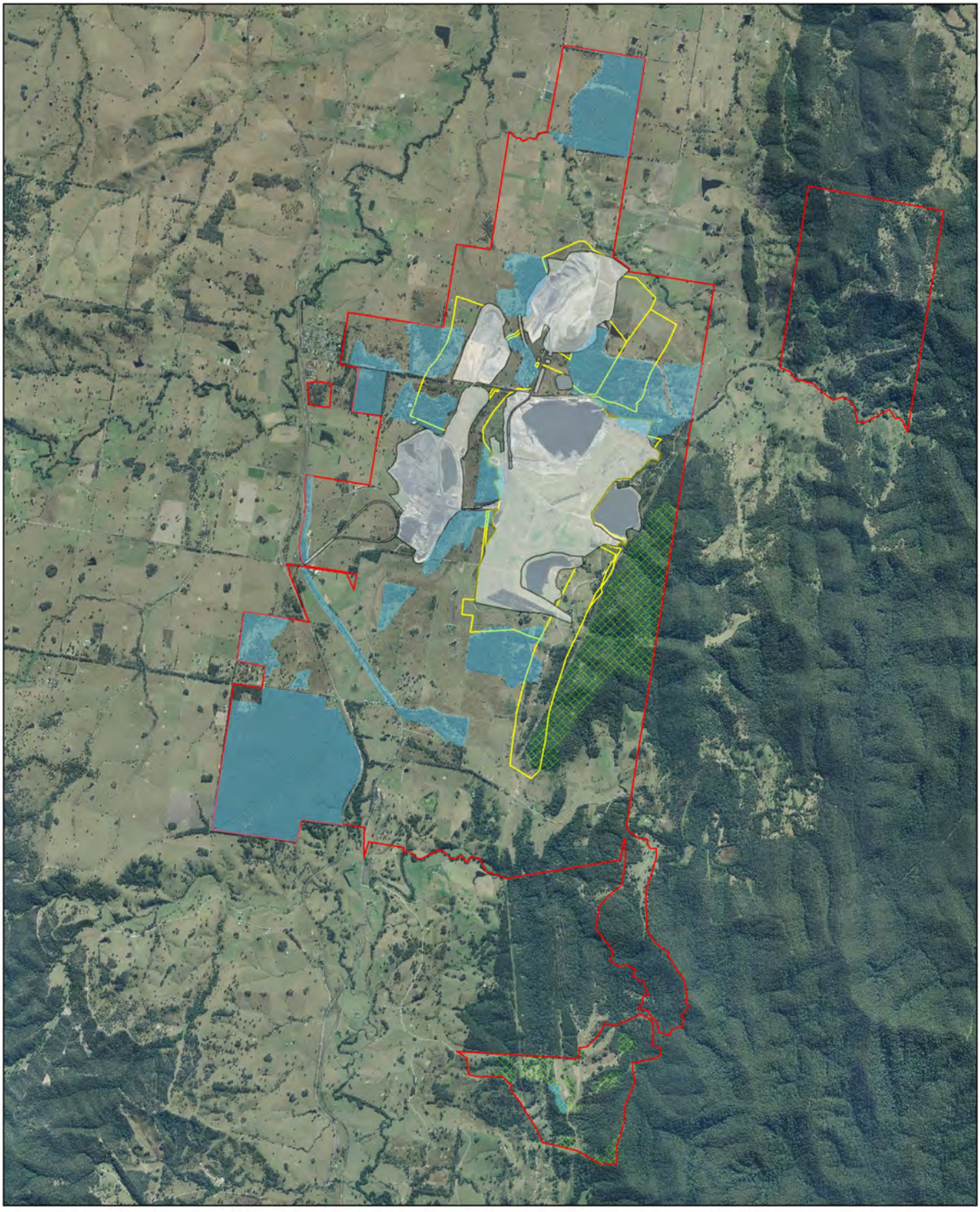


Figure C-16: Brown Treecreeper (eastern subspecies) - Potential Habitat

0 0.5 1 2 Kilometres

Legend

- Potential Habitat
- OEH Predicted Habitat
- Approximate Extent of Existing/Approved Surface Development
- Approximate Extent of Additional Project Surface Development
- Study Area

Notes: areas unmapped inside the study area are considered unlikely habitat where there is a low probability that the species would occur.

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Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*)

The Hooded Robin (south-eastern form) is listed as vulnerable is NSW under Schedule 2 the TSC Act.

It is widespread, found across Australia, except for the driest deserts and the wetter coastal areas northern and eastern coastal Queensland and Tasmania (OEH, 2012a). However, it is common in few places, and rarely found on the coast. It is considered a sedentary species, but local seasonal movements are possible. The south-eastern form (subspecies *cucullata)* is found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west, where it is replaced by subspecies *picata*. Two other subspecies occur outside NSW.

The Hooded Robin (south-eastern form) prefers lightly wooded country, usually open eucalypt woodland, Acacia scrub and Mallee, often in or near clearings or open areas. It requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses (OEH, 2012a). Recent modelling found that the Hooded Robin (south-eastern form) is most often associated with the edges of open vegetation dominated by ungrazed or lightly grazed grassy ground cover in which species of native perennial tussock-grass predominate, adjoining timbered native vegetation cover, on moderately deep to deep soils (Priday, 2010). The bird often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey. Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season. The Hooded Robin (south-eastern form) may breed any time between July and November, often rearing several broods. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1-5 m above the ground. The nest is defended by both sexes with displays of injury-feigning, tumbling across the ground. A clutch of two to three is laid and incubated for fourteen days by the female. Two females often cooperate in brooding. Nest predation is often high and inadequate to replace annual mortality (Fitri and Ford, 2003).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Brown Treecreeper has not been recorded in the Stratford Mining Complex and only three records exist in the wider area (Figure C-15).

The Hooded Robin (south-eastern form) was rarely recorded in the locality and was not recorded within the Stratford Mining Complex during any recent surveys (last record is from 1994). Potential habitat is limited within the Stratford Mining Complex and the species is considered unlikely to occur in the Stratford Mining Complex (Figure C-17).

The Project would result in the removal of potential foraging and breeding habitat in native vegetation, (i.e. dry sclerophyll forest and grassy woodland [66 ha for the Brown Treecreeper and 73 ha for the Hooded Robin (south-eastern form]). The habitat that would be removed also contains potential breeding hollows for the Brown Treecreeper. The density of tree hollows within the Project area is mostly less than 10 hollows per hectare, except in two small patches where tree hollows occur at a density of greater than 20 hollows per hectare (Figure 9). A portion of this habitat may represent potential nesting or refuge habitat for this species.

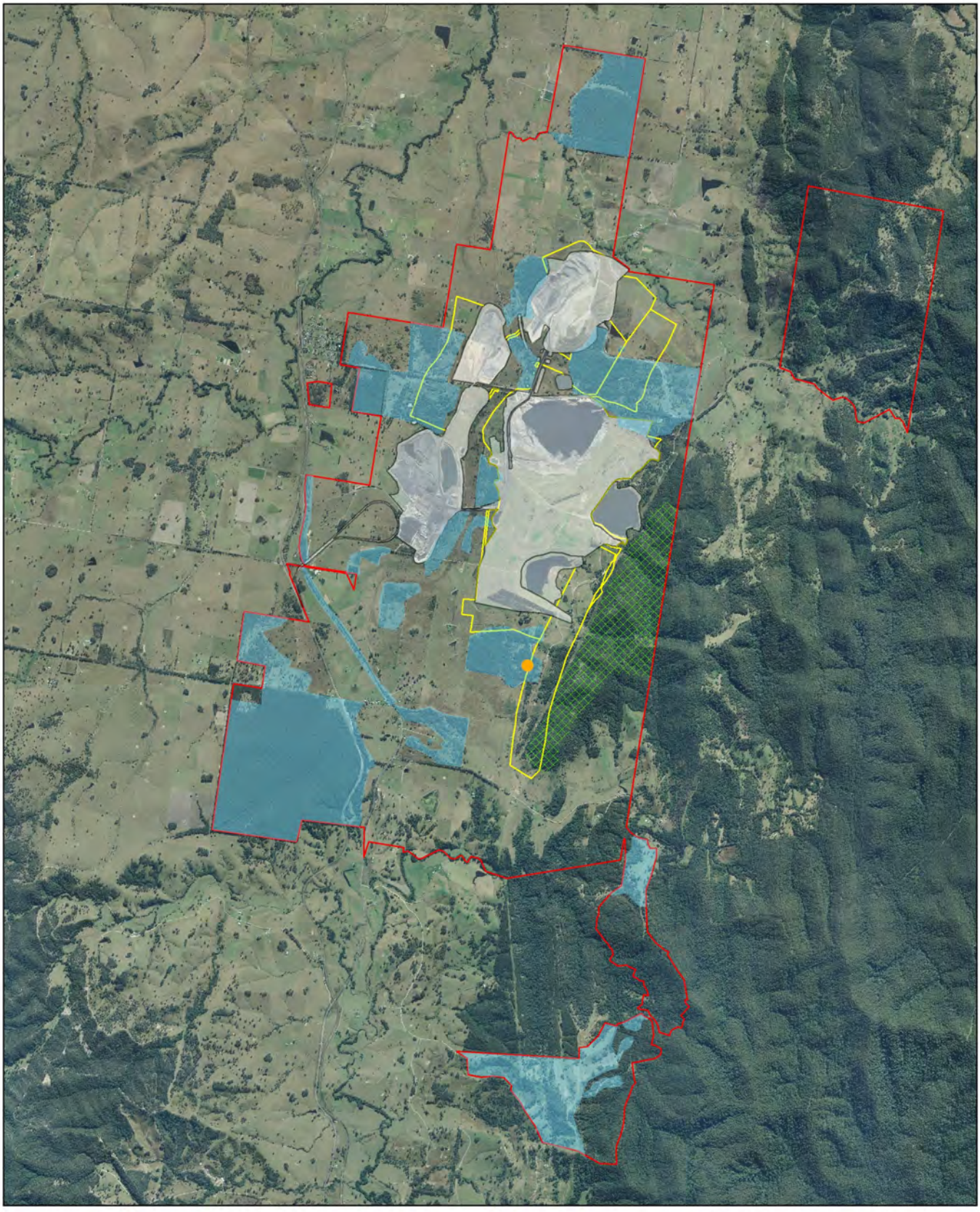


Figure C-17: Hooded Robin and Scarlet Robin - Potential Habitat

There is suitable foraging and breeding habitat available in the surrounding area and native habitat would be preserved in the Offset areas (137 ha for the Brown Treecreeper [i.e. Grassy woodland and dry sclerophyll forest] and 231 ha for the Hooded Robin (south-eastern form) [i.e. Grassy woodland and dry sclerophyll forest]). It is unlikely, therefore, that the proposed action would have an adverse effect on the life cycle of the species such that a viable local population is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would result in the removal of potential foraging and breeding habitat in native vegetation (66 ha for the Brown Treecreeper and 73 ha for the Hooded Robin [south-eastern form]). Hollow-bearing trees also occur in the habitat that is to be removed (at a density of mostly less than 10 per hectare). Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) No known habitat for these species would be removed fragmented or isolated as a result of the Project. The Project would result in the temporary fragmentation and isolation of potential habitat, until the revegetation programmes become established.

(iii) The Project would result in the loss of only a relatively small amount of potential habitat in native vegetation (Brown Treecreeper: 66 ha and Hooded Robin [south-eastern form]: 73 ha). Considerable suitable habitat occurs in the surrounding area and suitable native habitat (231 ha for Hooded Robin [south-eastern form] and 137 ha for Brown Treecreeper) would be preserved in the Offset areas. In addition, up to 435 ha of cleared land in the Offset areas would be revegetated, post-mining landforms would be rehabilitated and revegetated. Therefore, it is considered that the habitat to be removed is unlikely to adversely impact on the long-term survival of these species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for the Brown Treecreeper or Hooded Robin (south-eastern form) has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan has been prepared for either of the species. OEH (2012a) suggests a number of priority actions for the recovery of the species. These actions are very similar for the two species and include the protection of open woodland areas, open forest, grassland and Mallee from clearing, fragmentation and disturbance, the retention of hollow-bearing dead or living trees, stumps and hollow logs on the ground and the retention of and/or the increase of remnant size and connectivity.

Only a small amount of potential habitat in native vegetation (Brown Treecreeper: 66 ha and Hooded Robin [south-eastern form]: 73 ha) would be cleared. In addition, the offset would both protect habitat and ensure young trees are able to mature into hollow-bearing trees. The revegetation programme would likely create additional areas of potential habitat for both species. Therefore, the Project is not inconsistent with these suggested recovery actions.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes that are relevant to these species include clearing of habitat and the loss of hollow-bearing trees, removal of dead wood and trees, lack of regeneration of woodland and an increase in fragmentation and loss of habitat connectivity. The Project would result in foraging and breeding habitat in native vegetation being cleared (Brown Treecreeper: 66 ha, and Hooded Robin [south-eastern form]: 73 ha) and the loss of potential nesting-hollows, at a density of mostly less than 10 per hectare. It is also likely that some dead wood and dead trees would be removed. It is unlikely that these processes would have any significant adverse effect on these species considering the large amount of potential habitat in the surrounding area, the potential habitat in native vegetation that would be conserved in the Offset areas (231 ha for Hooded Robin [south-eastern form] and 137 ha for Brown Treecreeper), and the amount of additional habitat that would be created through revegetation of Offset areas (up to 435 ha). Further, dead wood would be retained and distributed throughout the revegetation areas.

Conclusion

It is anticipated that the Project would potentially impact these threatened woodland birds due to the removal of potential foraging and breeding habitat for these species. However, the Project is not likely to have a significant impact on these species such that a local viable population would be placed at risk of extinction given:

- few records exist of the species in the locality and they have not recently been recorded at the Stratford Mining Complex (last records in 1994) and resident populations of either species are unlikely to exist in the Project area;
- from a regional perspective, only a relative small amount of potential foraging and breeding habitat would be cleared for each species, consisting of the following (Section 7):
  - Brown Treecreeper: 66 ha primarily composed of grassy woodland and dry sclerophyll forest;
  - Hooded Robin (south-eastern form): 73 ha primarily composed of grassy woodland and dry sclerophyll forest; and
- potential habitat for these species occurs in the surrounding area; and

- the Project would result in only the temporary fragmentation and isolation of potential habitat, until the revegetation programmes become established (no known habitat would be impacted).

Further to the above, potential foraging and breeding habitat in the Offset areas would be conserved and improved (231 ha for the Hooded Robin [south-eastern form], and 137 ha for the Brown Treecreeper, of native vegetation composed of equivalent and/or additional vegetation types) (Section 7). In addition potential habitat would be created through revegetation of cleared land in offsets (up to 435 ha) and post-mining landforms (Section 7).

Diamond Firetail (Stagonopleura guttata)

The Diamond Firetail is listed as vulnerable is NSW under Schedule 2 of the TSC Act.

The Diamond Firetail occurs in south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. It is widely distributed in NSW, but not commonly found in coastal districts (OEH, 2012a). The species occurs in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) woodlands and also occurs in open forest, Mallee, natural temperate grassland, and in secondary grassland derived from other communities. It is often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland (OEH, 2012a). The birds roost in dense shrubs or in smaller nests built especially for roosting. The Diamond Firetail feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season) (OEH, 2012a). It is usually encountered in flocks of between five to 40 birds, occasionally more, these groups separate into small colonies to breed between August and January (OEH, 2012a). The species appears to be sedentary, though some populations move locally, especially those in the south (OEH, 2012a).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Few records for the Diamond Firetail exist in the locality, and it has not been recorded within the Stratford Mining Complex during recent surveys (last record is from 1994). This species is only likely to occur on occasion (Figure C-18). The Project would result in the removal of 105 ha potential foraging and breeding habitat in native vegetation, (i.e. dry sclerophyll forest and grassy woodland) and a further 98 ha of cleared land that the Diamond Firetail could utilise.

There is suitable foraging and breeding habitat available in the surrounding area and native habitat would be preserved in the Offset areas (515 ha of grassy woodland, dry sclerophyll forest and cleared land). In addition, the species may also utilise the grassland areas for foraging. It is unlikely, therefore, that the proposed action would have an adverse effect on the life cycle of the species such that a viable local population is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

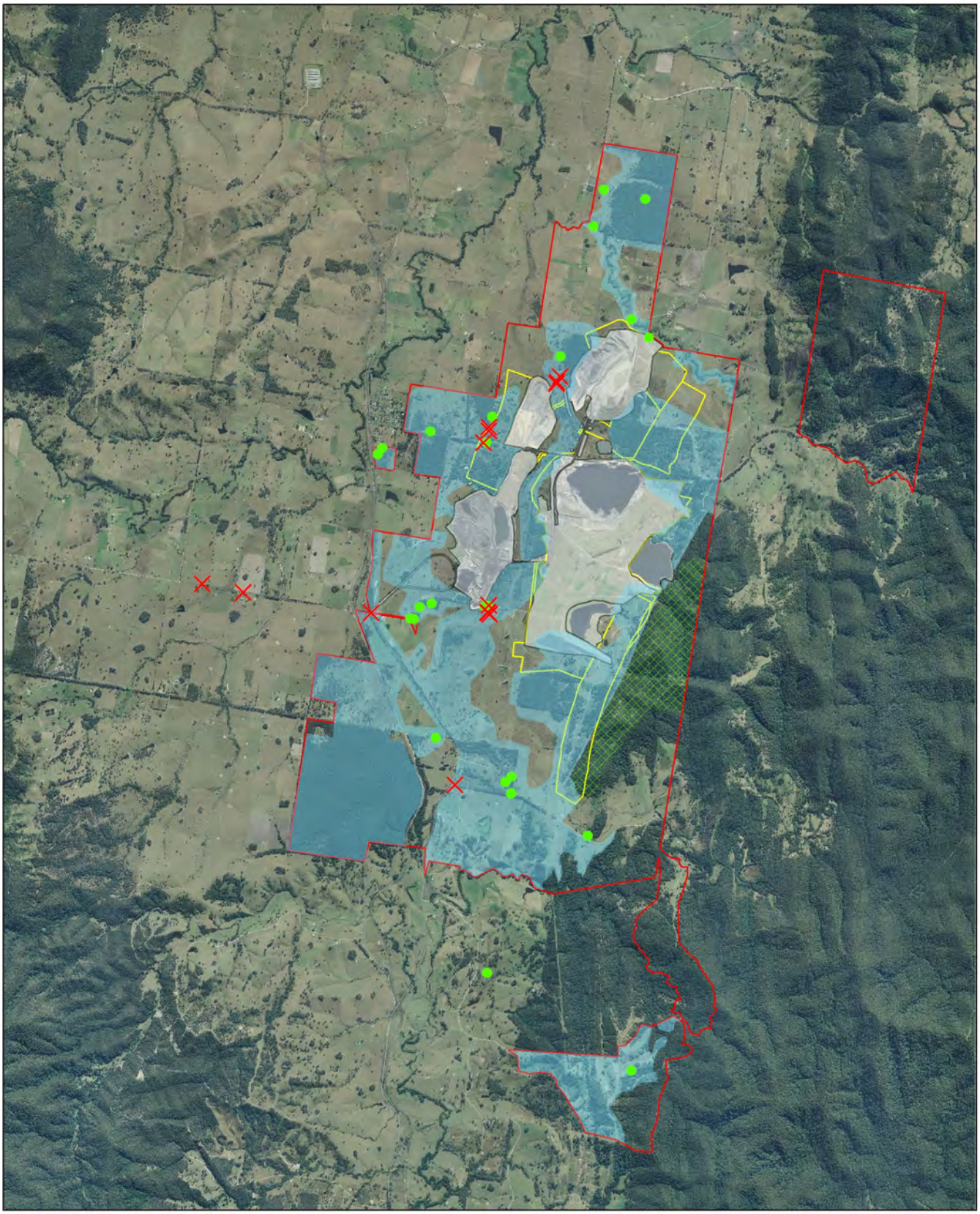


Figure C-18: Diamond Firetail and Grey-crowned Babbler - Potential Habitat

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would result in the removal of 105 ha of potential foraging and breeding habitat in native vegetation and 98 ha of cleared land that the Diamond Firetail could utilise. Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) The Project would increase fragmentation of potential foraging habitat, but the impact from this is only likely to be minor given the ability of the species to utilise fragmented landscape to some extent.

(iii) The Project would result in the loss of only a relatively small amount of potential habitat in native vegetation (105 ha) and a further 98 ha of cleared land that the Diamond Firetail could utilise. Considerable suitable habitat occurs in the surrounding area and approximately 515 ha that the Diamond Firetail could utilise would be preserved and improved in the Offset areas. In addition, up to 435 ha of cleared land in the Offset areas would be revegetated, and post-mining landforms would be rehabilitated and revegetated. Therefore, it is considered that the habitat to be removed is unlikely to adversely impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for the Diamond Firetail has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan has been prepared for this species. OEH (2012a) suggests a number of priority actions for the recovery of the species, which include the protection of open woodland areas, open forest, grassland and Mallee from clearing, fragmentation and disturbance, the retention of dead timber on the ground and/or the increase of remnant size and connectivity.

Only a small amount of potential habitat in native vegetation (105 ha) as well as an additional 98 ha of cleared land that the Diamond Firetail could utilise would be cleared. In addition, the offset would both enhance and protect habitat for this species in the Offset areas (515 ha of similar native vegetation and cleared land that the species could utilise). Therefore, the Project is not inconsistent with these suggested recovery actions.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes that are relevant to this species include clearing of habitat, the lack of regeneration of woodland and an increase in fragmentation and loss of habitat connectivity. The Project would result in 105 ha of foraging and breeding habitat in native vegetation being cleared, and the loss of 98 ha of cleared land that could be used by the species. It is unlikely that these processes would have any significant adverse effect on this species considering the large amount of potential habitat in the surrounding area, the potential habitat that would be conserved in the Offset areas (515 ha of native vegetation and cleared land that could be used by the species), and the amount of additional habitat that would be created through revegetation of Offset areas (up to 435 ha). Any increase in a key threatened process relevant to this species is only likely to be in the short-term.

Conclusion

It is anticipated that the Project would potentially impact the Diamond Firetail through the removal of potential foraging and breeding habitat. However, the Project is not likely to have a significant impact on this species such that a local viable population would be placed at risk of extinction considering that:

- few records exist of the species in the locality and it has not recently been recorded at the Stratford Mining Complex (last records in 1994) and resident populations of the species is unlikely to exist in the Project area;
- from a regional perspective, only a relative small amount of potential foraging and breeding habitat would be cleared (105 ha primarily composed of grassy woodland and dry sclerophyll forest, and 98 ha of cleared land) and potential habitat for this species occurs in the surrounding area (Section 7); and
- the impacts of habitat fragmentation from the Project are only likely to be minor given the species can utilise fragmented landscapes to some extent.

Further to the above, potential foraging and breeding habitat in the Offset areas would be conserved and improved (515 ha that this species could potentially use) (Section 7). In addition potential habitat would be created through revegetation of cleared land in offsets (up to 435 ha) (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Speckled Warbler (Pyrrholaemus sagittata)

The Speckled Warbler is listed as vulnerable under Schedule 2 of the TSC Act. It has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians (OEH, 2012a). The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast (OEH, 2012a).

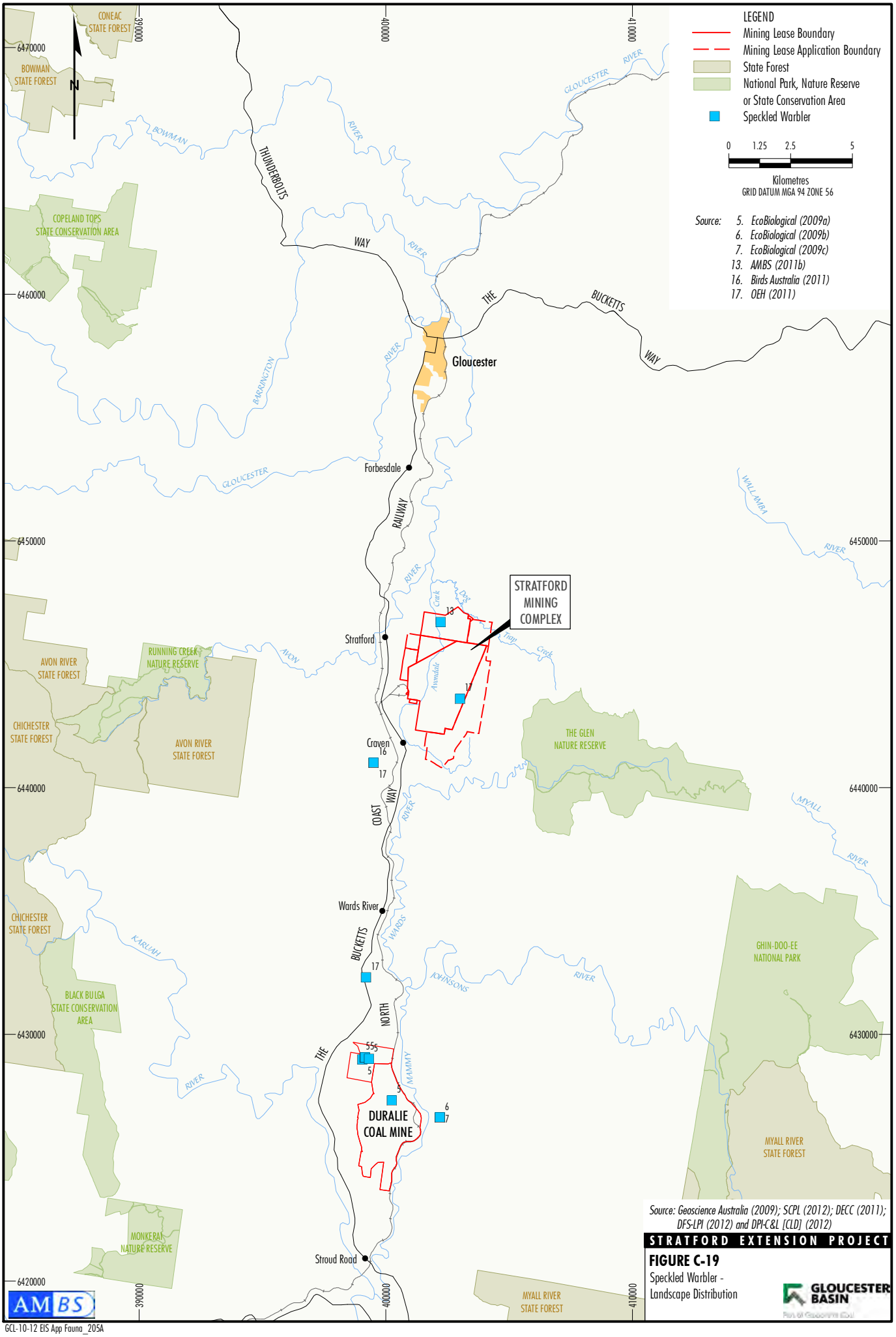
It occupies a range of drier eucalypt woodlands that have a grassy understorey, often on rocky ridges or in gullies (OEH, 2012a). The understorey component appears to be important for the species, and it prefers an open grassy understorey with tussocks, fallen timber and rocks (Pizzey and Knight, 2003). This species also occurs in woodlands with one or more shrub layers, but does not occur in areas of dense woody understorey. The Speckled Warbler appears to be displaced by White-browed Scrub Wrens (*Sericornis frontalis*) where the understorey becomes denser (Pizzey and Knight, 2003).

Large, relatively undisturbed remnants are required for the Speckled Warbler to persist in a given area. Barrett *et al*. (1994) found that the Speckled Warbler decreased in abundance as woodland area decreased, and it appears to be extinct in districts where no fragments larger than 100 ha remain. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100 ha survive (OEH, 2012a). This species forages for seeds and insects on the ground utilising grass tussocks, dense litter and fallen branches, which all can be impacted by grazing. Pairs are sedentary and occupy breeding territories of about 10 ha (OEH, 2012a). The nest is rounded, domed and roughly built of dry grass and strips of bark and is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside. A clutch of 3-4 eggs is laid, between August and January, and both parents feed the nestlings. Some cooperative breeding occurs (OEH, 2012a).

This species is threatened by a number of processes including clearance of remnant grassy woodland habitat, poor regeneration of grassy woodland habitats, modification and destruction of ground habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, heavy grazing and compaction by stock, and frequent fire (OEH, 2012a). As habitat is lost and further fragmented, nest predation increases significantly, with nest failure rates of over 80% being recorded in isolated fragments (OEH, 2012a). Nest failure due to predation by native and non-native birds, cats, dogs and foxes is a major problem since the nests occur on the ground, particularly in fragmented and degraded habitats (OEH, 2012a).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Speckled Warbler was recorded to the north of the Project area during recent surveys (Figure 4a). Additional database records exist within the locality, including within the Stratford Mining Complex (note the accuracy of this record is questionable as it is from 1994) and in the Voluntary Conservation Area (Figure C-19). Suitable or potentially suitable habitat for the Speckled Warbler is limited within the Project area and surrounds, and the Project largely avoids the best areas of potential habitat, including the location of the most recent record (Figure C-20). The proposed area for the Avon North Open Cut may affect potential habitat for the species by removing a small portion of potentially suitable habitat and fragmenting and isolating a part of the original habitat patch.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-19

Speckled Warbler - Landscape Distribution

AMBS

GLOUCESTER BASIN

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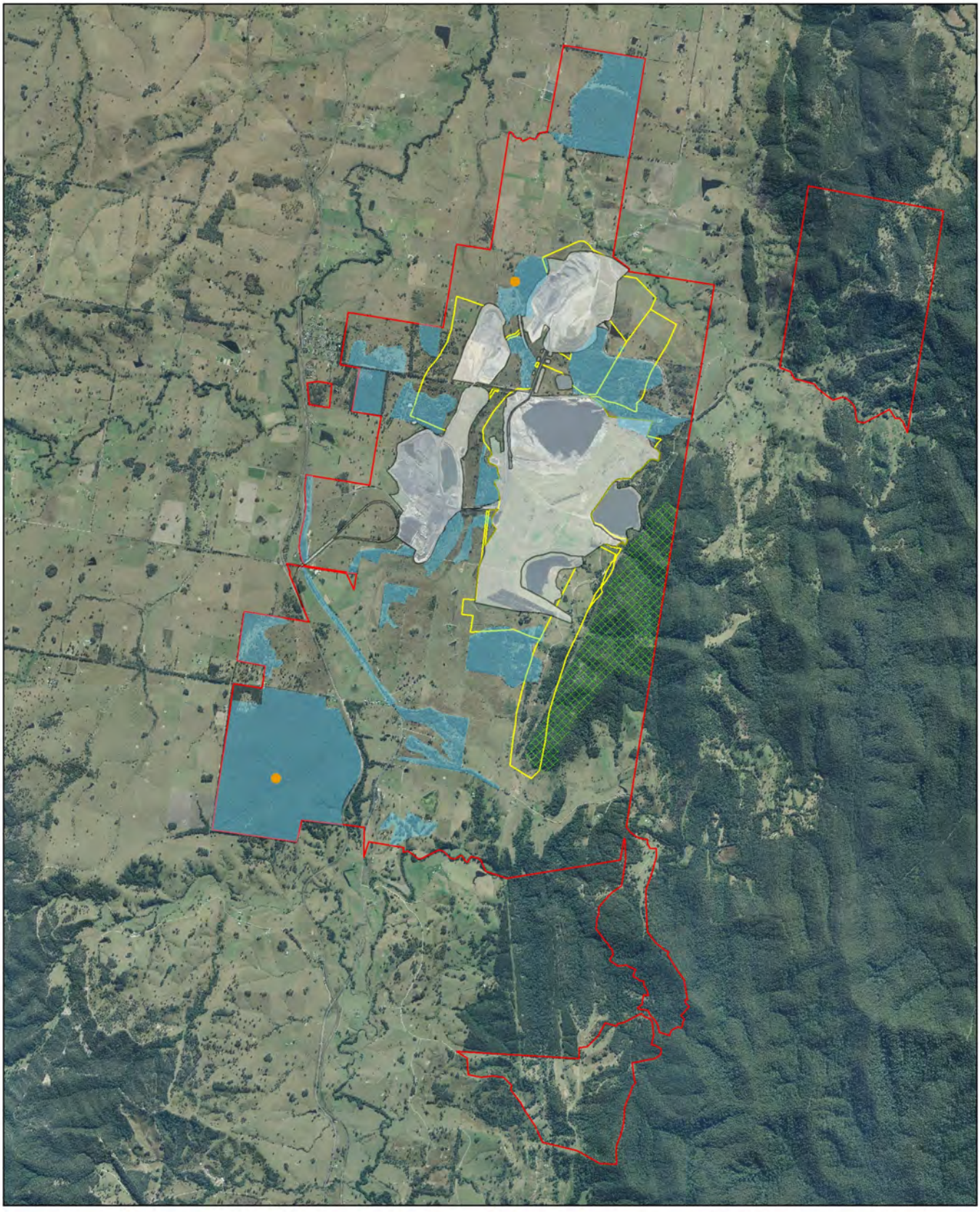

Figure C-20: Speckled Warbler - Potential Habitat

The Project would result in the removal of approximately 52 ha suitable habitat (grassy woodland and dry sclerophyll forest) and fragmentation and isolation of potentially suitable habitat. However, this is not expected to significantly affect the lifecycle of this species, since:

- there is only limited suitable habitat for this species in the Project area;
- the impact area is relatively small and while it does constitute potential habitat, higher quality habitat would remaining largely unaffected (e.g. the habitat west of the Bowens Road North Open Cut where the species was recently recorded);
- potential habitat remains in other locations outside the Project area;
- Offset areas are likely to expand and improve suitable habitat for the species (123 ha); and
- additional habitat would be created through revegetation of Offset areas (up to 435 ha) and post-mining landforms.

The Project is unlikely, therefore, to disrupt the lifecycle of the Speckled Warbler to the extent that a viable local population of the species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would results in the removal of a relatively small area of potential habitat (approximately 52 ha grassy woodland and dry sclerophyll forest). Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss. .

(ii) The Project may result in some fragmentation or isolation from other areas of potentially suitable habitat for this species. The Avon North Open Cut at its southern end would remove some potentially suitable habitat and would result in the fragmentation of the larger patch, and isolate the woodland area north of the Stratford Main Pit and west for the proposed Avon North Open Cut.

(iii) The area where the only record from recent surveys was collected would not be affected by the Project. The habitat that would be fragmented or isolated is relatively small from a regional perspective, and potential habitat occurs in the surrounding area (e.g. the Voluntary Conservation Area where there are historical records for the species). In addition, approximately 123 ha of suitable habitat in native vegetation would be conserved and improved in the Offset areas and up to 435 ha of cleared land would be potentially created through revegetation. Further, post-mining landforms would be rehabilitated and revegetated. Therefore, it is considered that the removal of this habitat is unlikely to impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for the Speckled Warbler has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Speckled Warbler. Actions that are recommended to facilitate the conservation and recovery of the species include retaining native vegetation and increasing the size of remnants (OEH, 2012a). The Project would remove a relatively small area of potential habitat (approximately 52 ha). However, the proposed Offset areas would contribute to the conservation and improvement and addition of suitable habitat (123 ha) for the species in the region in the long-term through conservation, enhancement and revegetation of Offset areas (Section 7). In addition, post-mining landforms would be rehabilitated and revegetated.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to this species include clearing or degradation of habitat and reduction of patch size, predation by foxes and cats (OEH, 2012a). The Project would result in the clearing of approximately 52 ha suitable habitat and would result in increased fragmentation and decrease in patch size of potentially suitable habitat.

In the short-term there is likely to be a relatively small increase in a key threatening process. However it is unlikely that these processes would have a significant adverse impact on the species considering the availability of potential habitat in the surrounding area that would be unaffected by the Project, the native vegetation that would be conserved in the Offset areas (123 ha), and the amount of additional habitat that would be potentially created through revegetation of Offset areas (up to 435 ha) and post-mining landforms. The Project would include a feral animal control programme, and grazing by cattle would be controlled.

Conclusion

It is anticipated that the Project would impact on the Speckled Warbler considering the species requires large, relatively undisturbed remnants to persist in an area; further, they are highly territorial and sedentary. In addition, the species is uncommon in the area and the valley habitat (e.g. grassy woodland) that this species is dependent upon is limited in the wider locality. Overall, the Project is not anticipated to have a significant impact on the persistence of the species in the locality given that:

- the single location where Speckled Warbler was recorded during recent surveys would remain largely unaffected by the Project (Figure 4a);
- from a regional perspective, the Project would only remove approximately 52 ha of potential habitat composed primarily of grassy woodland and dry sclerophyll forest (Section 7);
- potential habitat exists in locations outside the Project area that would remain unaffected (e.g. the Voluntary Conservation Area where there are historical records); and
- the Project would only temporarily fragment areas of potential habitat, until revegetation programmes become established.

Further to the above, Offset areas are likely to expand and improve suitable habitat for the species in perpetuity (123 ha of native vegetation composed of equivalent and/or additional vegetation types) and cleared land would be revegetated throughout the Offset areas (up to 435 ha), and post-mining landforms would be rehabilitated and revegetated (Section 7). These revegetation programmes are likely to provide potential habitat for the species in the future (Section 7).

Regent Honeyeater (Anthochaera phrygia)

The Regent Honeyeater is listed as a critically endangered species under Schedule 1 of the TSC Act. It is also listed as an endangered species and as a migratory species on a national scale under the EPBC Act (OEH, 2012a).

The range of this species has declined dramatically. Its distribution is extremely disjointed and the population is believed to contain fewer than 1,500 individuals (NPWS, 1999b). There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region (OEH, 2012a). In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. However, in some years non-breeding flocks converge on flowering coastal woodlands and forests (OEH, 2012a).

Two habitat types are of particular importance for the Regent Honeyeaters. Most records of the species have come from box-ironbark eucalypt associations and it seems to prefer wetter, more fertile sites within these associations, such as along creek flats, broad river valleys and lower slopes. Along streams in NSW, riparian forests of River She-oak (*Casuarina cunninghamia*) are also important for feeding and breeding. The other major environment regularly utilised by Regent Honeyeaters, perhaps largely as a drought refuge, is wet lowland coastal forest dominated by Swamp Mahogany (*Eucalyptus robusta*) or Spotted Gum (*E. maculata*) (Menkhorst *et al.*, 1999). These woodlands have significantly large numbers of mature trees, high canopy cover and an abundance of mistletoes (OEH, 2012a). A recent study identified the typical breeding habitat in remnant native vegetation occupied by Regent Honeyeaters in the Bunderra-Barraba region as linear, well-connected woodland patches surrounded by cleared grazing land (Oliver and Lollback, 2010).

Colour-banding of Regent Honeyeater has shown that the species can undertake large-scale nomadic movements in the order of hundreds of kilometres. However, the exact nature of these movements is still poorly understood. It is likely that movements are dependent on spatial and temporal flowering and other resource patterns.

Nectar comprises the main diet of Regent Honeyeaters, with 16 species of eucalypt and two species of mistletoe browsed. However, three species of eucalypt make up the predominant nectar sources: Red Ironbark (*Eucalyptus sideroxylon*), White Box (*Eucalyptus albens*) and Yellow Box (*Eucalyptus melliodora*) (Webster and Menkhorst, 1992). Lerps and honeydew comprise a large proportion of the diet when nectar is scarce. Other insects comprise a smaller dietary component but are important for nestlings (OEH, 2012a).

Breeding occurs between July and January in Box-Ironbark and temperate woodlands and riparian gallery forest dominated by River She-oak (OEH, 2012a). Nests are frequently located in Red Ironbark and River Red Gum but may also be in other eucalypts, mistletoe clumps and casuarinas (OEH, 2012a). The nest constructed of bark, grass, twigs and wool is built solely by the female who also incubates the two to three eggs. Subsequent care for the nestlings is shared between both parents.

This species is threatened by a number of processes including fragmentation and degradation of habitat, key habitat tree species and remnant woodlands from clearing for agricultural, residential development, and timber gathering, particularly fertile Yellow Box-White Box-Blakely's Red Gum woodlands (OEH, 2012a). Overgrazing suppresses the regeneration of overstorey tree species and shrub species, with Riparian gallery forests being particularly impacted upon (OEH, 2012a). Other threats include competition from larger aggressive honeyeaters (e.g. Noisy Miners, Noisy Friarbirds, Red Wattlebirds), and egg/nest predation by native birds (OEH, 2012a).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

There are no records of the Regent Honeyeater in the Project area or the wider locality, and it is considered that the species is only likely to occur as a very occasional vagrant. The Project would, however, result in the removal of approximately 105 ha of potential foraging habitat in native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 28 ha of cleared land that this species could utilise on occasion (Figure C-21). The impact on this species is only expected to be minor when considering the large undisturbed areas of potential habitat available in the surrounding area and that 490 ha of wet sclerophyll forest, grassy woodland, dry sclerophyll forest and 40 ha of cleared land that this species could use exist in the proposed Offset areas. The Project would not impact or disturb any known breeding sites, and therefore would not adversely affect the life cycle of the species, such that a viable local population would be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would result in the removal of approximately 105 ha of potential foraging habitat in native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 28 ha of cleared land that this species could utilise. Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss

(ii) The Project would increase fragmentation of potential habitat on a small scale, and the impact from this is only likely to be minor from a regional perspective, and given the highly mobile and wide ranging nature of the species.

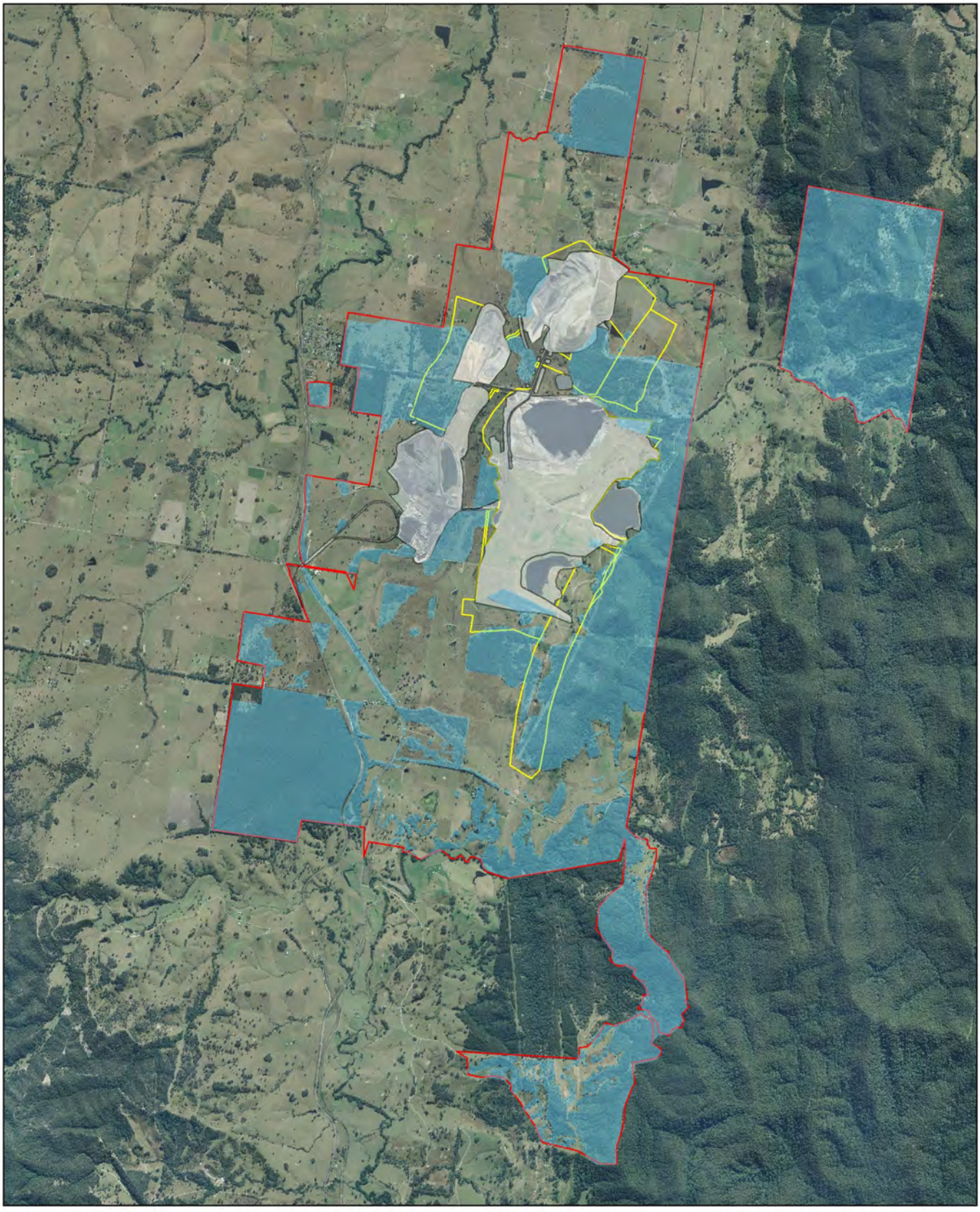

Figure C-21: Regent Honeyeater - Potential Habitat

0 0.5 1 2 Kilometres

Legend

- Potential Habitat
- Approximate Extent of Existing/Approved Surface Development
- Approximate Extent of Additional Project Surface Development
- Study Area

Notes: areas unmapped inside the study area are considered unlikely habitat where there is a low probability that the species would occur.

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(iii) From a regional perspective, only a relatively small amount of potential habitat would be cleared, in comparison to the large areas of undisturbed habitat in the surrounding area. The habitat that would be lost is not a known breeding area, and this species is not expected to be reliant on habitat in the Stratford Mining Complex for its long-term survival. In addition, the proposed offset would ensure that potential habitat (490 ha in native vegetation and 40 ha of cleared land that this species could utilise) would be conserved and improved in the Offset areas (Section 7). In addition, further habitat (up to 435 ha) would be created through revegetation of cleared land in the proposed Offset areas, and post-mining landforms.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for the Regent Honeyeater has been declared by the Minister for the Environment or in the Gloucester LEP or relevant SEPP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Regent Honeyeater. OEH (2012a) lists a number of suggested recovery actions for this species, including encouraging landholders to remove stock from sensitive riparian breeding sites, preventing the loss of mature key nectar tree species, minimising the removal of mistletoes at key sites, protecting and enhancing key breeding and foraging habitats, encouraging natural regeneration and increasing the remnant size of known and potential Regent Honeyeater habitats, and preventing further loss of known woodland and forest habitat throughout their range. The Project is not inconsistent with these suggested actions considering the relatively small amount of land that would be cleared and that additional habitat would be conserved and improved in the Offset areas. Moreover, potential habitat would be increased through revegetation of Offset areas, which is consistent with the suggested actions.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Regent Honeyeater includes the clearing of native vegetation (NSW Scientific Committee, 2001b). In the short-term, the Project would result in a relatively small increase in a key threatening process through the clearing of 105 ha of native vegetation and the loss of 28 ha of cleared land that this species could utilise, resulting in a loss of potential foraging habitat. However, a local population (were one to exist) is not likely to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the adjacent areas and that the proposed offset would ensure that potential habitat (490 ha of native vegetation and 40 ha of cleared land) for the species would be conserved and improved in the region in the long-term (Section 7). Further, revegetation programmes would increase the area of potential habitat for the species.

Conclusion

Potential foraging habitat for the Regent Honeyeater would be removed; however, the species is a generalist forager and is known to undertake extensive nomadic movements in relation to spatial availability of food sources. Overall, the Project is unlikely to have a significant impact on the Regent Honeyeater such that a local viable population would be placed at risk of extinction given that:

- database searches did not reveal any records for this species within approximately 23 km of the Project area, and the species is therefore not likely to depend on the habitat in the Project area, and is only likely to occur as a very occasional vagrant;
- from a regional perspective, the Project would only remove approximately 105 ha of potential foraging habitat, composed primarily of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and potentially 28 ha of cleared land (Section 7);
- potential habitat would be fragmented on a small scale in the short-term, until the revegetation programmes are established; and
- the Project would not impact on any known key breeding areas.

Further to the above, potential habitat for the species would be conserved and improved in the region in the long-term in the proposed Offset areas, including conservation of 490 ha of wet sclerophyll forest, grassy woodland and dry sclerophyll forest composed of equivalent and/or additional vegetation types, and 40 ha of cleared land that the species could utilise (Section 7). Up to 435 ha of land would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Flame Robin (Petroica phoenicea)

The Flame Robin is listed as vulnerable under Schedule 2 of the TSC Act. This small Australian robin is endemic to south-east Australia, and ranges from near the Queensland border to south-east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands (NSW Scientific Committee, 2010b).

Flame Robins breed in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. They prefer clearings or areas with open understoreys (NSW Scientific Committee, 2010b). The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. This species occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes.

In winter, Flame Robins migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains) where it lives in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees. These birds often occur in recently burnt areas; however, habitat becomes unsuitable as vegetation closes up following regeneration.

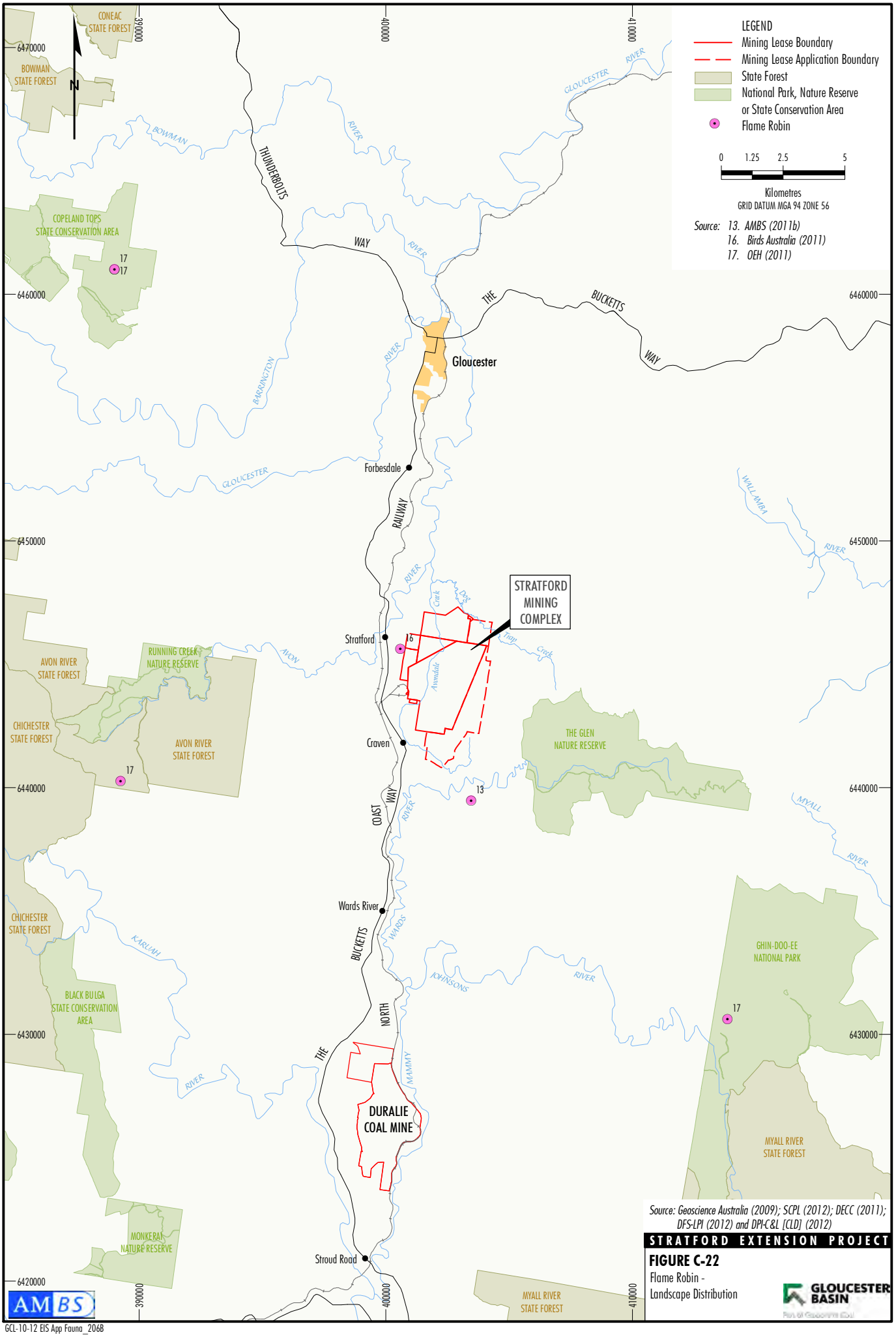
Flame Robins forage from low perches, from which they sally or pounce onto small invertebrates. Prey items are taken from the ground or off tree trunks, logs and other coarse woody debris. Flying insects are often taken in the air and they sometimes glean for invertebrates from foliage and bark. In their autumn and winter habitats, these birds often sally from fence-posts or thistles and other prominent perches in open habitats. Flame Robins occur singly, in pairs, or in flocks of 40 birds or more; in the non-breeding season they will join up with other insectivorous birds in mixed feeding flocks.

Breeding occurs in spring to late summer. Nests are often near the ground and are built in sheltered sites, such as shallow cavities in trees, stumps or banks. The nest is an open cup made of plant materials and spider webs. The clutch size is typically three or four eggs which are oval in shape and are pale bluish- or greenish-white and marked with brownish blotches.

Threats to Flame Robins include clearing and degradation of breeding and wintering habitat by overgrazing and the removal of standing dead timber, logs and coarse woody debris. Threats are also posed by nest predation by native and exotic predators, including artificially large populations of Pied Currawong (*Strepera gragraculina*) in some areas (Higgins and Peter, 2002). Changed fire regimes are an additional threat due to the habitat for this species becoming unsuitable if dense regeneration occurs after bushfires or other disturbances.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Flame Robin was recorded once during recent surveys, near Offset area 3 (Figure 4a). There is also a database record from the remnant Crown Land to the west of the proposed Roseville West Pit Extension (Figure C-22). There are a few records from the wider locality, including inside protected areas (Figure C-22). Suitable breeding habitat for the species is present in the ranges adjacent to the Stratford Mining Complex and suitable wintering habitat is present throughout the Stratford Mining Complex (Figure C-23).



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-22

Flame Robin - Landscape Distribution

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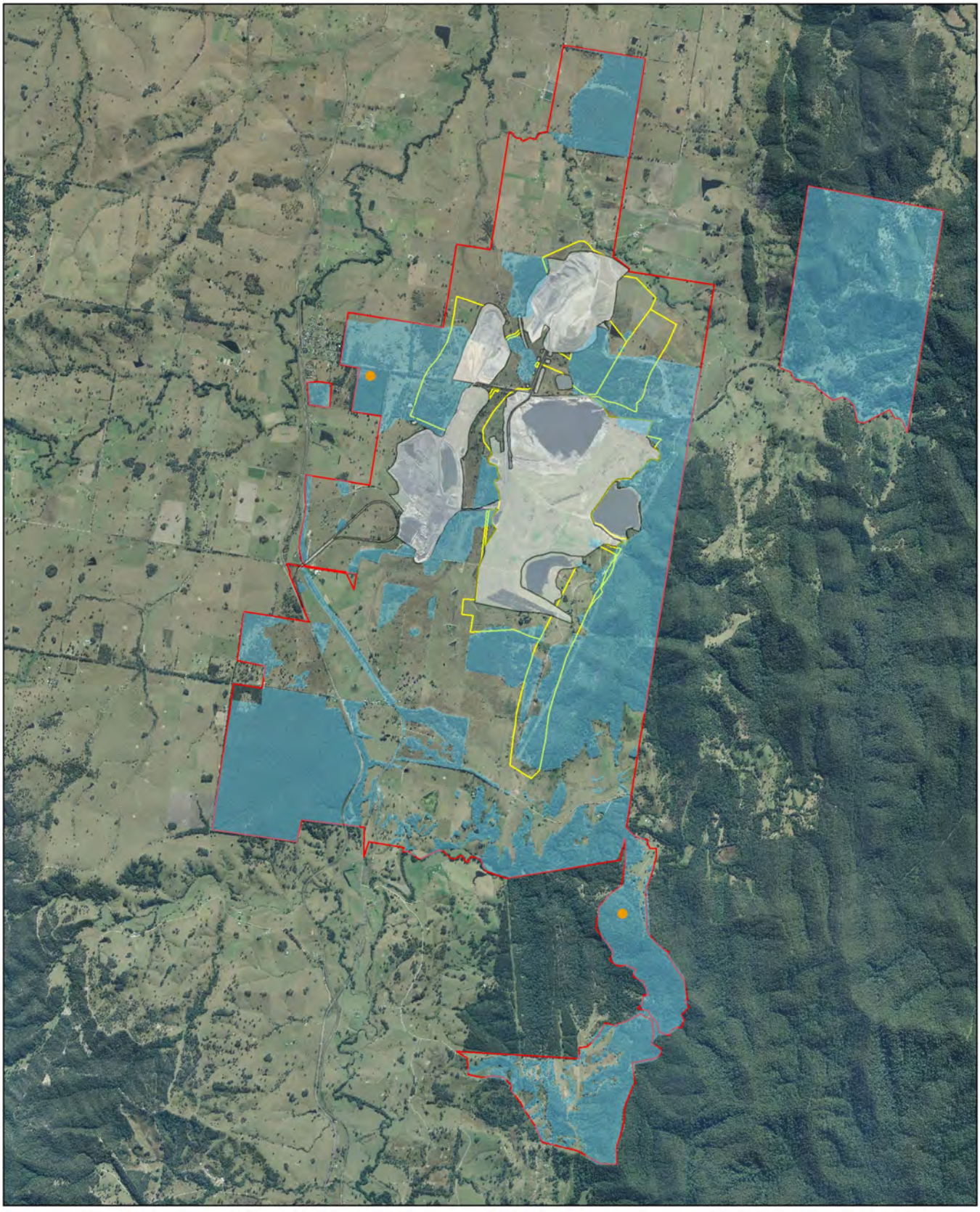


Figure C-23: Flame Robin - Potential Habitat

0 0.5 1 2 Kilometres

Legend

- Potential Habitat
- Flame Robin
- Approximate Extent of Existing/Approved Surface Development
- Approximate Extent of Additional Project Surface Development
- Study Area

Notes: areas unmapped inside the study area are considered unlikely habitat where there is a low probability that the species would occur.

N

AMBS

The Project would result in the removal of 105 ha in native vegetation (i.e. grassy woodland), and 26 ha of cleared land that this species could utilise. This is likely to be restricted to potential wintering habitat.

The removal of approximately 105 ha of potential habitat is not likely to affect the lifecycle of this species such that a local population is likely to be placed at risk of extinction, since:

- the impact area is relatively small (105 ha of native vegetation [i.e. grassy woodland, dry sclerophyll forest and wet sclerophyll forest] and 26 ha of cleared land that this species could utilise) compared to the amount of habitat in the surrounding area and in the proposed Offset areas (490 ha wet sclerophyll forest, grassy woodland, dry sclerophyll forest and 40 ha of cleared land that this species could utilise); and
- the Project is unlikely to impact on potential nesting habitat.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) the Project would require the removal of a relatively small area (105 ha) of potential habitat in native vegetation (i.e. grassy woodland, dry sclerophyll forest and wet sclerophyll forest) and 26 ha of cleared land that this species could utilise. Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) the Project would result in the temporary fragmentation or isolation from other areas of potential habitat for this species. The sections that would become isolated contain wintering habitat for the species. In the northern section of the Project site, the patch of forest north or Stratford Main Pit would become isolated from the forested area to the east due to the planned Avon North Open Cut. Similarly at the southern end of the mine the forest patch south of the Waste Emplacement Extension would become isolated from the woodland to the east through the Stratford East Open Cut.

(iii) from a regional perspective, the loss and fragmentation of habitat (i.e. 105 ha of native vegetation and 26 ha of cleared land) is only likely to be minor. Similar potential habitat occurs in the surrounding area, and it is highly unlikely that the relatively small areas of habitat that would be removed would significantly impact a local population of the species. Further, additional areas of habitat would be created through revegetation in the Offset areas, and rehabilitated of post-mining landforms. The removal of this habitat is unlikely to impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" of relevance to the Flame Robin has been declared by the Minister for the Environment or in the Gloucester LEP or relevant SEPP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Flame Robin. Actions that are recommended by OEH (2012a) to facilitate the conservation and recovery of the species include retaining native vegetation and increasing the size of remnants. The Project would remove a relatively small area (approximately 105 ha of native vegetation and 26 ha of cleared land) of suitable foraging habitat for the species and contribute to habitat fragmentation and reduction of patch size. However, the proposed offset would contribute to the conservation and improvement of potential habitat (490 ha of native vegetation and 40 ha of cleared land that this species could utilise) for the species in the region in the long-term (Section 7) as would revegetation of cleared land (up to 435 ha) in the proposed offsets.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to this species include clearing of native vegetation and removal of dead wood (OEH, 2012a).

In the short-term, The Project would increase a key threatening process, due to the clearing of approximately 105 ha of native vegetation, which contains wintering habitat and would result in increased fragmentation and a decrease in patch size. Dead wood would also be removed. However, potential habitat also exists in the surrounding area and would be conserved and improved in the Offset areas. As such the impact would be unlikely to have a significant adverse impact on a local population. Further, dead wood would be retained and reintroduced in the revegetated areas.

Conclusion

It is anticipated the Project would potentially impact the Flame Robin due to the removal of potential foraging habitat for the species. The Project would temporarily impact potential movement between the highlands and the lowlands, until lowland areas are revegetated. However, this impact is not considered to be significant such that a local viable population would be placed at risk of extinction given:

- the species is not known to use the habitat in the Project area, with only a single record from near the Project area in the crown reserve, and one additional record near Offset area 4 (Figure 4a);
- from a regional perspective, the impact area is relatively small (105 ha of native vegetation primarily composed of grassy woodland and 26 ha of cleared land that this species could utilise) (Section 7);

- the Project would only temporarily fragment areas of potential habitat until revegetation; and
- substantial potential habitat for this species exists in the surrounding area.

Further to the above, potential habitat in the Offset areas would be conserved and improved (490 ha wet sclerophyll forest, grassy woodland and dry sclerophyll forest composed of the equivalent and/or additional vegetation types and 40 ha of cleared land that this species could utilise) (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7) and revegetation of post-mining landforms.

Scarlet Robin (Petroica boodang)

The Scarlet Robin is listed as vulnerable under Schedule 2 of the TSC Act (OEH, 2012a). The distribution of the Scarlet Robin extends from south-eastern Australia (extreme south-east Queensland to Tasmania, western Victoria and south-east South Australia) to south-west Western Australia. In NSW it occupies open forests and woodlands from the coast to the inland slopes (Higgins and Peter, 2002). Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains.

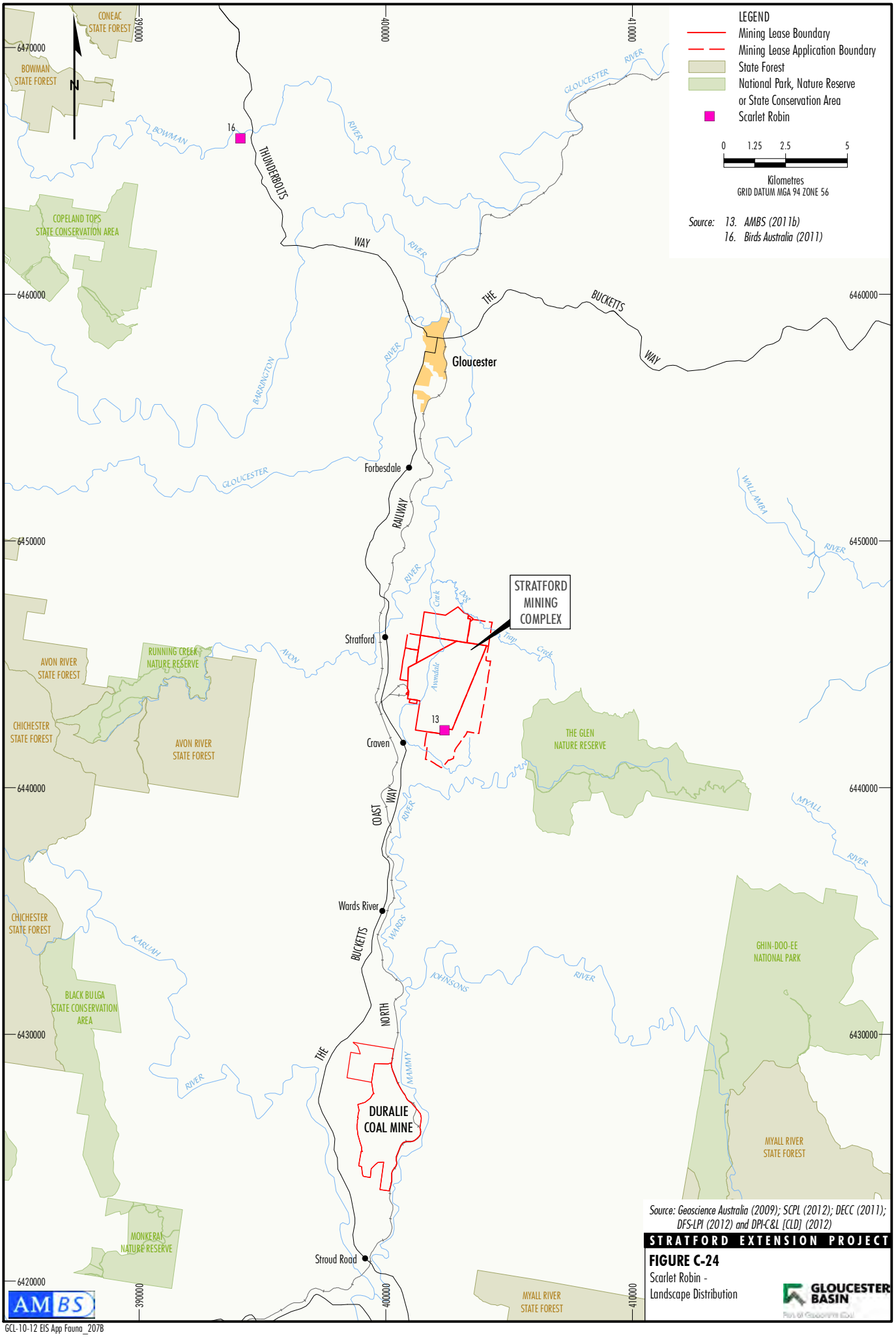
The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. The species lives in both mature and regrowth vegetation. It occasionally occurs in Mallee or wet forest communities, or in wetlands and tea-tree swamps. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. Abundant logs and coarse woody debris are important structural components of its habitat. They forage from low perches, from where they pounce on small insects and other invertebrates which are taken from the ground, or off tree trunks and logs; they sometimes forage in the shrub or canopy layer. The robin builds an open cup nest of plant fibres and cobwebs, sited in the fork of tree (often a dead branch in a live tree, or in a dead tree or shrub) which is usually more than 2 m above the ground (Higgins and Peter, 2002; Debus, 2006a, 2006b). Scarlet Robin pairs defend a breeding territory and mainly breed between the months of July and January; they may raise two or three broods in each season. Pairs stay together year-round.

In recent decades the Scarlet Robin is believed to have undergone a moderate reduction in population size in NSW based on comparative evidence from broadscale surveys (NSW Scientific Committee, 2010c). The Scarlet Robin is sensitive to habitat degradation (Watson *et al.*, 2001, 2003; Radford *et al.*, 2005; Radford and Bennett, 2007), and overgrazing (Olsen *et al.*, 2005). For instance, its occurrence (presence/absence) is positively associated with patch size and components of habitat complexity including increasing tree canopy cover, shrub cover, ground cover, logs, fallen branches and litter (Watson *et al.*, 2003). Nest sites, food sources and foraging substrates, such as standing dead timber, logs and coarse woody debris, are susceptible to depletion by grazing, firewood collection and 'tidying up' of rough pasture (e.g. Recher *et al.*, 2002). Over-abundant populations of Pied Currawongs, supported by exotic berry-producing shrubs, may be a potentially severe threats to the robin's breeding productivity (Debus, 2006c), exacerbated by other native and exotic predators. Habitat for the Scarlet Robin may become unsuitable if dense regeneration occurs after bushfires or other disturbances.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Scarlet Robin has only rarely been detected in the vicinity of the Project (Figures 4-a and C-24). There is one recent record near the proposed Stratford East Open Cut and the Scarlet Robin was recorded on one other occasion approximately 25 km north of the Project site (Figure C-24).

From a regional perspective, the Project would result in the removal of a relatively small amount (approximately 73 ha) of potential foraging and breeding habitat for the Scarlet Robin (i.e. grassy woodland and dry sclerophyll forest) (Figure C-17). Considering the amount of suitable foraging and breeding habitat that is available in the surrounding area (Figure C-24), and the amount of potential habitat that would be conserved in the Offset areas (231 ha of native vegetation that the species could utilise), the Project would be unlikely to adversely affect the life cycle of the species, such that a viable local population would be placed at risk of extinction.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-24

Scarlet Robin - Landscape Distribution

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(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would result in the removal of approximately 73 ha of potential breeding and foraging habitat for the Scarlet Robin (i.e. grassy woodland and dry sclerophyll forest). Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.
(ii) The Project would result in the temporary fragmentation and isolation of potential habitat, until the revegetation programmes become established.
(iii) The Project would result in the removal of a relatively small amount (approximately 73 ha) of potential Scarlet Robin breeding and foraging habitat (i.e. grassy woodland and dry sclerophyll forest), and a portion of this would become temporarily fragmented or isolated. However, potential habitat occurs surrounding area, and additional habitat that would be conserved and improved in the proposed Offset areas (231 ha). Further, revegetation would occur throughout the Offset area (up to 435 ha) and post-mining landforms would be rehabilitated and revegetated. Therefore, it is considered that the habitat to be removed is unlikely to adversely impact on the long-term survival of these species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No “critical habitat” for the Scarlet Robin has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Scarlet Robin. OEH (2012a) lists a number of suggested recovery actions for this species and these actions include the retention of existing forest, woodland and remnant grassland vegetation, including paddock trees; the retention of dead timber on the ground in open forest and woodland areas; and the enhancement of potential habitat through regeneration by reducing the intensity and duration of grazing.

Only a relatively small amount of potential habitat in native vegetation (73 ha) would be cleared, the Offset areas (Section 7) would enhance potential habitat (231 ha) for this species, and additional areas of habitat would be created through the revegetation programmes. Further, dead timber would be retained for use within the revegetation areas, and grazing within these areas would be managed. Therefore, the Project is not inconsistent with these suggested recovery actions.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Scarlet Robin include the clearing of native vegetation and loss of dead wood (NSW Scientific Committee, 2010c). A threatening process is defined under the TSC Act as "a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities".

The Project would result in the clearing of native vegetation, resulting in a loss of potential foraging and breeding habitat, and removal of dead wood. However, from a regional perspective, this clearing is considered to be small, when considering the amount of surrounding habitat available in the adjacent areas, and that the proposed offset would ensure potential habitat for the species would be conserved and improved in the region in the long-term (Section 7). Further, dead wood would be retained and reintroduced into the revegetated areas. It is unlikely that the small short-term increase in this key threatened process would have a significant adverse impact on the species.

Conclusion

It is anticipated that the Project would potentially impact the Scarlet Robin due to the removal of potential foraging and breeding habitat for this species. However, the Project is not likely to have a significant impact on this species such that a local viable population would be placed at risk of extinction given:

- the Scarlet Robin has only rarely been recorded in the area;
- from a regional perspective, the Project would only remove a small area of potential habitat in native vegetation (73 ha) primarily composed of grassy woodland and dry sclerophyll forest (Section 7);
- potential habitat for this species occurs in the surrounding area; and
- the Project would result in only the temporary fragmentation and isolation of potential habitat, until the revegetation programmes become established.

Further to the above, potential habitat (231 ha) composed of equivalent and/or additional vegetation types for the species would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). In addition, areas of land that would be revegetated throughout the Offset areas (up to 435 ha) may provide potential habitat for the species in the future (Section 7), as well as the revegetated areas of post-mining landforms.

Grey-crowned Babbler (eastern subspecies) (Pomatostomus temporalis temporalis)

The Grey-Crowned Babbler (eastern subspecies) is listed as vulnerable in NSW under Schedule 2 of the TSC Act. There are two distinct sub-species of Grey-crowned Babbler that intergrade to the south of the Gulf of Carpentaria. To the west the subspecies *rubeculus*, which was formerly considered a separate species (Red-breasted Babbler), is still widespread and common. The eastern subspecies (*temporalis*) occurs from Cape York south through Queensland, NSW and Victoria and formerly to the south east of South Australia. In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW.

The Grey-crowned Babbler (eastern subspecies) has declined in numbers and disappeared from large parts of its range. The species is extinct in the Orange area (Heron, 1973) and possibly also from around Bathurst. Recent surveys show a decline in the number of family groups that remain in the southern portion of its range, such that approximately five groups remain in Boorowa Shire, less than 10 around Wagga Wagga, and less than 30 groups in the shires of Young, Junee and Harden. A survey of 96 woodland sites in Holbrook Shire revealed only four groups. Further, the species has apparently disappeared from the Shires of Gundagai, Gunning, Yass and Yarrowlumla. There are probably no Grey-crowned Babblers (eastern subspecies) left on the New England Tableland and they are now very uncommon in the Hunter Valley with most family groups reduced to two or four members. It may be extinct in the southern, central and New England tablelands (NSW Scientific Committee, 2001c).

The Grey-crowned Babbler (eastern subspecies) inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. They prefer open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs. Their flight is laborious and birds often hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas.

This species lives in family groups that consist of a breeding pair and young from previous breeding seasons. A group may consist of up to fifteen birds. All members of the family group remain close to each other when foraging. A soft ‘chuck’ call is made by all birds as a way of keeping in contact with other group members. Grey-crowned Babblers (eastern subspecies) feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses.

They build and maintain several conspicuous, dome-shaped stick nests about the size of a football. A nest is used as a dormitory for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Nests are maintained year round, and old nests are often dismantled to build new ones.

Grey-crowned Babblers (eastern subspecies) breed between July and February. Usually two to three eggs are laid and incubated by the female. During incubation, the adult male and several helpers in the group may feed the female as she sits on the nest. Young birds are fed by all other members of the group.

Territories range from 1 to 50 ha (usually around 10 ha) and are defended all year. Territorial disputes with neighbouring groups are frequent and may last up to several hours, with much calling, chasing and occasional fighting.

The Grey-crowned Babbler (eastern subspecies) is threatened by clearance and the fragmentation of habitat including removal of dead timber (Gloucester Shire Council 2006). The species occupies woodlands on fertile soils of plains and undulating terrain. Therefore, Grey-crowned Babbler (eastern subspecies) habitat has been disproportionately cleared for agriculture. Isolation of populations in scattered remnants is exacerbated by the apparent reluctance of birds to traverse tracts of cleared land.

As reduced family groups, these isolated small populations are vulnerable to extinction via stochastic events and to loss of genetic viability in the long-term. Habitat degradation also threatens Grey-crowned Babblers (eastern subspecies), particularly as a result of weed invasion and grazing by stock. In addition, it is likely that increased abundance of competitors, such as Noisy Miners, and nest predators, including the Pied Currawong and Australian Raven (Major *et al*., 1996) threaten Babbler foraging efficiency and breeding success.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

There are a number of previous records for this species in the Stratford Mining Complex including several records from recent surveys (Figures 4-a and C-25). There is known and potential breeding and foraging habitat for this species throughout much of the remaining lowland vegetation, within and around the Project area (Figure C-17).

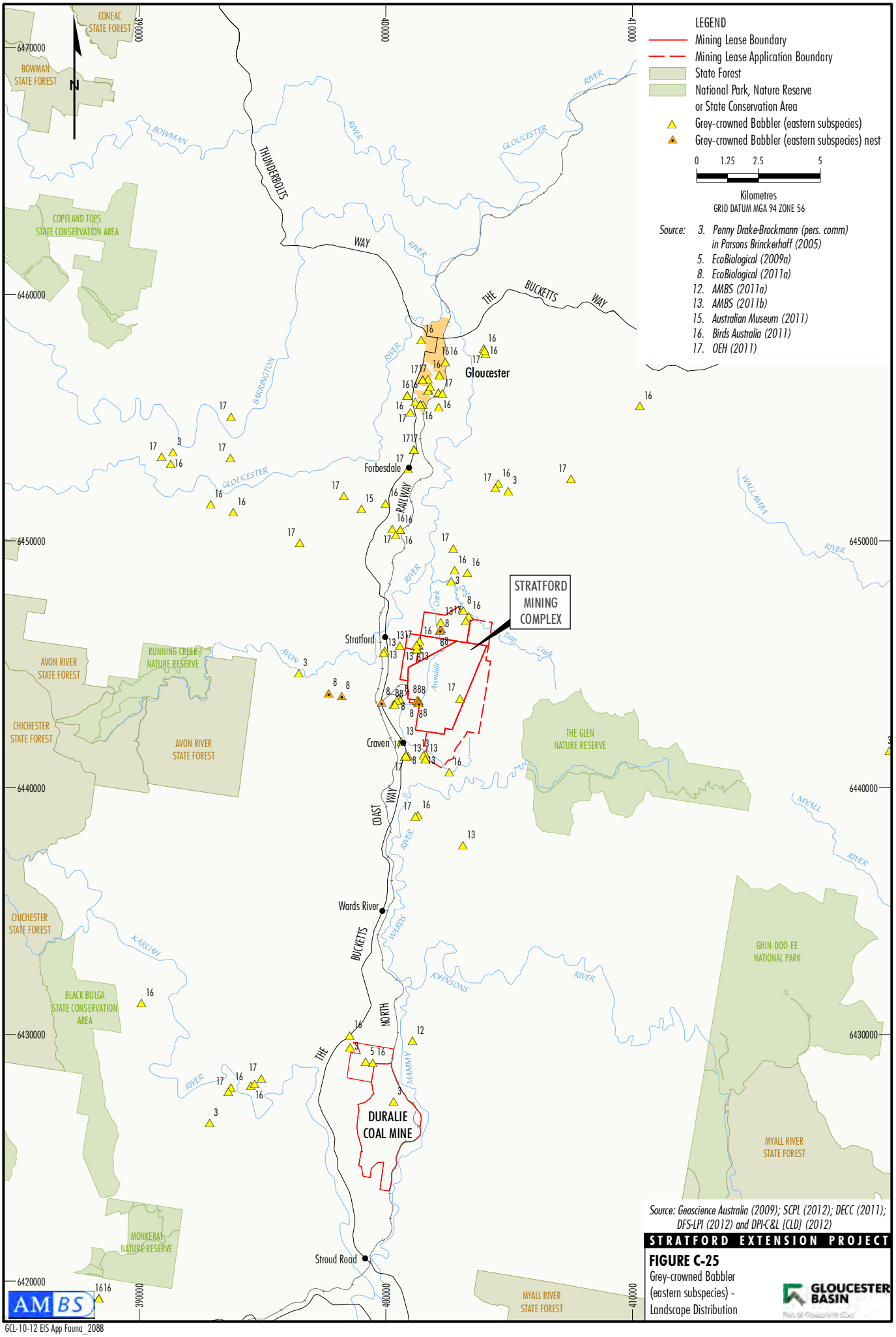
The Project would result in the loss or modification of approximately 105 ha of known and potential Grey-crowned Babbler (eastern subspecies) breeding and foraging habitat in native vegetation (i.e. grassy woodland and dry sclerophyll forest) and a further 56 ha of cleared land that this species could utilise (Figure C-17). This is considered to be a relatively small area from a regional perspective, and known habitat for the species occurs in several other locations outside the Project area. Approximately 665 ha of potential habitat (i.e. grassy woodland, dry sclerophyll forest and cleared land) of known and potential habitat for the species would be conserved and enhanced in the Offset areas, of which some areas appear to contain the species (e.g. Offset area 3). Further, post-mining landforms would be rehabilitated and revegetated. Considering the above, it is unlikely that the loss of habitat due to the Project would have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

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FIGURE C-25
Grey-crowned Babbler (eastern subspecies) - Landscape Distribution

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(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would result in the removal or disturbance of approximately 105 ha of Grey-crowned Babbler (eastern subspecies) breeding and foraging habitat in native vegetation (i.e. grassy woodland and dry sclerophyll forest) and the loss of 56 ha of cleared land that this species could potentially utilise. Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) The Project would result in the temporary fragmentation and isolation of potential habitat, but this impact is only likely to be minor given that the species can utilise fragmented landscapes to some extent. Further, revegetation programmes would establish new areas of potential habitat, improving linkages in areas in which they are currently poor.

(iii) Considering the wide-spread occurrence of this species and potential habitat in and around the Stratford Mining Complex, the relatively small amount of habitat that would be removed, and the area that would be conserved and improved within the Offset areas, it is considered that the habitat to be removed is unlikely to adversely impact on the long-term survival of this species in the locality. Further, post-mining landforms would be rehabilitated and revegetated.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for the Grey-crowned Babbler (eastern subspecies) has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Grey-crowned Babbler (eastern subspecies) (OEH, 2012a). OEH (2012a)) and Gloucester Shire Council (2006) lists a number of suggested recovery measures for this species, including retaining existing woodland vegetation, retaining dead timber on the ground in open woodland areas, encouraging regeneration of habitat by fencing remnant stands and increasing the size of existing remnants by planting trees (OEH, 2012a). Enhancing the habitat of existing groups to promote increases in group size, restoring degraded habitats, and creating habitat corridors for tree-less areas are also recommended in the Gloucester Shire Council Grey-crowned Babbler Retention Plan (Department of State and Regional Development, 2005).

Only a relatively small amount of habitat for the species would be removed as a result of the Project (105 ha of native vegetation plus 56 ha of cleared land), in comparison to the amount of habitat that would be conserved and enhanced in the Offset areas (665 ha of native vegetation and cleared land). Additional habitat would also be created through the revegetation programme (up to 435 ha in the Offset areas) and rehabilitated post-mining landforms. Further, dead wood would be retained and introduced into revegetation areas.

Therefore, the Project is not inconsistent with these suggested recovery actions. Moreover, some of the actions specifically recommended in the Grey-crowned Babbler Retention Plan (Department of State and Regional Development, 2005) will occur as a result of conservation and revegetation of the Offset areas. For example, grazing in remnants will be controlled, and cleared land will be revegetated to connect roadside vegetation.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Grey-crowned Babbler (eastern subspecies) includes the clearing of native vegetation (OEH, 2012a). In the short-term, the Project would result in the clearing of native vegetation, and therefore an increase in this key threatened process. It is unlikely that this would have a significant adverse impact on this species considering the large amount of potential habitat in the surrounding area, the potential habitat that would be conserved and improved in the Offset areas, and the revegetation programmes.

Conclusion

It is anticipated that the Project would have an impact on the Grey-crowned Babbler (eastern subspecies) considering the Project would remove some known nesting sites and foraging habitat. The species is highly territorial, sedentary and utilises the same nests year after year. Furthermore, the species is generally unable to cross large open patches due to its laborious flight and the valley habitat (e.g. grassy woodland) that this species is dependent upon is limited in the wider locality. However, the Project is unlikely to have a significant impact on the Grey-crowned Babbler (eastern subspecies) such that a local viable population would be placed at risk of extinction given:

- the species is relatively widespread in and around the Project area and locality (Figure 4a);
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of grassy woodland and dry sclerophyll forest, and 56 ha of cleared land) of potential foraging and breeding habitat within the Project area (Section 7); and
- the Project would only temporarily isolate areas of potential habitat for this species.

Further to the above, potential habitat for the species (665 ha of native vegetation composed of the equivalent and/or additional vegetation types and cleared land) would be conserved and improved in the region in the long-term due to the proposed offset (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Varied Sittella (Daphoenositta chrysoptera)

The Varied Sittella is listed as a vulnerable species in NSW under Schedule 2 of the TSC Act. The following information has been sourced from the OEH Threatened Species Profile (OEH, 2012a) and the final determination for the threatened species listing of the NSW scientific Committee for the Varied Sittella (NSW Scientific Committee, 2010d).

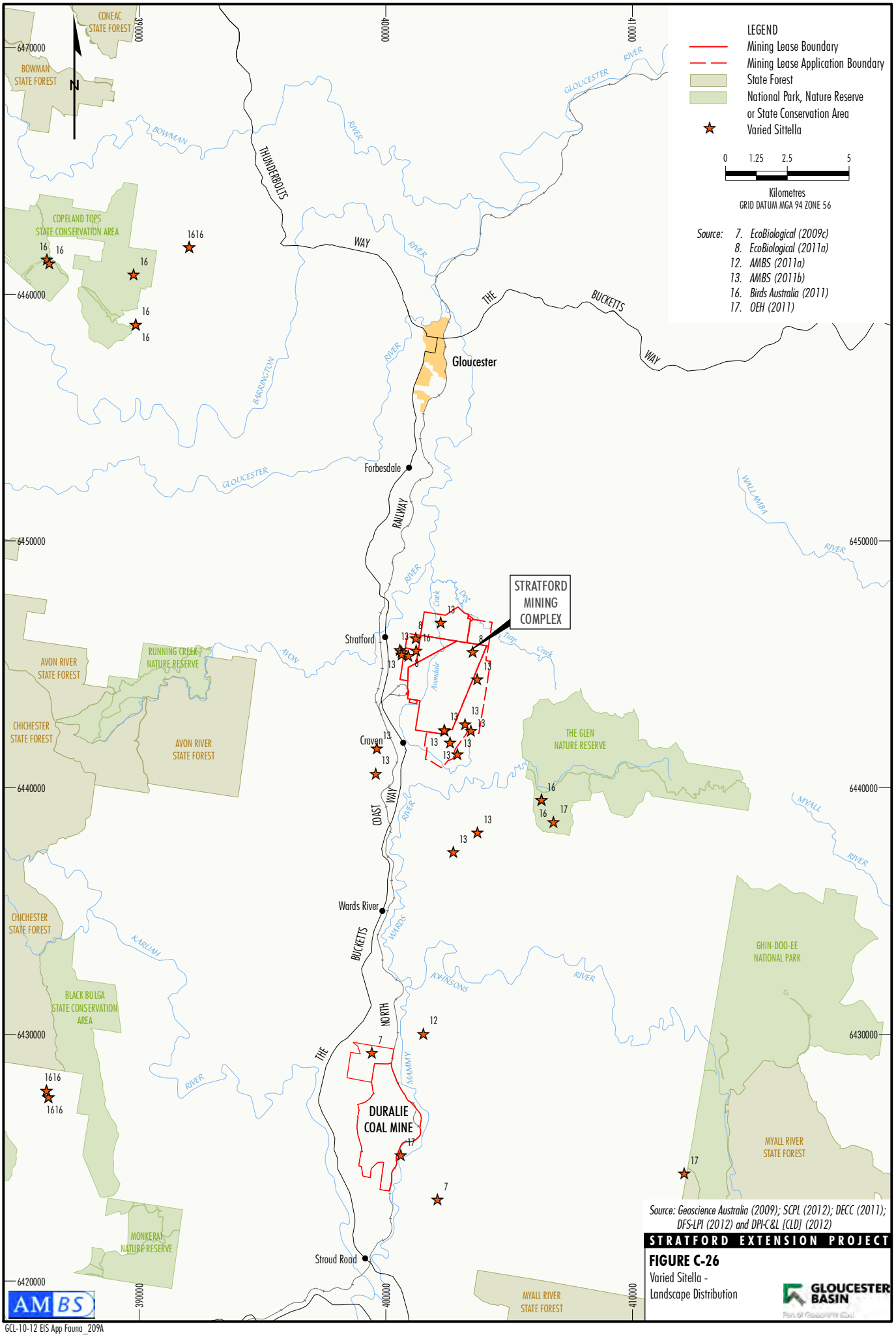
The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, Mallee and Acacia woodland. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.

The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction in population size on the basis of comparative atlas surveys over the past several decades. The apparent decline has been attributed to declining habitat cover and quality. The sedentary nature of the Varied Sittella makes cleared agricultural land a potential barrier to movement. Survival and population viability are sensitive to habitat isolation, reduced patch size and habitat simplification, including reductions in tree species diversity, tree canopy cover, shrub cover, ground cover, logs, fallen branches and litter. The Varied Sittella is also adversely affected by the dominance of Noisy Miners in woodland patches. Current threats include habitat degradation through small-scale clearing for fence lines and road verges, rural tree decline, loss of paddock trees and connectivity, 'tidying up' on farms, and firewood collection. 'Clearing of native vegetation' and 'Removal of dead wood and dead trees' are listed as key threatening processes in NSW under the TSC Act.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

This species was recorded during surveys at the Stratford Mining Complex and records from surveys as well as database records exist for the greater locality (Figures 4-a and C-26). Suitable foraging habitat and nesting habitat is present throughout the Stratford Mining Complex (Figure C-2). Even though the area of vegetation that is proposed to be removed is relatively small (approximately 105 ha of native vegetation [i.e. grassy woodland, dry sclerophyll forest and wet sclerophyll forest] and 26 ha of cleared land that this species could utilise) it would contribute to increasing fragmentation, isolation and decrease in patch size of habitat. Patch size and connectivity are important requirements for sedentary species like the Varied Sittella.

Suitable habitat is likely to be present in the greater locality, and in several locations outside the Project area where the species has been recorded (e.g. the Voluntary Conservation Area). Considering the above, and given the area of potential habitat that would be conserved in the Offset areas (490 ha in native vegetation and 40 of cleared land) the Project is unlikely to disrupt the lifecycle of the Varied Sittella "to the extent that a viable local population of the species is likely to be placed at risk of extinction". Further, additional areas (up to 435 ha) within the Offset areas would be revegetated, some of which would provide additional potential habitat in the future.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

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FIGURE C-26

Varied Sittella - Landscape Distribution

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(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, the Project would remove a relatively small area of potential habitat (approximately 105 ha of native vegetation and 26 ha of cleared land that this species could utilise). Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) The Project would result in some fragmentation or isolation from other areas of habitat for this species. In the northern section of the mining site the patch of forest north of the Stratford Main Pit would become isolated from the forested area to the east through the planned Avon North Open Cut. Similarly at the southern end of the mine the forest patch south of the Waste Emplacement Extension would become isolated from the woodland to the east through the Stratford East Open Cut.

(iii) The sedentary nature of the Varied Sittella makes cleared agricultural land a potential barrier to movement. Survival and population viability are sensitive to habitat isolation, reduced patch size and habitat simplification. Even though only a relatively small area of vegetation is proposed to be removed, it would contribute to the fragmentation, isolation and reduction in patch size for this species. The long-term survival of the species in the locality may be affected, if habitat patch size reaches a critical threshold where it does not hold sufficient resources for the species to survive. Considering the species is known from several locations outside the Project area, the area of potential and known habitat that would be conserved in the Offset areas (490 ha in native vegetation and 35 of cleared land), and the revegetation programmes, the habitat to be removed is unlikely to adversely impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" of relevance to the Varied Sittella has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Varied Sittella. Actions that are recommended to facilitate the conservation and recovery of the species include retaining native vegetation and remnant stands along roadsides, increase the size of existing remnants and re-establish connective links. From a regional perspective, the Project would remove a relatively small area (approximately 105 ha of native vegetation and 26 ha of cleared land) of suitable foraging and breeding habitat of the species and contribute to habitat fragmentation and reduction of patch size. However, the potential habitat in the proposed offset (490 ha of native vegetation and 40 ha of cleared land) would contribute to the conservation and improvement of potential habitat for the species in the region in the long-term (Section 7). Therefore, the Project is not inconsistent with these suggested recovery actions.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to this species include the clearing of native vegetation and removal of dead wood and dead trees (OEH, 2012a).

In the short-term, the Project would result in an increase in these key threatening processes. The Project would result in the clearing of approximately 105 ha of native vegetation and 26 ha of cleared of potential habitat. Some of this habitat is likely to contain dead wood and dead trees. It is unlikely that these processes would have a significant adverse impact on the species considering the large amount of potential habitat in the surrounding area, the potential habitat in native vegetation that would be conserved in the Offset areas (490 ha in native vegetation and 40 ha in cleared land), and the amount of additional habitat that would be created through revegetation of Offset areas (up to 435 ha), and rehabilitation of post-mining landforms. Further, dead wood would be retained and distributed throughout the revegetation areas.

Conclusion

It is anticipated that the Project would have an impact on the Varied Sittella considering the species is sedentary, and decreases in patch size and connectivity are important requirements for sedentary species. Further, this species is associated with the valley habitats which are limited in the wider locality. However, despite this, the Project is unlikely to have a significant impact on the Varied Sittella such that a local viable population would be placed at risk of extinction given:

- the species has been recorded in several locations outside the Project area (Figure 4a);
- from a regional perspective, only a relatively small area of potential habitat would be cleared (105 ha of native vegetation composed primarily of grassy woodlands, dry sclerophyll forest and wet sclerophyll forest) and a further 26 ha of cleared land that this species could utilise (Section 7); and
- the Project would only temporarily fragment areas of potential habitat for this species.

Further to the above, potential habitat for the species (490 ha of native vegetation composed of the equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term due to the proposed Offset areas (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7), and rehabilitation and revegetation of post-mining landforms.

Spotted-tailed Quoll (Dasyurus maculatus)

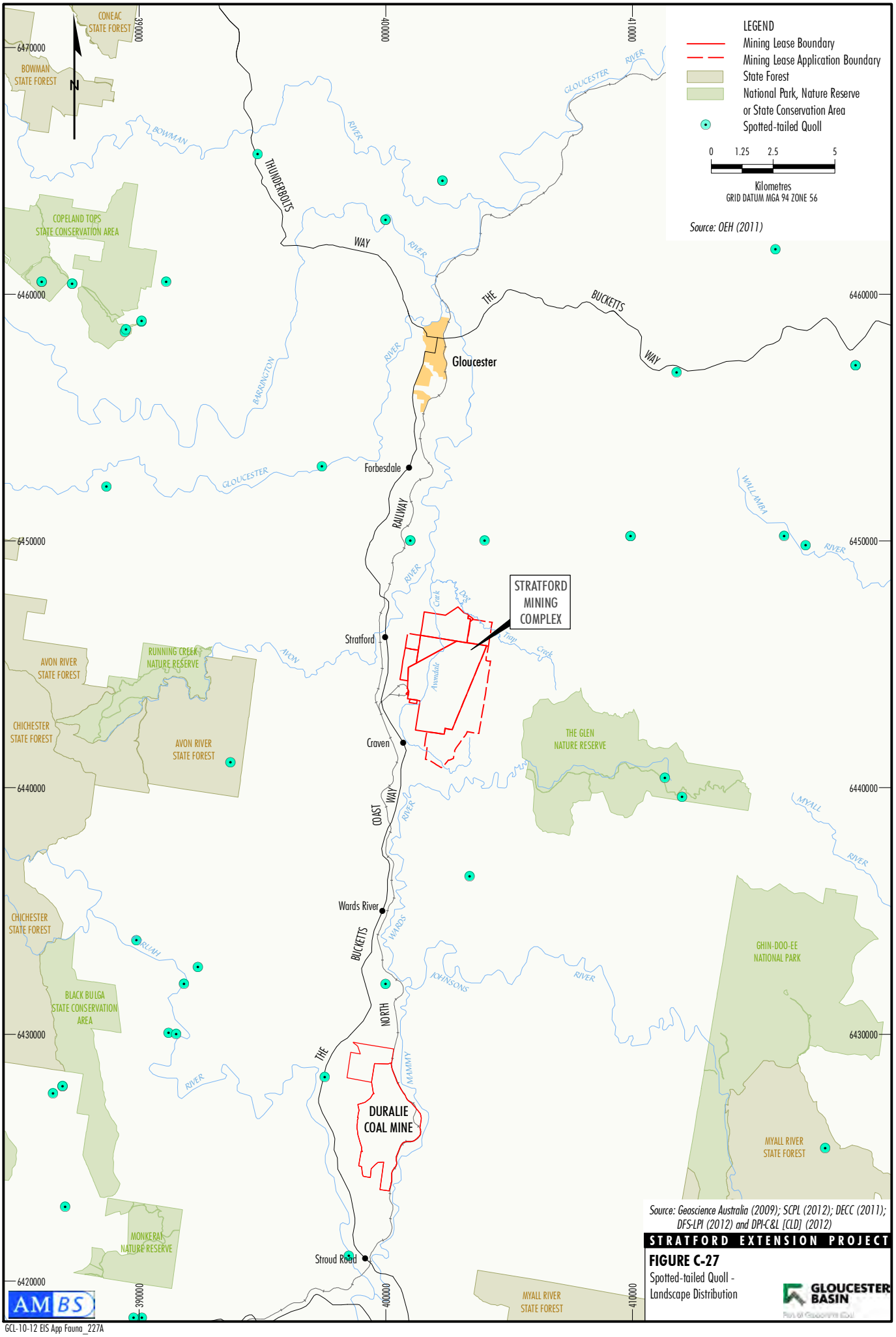
The Spotted-tailed Quoll is listed as a vulnerable species under Schedule 2 of the TSC Act (OEH, 2012a) as well as endangered on the EPBC Act. It occupies a range of environments within a disjunct distribution along the east coast of Australia, extending from south-eastern Queensland through NSW and Victoria to Tasmania. This species is found in a variety of habitats, including sclerophyll forest and woodlands, coastal heathlands and rainforests (Dickman and Read, 1992; Edgar and Belcher, 1995). Occasional sightings are made in open country, grazing lands, rocky outcrops and other treeless areas.

Prey items include gliders and possums, small wallabies, rats, birds, bandicoots, rabbits, insects and carrion. Although mainly terrestrial, the Spotted-tailed Quoll is an agile climber and may raid possum and glider dens and prey on roosting and fledgling birds. Nesting occurs in rock shelters, hollow logs, caves or tree hollows and they use numerous dens within the home range. Estimates of home ranges vary from 800 ha to 20 km^2 and individuals may move several kilometres in a night. It is a highly mobile species and there are numerous records of overnight movements of several kilometres (Edgar and Belcher, 1995). Breeding occurs from April to July with an average litter size of five (Edgar and Belcher, 1995).

The Spotted-tailed Quoll is threatened by a number of processes including loss, fragmentation and degradation of habitat through clearing of native vegetation and subsequent development, logging and frequent fire (Edgar and Belcher, 1995; Dickman and Read, 1992). The loss of large hollow logs and other potential den sites (Scotts, 1992) is a major problem, as well as competition for food and predation by foxes and cats (Edgar and Belcher, 1995; Dickman and Read, 1992). Cats may also spread parasitic protozoan epidemics to Quolls (Edgar and Belcher, 1995; Dickman and Read, 1992). Persecution by humans is still an issue, because humans perceive Quolls as a predator on stock and poultry (Edgar and Belcher, 1995; Dickman and Read, 1992). Baiting of dingoes may result in direct poisoning of Spotted-tailed Quolls but may also change the relative abundance of predator. Reducing dingo numbers favours foxes which compete with quolls (Edgar and Belcher, 1995; Dickman and Read, 1992).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

There is marginal potential habitat for the Spotted-tailed Quoll throughout most of the Project area. There are records of the species from the region but none from the Project area or surrounds despite previous surveys (Figure C-27). Approximately 105 ha of potential foraging and breeding habitat (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 90 ha of cleared land would be impacted by the Project (Figure C-28). The Project would remove a number of hollow bearing trees and logs, but few are likely to be large enough to be used by the species. The density of hollow bearing trees within the Project area is mostly less than 10 per ha, except in two small patches where the hollows occur at a density of greater than 20 hollows per hectare (Figure 9). The species is more likely to occur east of the Project area in the ranges, where more extensive and less fragmented habitat occurs.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

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FIGURE C-27

Spotted-tailed Quoll - Landscape Distribution

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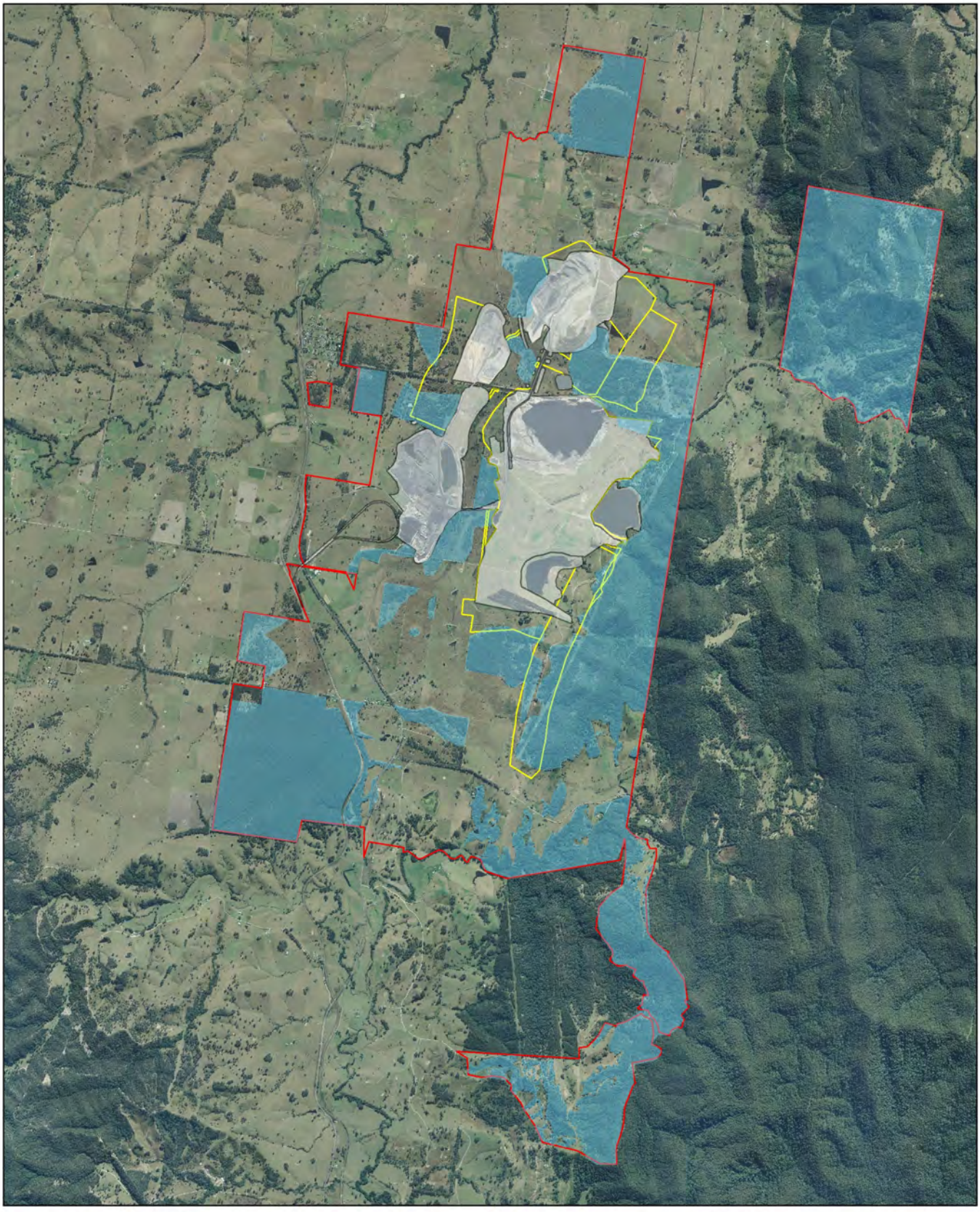


Figure C-28: Spotted-tailed Quoll - Potential Habitat

It is unlikely that the Project would have an adverse effect on the species such that viable local population of the species is likely to be placed at risk of extinction, given the habitat for the species in the locality is not ideal and substantial potential habitat exists in the surrounding area, including the offset area (447 ha of native vegetation and 10 ha of planted trees), which would be conserved and improved, and the Glen Nature Reserve where the species has been recorded. Further, revegetation of areas throughout the Offset areas (up to 435 ha) would likely provide additional potential habitat in the future.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, a small amount (approximately 105 ha) of potential habitat for Spotted-tailed Quolls would be removed (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest). Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) Two areas of potential habitat for this species would be temporarily further fragmented and isolated as a result of the Project: the area to the west of the Avon North Open Cut and the area to the West of the Stratford East Open Cut. However, it is unlikely that the species would utilise these areas given the already highly fragmented nature of the habitat within the Stratford Mining Complex.

Spotted-tailed Quolls are wide ranging, and prefer habitats with old growth features, which are not abundant within the Project area. Few old growth logs large enough for this species were observed within the Project area and no rock crevices suitable for sheltering. The species is considered more likely to occur within nearby Conservation Reserves. The Offset areas would conserve better quality potential habitat for this species (457 ha of native vegetation and cleared land that this species could use), and in the long-term this would develop a greater abundance of old growth features. Therefore, the habitat that would be removed is not likely to adversely impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No 'critical habitat' for Spotted-tailed Quolls has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan has been prepared for Spotted-tailed Quolls. Actions suggested by OEH (2012a) for the recovery of this species that are relevant to the Project include retaining and protecting large forested areas with hollow logs and rocky outcrops. While some forested areas would be lost as a result of the Project, there is substantial potential habitat in the surrounding area, including 457 ha of native vegetation and planted trees in the proposed offset area. This habitat is considered to be more suitable for this species as it is less fragmented, and it would be conserved and improved, which is consistent with the suggested recovery actions. Further, additional areas of potential habitat would be created through revegetation of up to 435 ha of currently cleared land in the Offset areas, and revegetation of rehabilitated post-mining landforms.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Spotted-tailed Quoll include the clearing of native vegetation, removal of dead wood/trees, and high frequency fires (OEH, 2012a).

The Project would result in the clearing of native vegetation (and possibly some dead wood that the species could use), resulting in a small loss of potential foraging and breeding habitat. A local population (were one to exist) is not likely to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the adjacent area, including less fragmented habitat that would be conserved and improved in the Offset areas. The relocation of fallen logs is included in the mitigation measures and the Project would not increase the frequency of fires in the area.

Conclusion

It is anticipated that the Project would potentially impact on the Spotted-tailed Quoll due to the removal of potential foraging habitat. Overall, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the species was not recorded during any surveys in the study area;
- from a regional perspective, only a relatively small area of potential habitat would cleared (105 ha of potential habitat in native vegetation, primarily composed of wet sclerophyll forest, grass woodland, and dry sclerophyll forest) and a further 90 ha of cleared land that could be utilised by this species (Section 7);
- there is substantial less fragmented habitat for this species in the surrounding area, including the Glen Nature Reserve; and
- no known area of habitat would be fragmented or isolated as a result of the Project.

Further to the above, potential habitat in the Offset areas would be conserved and improved (447 ha of native vegetation composed of the equivalent and/or additional vegetation types, and 10 ha of planted trees) (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7), and revegetation of rehabilitated post-mining landforms.

Brush-tailed Phascogale (Phascogale tapoatafa)

The Brush-tailed Phascogale is listed as vulnerable under Schedule 2 of the TSC Act. The species is distributed patchily within forest habitats along the coast of NSW, particularly on the Great Dividing Range. In NSW, Brush-tailed Phascogales are most common in the north east and south east of the state but are rare in semiarid and arid environments (OEH, 2012a).

Brush-tailed Phascogales primarily occur where annual rainfall is above 500 millimetres (mm). They prefer dry sclerophyll open forest but are also known to inhabit forested wetlands, grassy woodlands, heathland, swamps, rainforest and wet sclerophyll forest (Dickman and McKechnie, 1985).

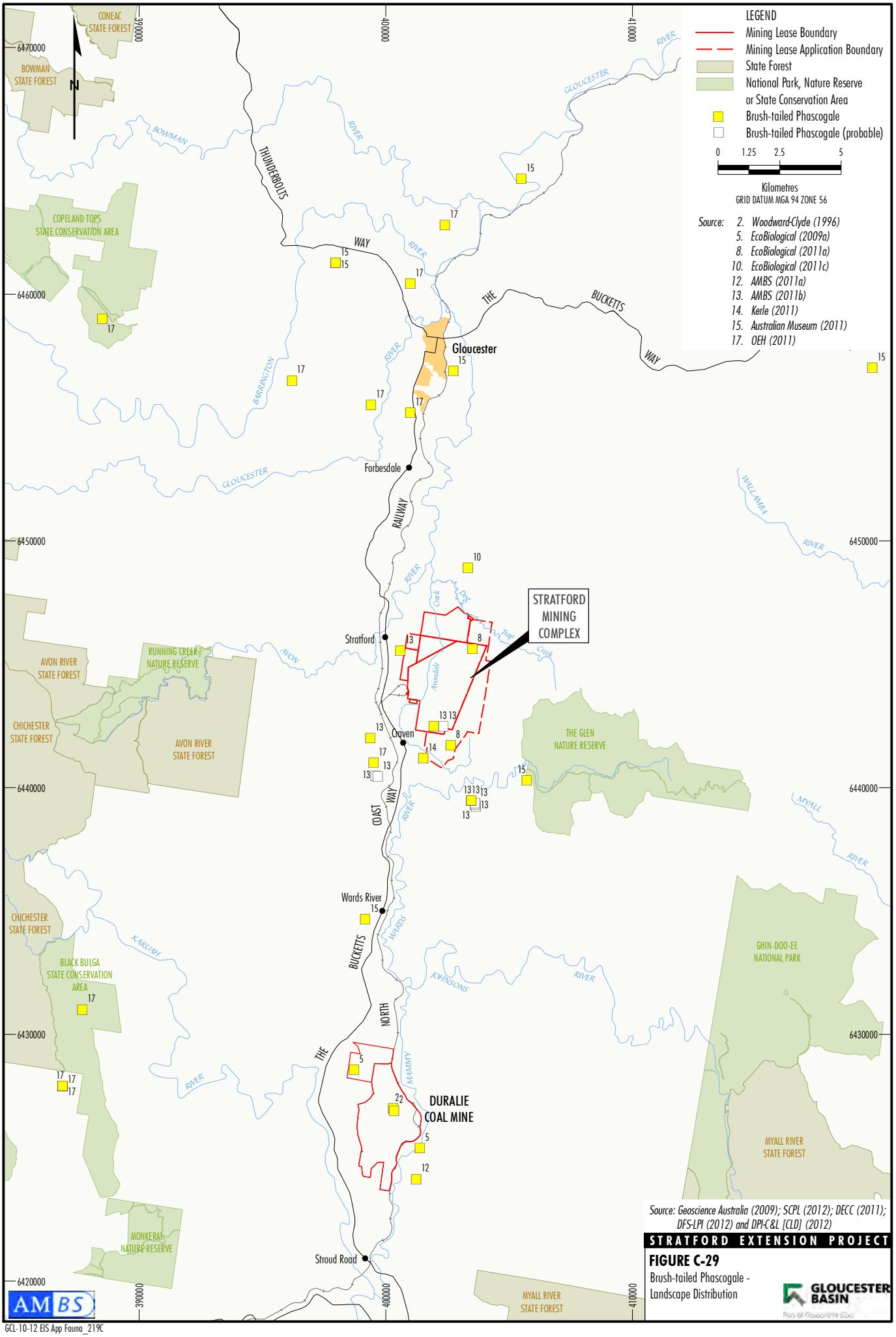
The species is mostly arboreal and is a proficient climber. They are found mostly in rough-barked trees of at least 25 cm diameter at breast height. Brush-tailed Phascogales are nocturnal and are predominantly carnivorous. Their diet consists mainly of invertebrates, such as spiders, centipedes, beetles and cockroaches but they will also occasionally eat small vertebrates (Soderquist, 1995). They will also eat nectar. Individuals are territorial with females occupying territories of 20 to 60 ha and males occupying territories up to 100 ha. Therefore, only small populations can exist over a large area. Brush-tailed Phascogales are reliant on tree hollows for nests and shelter and they will use numerous different trees and hollows over a short period of time (van der Ree *et al.*, 2006). They line their hollow with leaves and bark and use pungent faeces as a territorial marker.

Brush-tailed Phascogales mate between May and July. During this time the males can travel outside of their territories and they die soon after the mating season. Females can live for up to three years but typically produce just one litter. The gestation period is approximately 30 days and females usually produce between 3 and 8 young per litter. Juveniles leave the pouch at around 7 weeks of age but stay in the nest until about 20 weeks. Mortality is usually high during this period. After weaning, males will normally disperse while females will establish territories nearby or within their home range.

The major threat to the Brush-tailed Phascogale is land clearing and habitat fragmentation and the loss of hollow-bearing trees. Changes to forest structure and loss of hollows can also lead to increased exposure to feral predators such as cats and foxes. The introduced honeybee also competes with Brush-tailed Phascogales for tree hollows.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Brush-tailed Phascogale has been recorded on several occasions within and surrounding the Stratford Mining Complex, including in a recent survey (Figures 4-b and C-29). The Project would result in the loss of approximately 52 ha of good quality habitat and approximately 63 ha of marginal habitat for the Brush-tailed Phascogale (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) (Figure C-30). Marginal habitat occurred east of the Project area on the slope where wet sclerophyll forest had a greater influence on habitat type, and dead wood was less abundant. Core habitat appears to be preferred in the study area, consisting of the dry valley habitats which have a limited distribution in the surrounding area. The habitat that would be removed also contains potential nesting hollows for the Brush-tailed Phascogale. The density of tree hollows within the Project area is mostly less than 10 hollow per hectare, except in two small patches where the tree hollow density is greater than 20 hollows per hectare (Figure 9). A portion of this habitat represents potential nesting or refuge habitat for this species.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-29

Brush-tailed Phascogale - Landscape Distribution

AMBS

GLOUCESTER BASIN

GCL-10-12 EIS App Fauna_219C

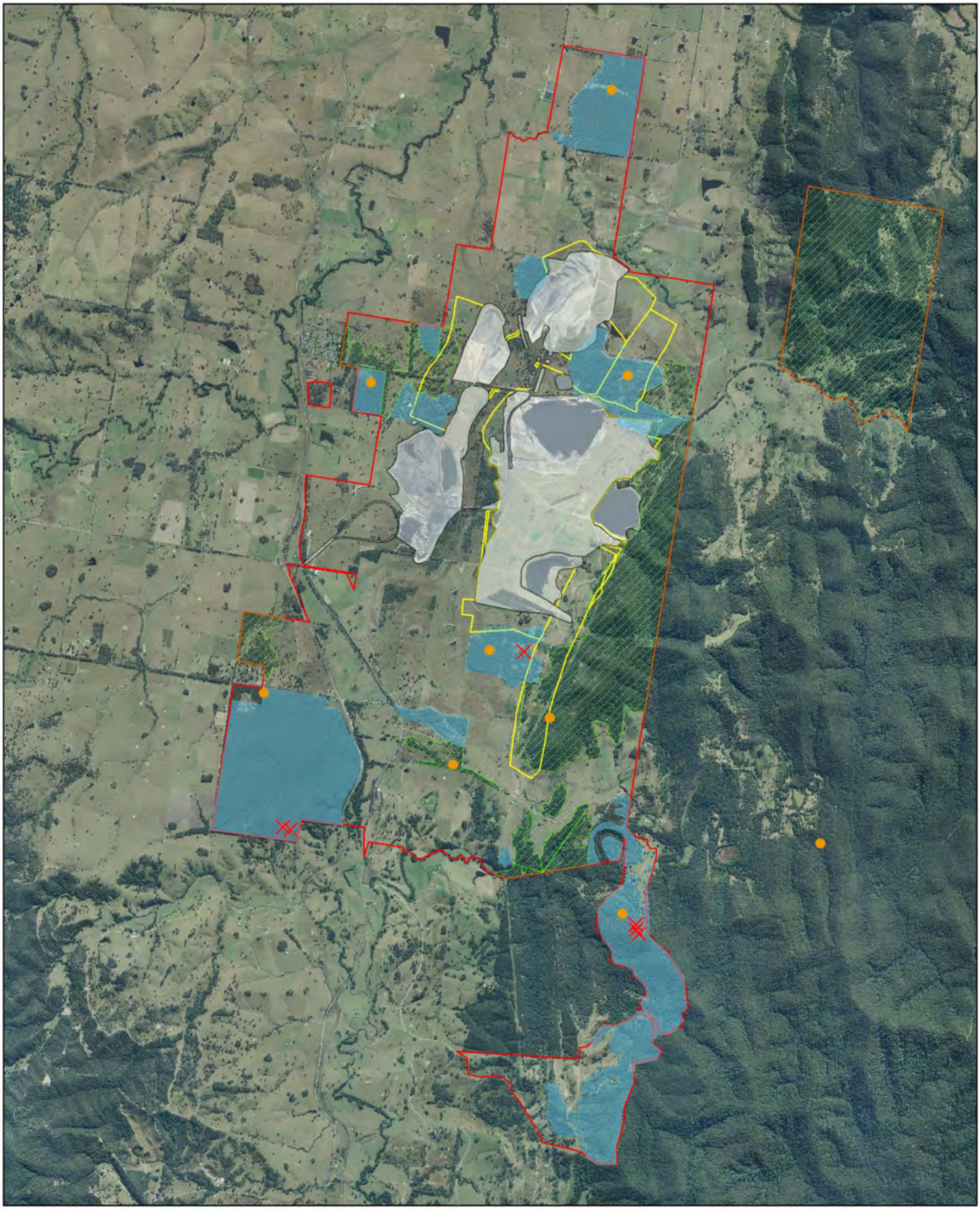


Figure C-30: Brush-tailed Phascogale - Potential Habitat

Although suitable habitat would be removed, the species was recorded in several other locations outside the Project area, including the Offset areas and Voluntary Conservation Area, and the amount of land to be cleared as a result of the Project is unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, the Project would result in the loss of a relatively small area (approximately 52 ha) of good quality habitat and approximately 63 ha of marginal habitat for the Brush-tailed Phascogale (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest). Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) Brush-tailed Phascogales have been found in the patch of vegetation just west of the proposed Stratford East Open Cut and this area of vegetation would become temporarily isolated as a result of that Project. However, Brush-tailed Phascogales require large home ranges (20-60 ha for females and up to 100 ha for males) so this patch of potentially isolated land may not be of great importance to the species over the entire landscape. In addition, there is potential for further habitat for this species to be conserved and improved in the proposed Offset areas, including expansion of areas of known habitat throughout revegetation of currently cleared land.

(iii) While 115 ha of known or potential habitat would be lost as result of the Project, the Brush-tailed Phascogale has been recorded in several other locations outside the Project area, including the Offset areas and Voluntary Conservation Area. Further, considering the amount of suitable habitat in the surrounding area, and the habitat that would be conserved and improved in the Offset areas (157 ha of good quality habitat and 191 ha of low quality habitat), the habitat that would be removed is not considered to be of importance to the long-term survival of the species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for the Brush-tailed Phascogale has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Brush-tailed Phascogale. OEH (2012a) lists a number of suggested recovery measures for this species, including retaining and protecting habitat, retaining nest trees and recruitment trees (future hollow-bearing trees), and providing nest boxes in areas where tree-hollows have been removed. Given the large areas of known and potential habitat that would be conserved and enhanced in the Offset areas (157 ha of high quality habitat and 191 ha marginal habitat in native vegetation), and the areas of currently cleared land that would be revegetated (up to 435 ha), some of which would likely provide potential habitat in the future, the small amount of habitat that would be removed as a result of the Project is not inconsistent with these suggested actions. Further, post-mining landforms would be rehabilitated and revegetated.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Brush-tailed Phascogale include the clearing of native vegetation, loss of hollow bearing trees and the removal of dead wood (OEH, 2012a). While the Project would result in the clearing of approximately 115 ha of native vegetation (52 ha of good quality habitat and 63 ha of low quality habitat), and the loss of some hollow-bearing trees, this would result in only a small reduction in the available foraging and nesting resources for the species in the region. In addition, there would be additional habitat conserved and improved in the proposed Offset areas, and additional habitat created through the revegetation programme, which would include expansion on existing areas of known habitat for the species. Dead wood would be reintroduced into the revegetation areas.

Conclusion

It is anticipated the Project would have an impact on the Brush-tailed Phascogale considering the preferred habitat for the species (dry sclerophyll forest) is limited throughout the valley, and the Project is likely to remove some potential foraging and shelter/nesting habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the species has been recorded in several locations outside the Project area;
- from a regional perspective, the Project would only remove a small area (52 ha of good quality habitat and 63 ha of patchy habitat, primarily composed of grassy woodland, dry sclerophyll forest, and wet sclerophyll forest) of potential habitat within the Project area (Section 7); and
- the Project would only temporarily fragment areas of potential habitat for the species, until the revegetation programmes are established.

Further to the above, potential habitat for the species (157 ha of high quality habitat and 191 ha of patchy habitat composed of the equivalent and/or additional vegetation types) would be conserved and improved in the region in the long-term due to the proposed offset areas (Section 7), which includes the extension of known Brush-tailed Phascogale habitat as a result of proposed Offset area 2. Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Common Planigale (Planigale maculata)

The Common Planigale is listed as vulnerable in NSW under Schedule 2 of the TSC Act. The distribution of the Common Planigale extends from coastal north-eastern NSW to coastal east Queensland and Arnhem Land. The species reaches its confirmed southern distribution limit on the NSW lower north coast however there are reports of its occurrence as far south as the central NSW coast west of Sydney (OEH, 2012a). The Common Planigale is found in coastal and sub-coastal areas of north-western Western Australia south to Broome, across the Top End, Cape York Peninsula and along the east coast of Australia as far south as Gosford (OEH, 2012a).

The species occurs in a wide variety of habitats, from cool mountain rainforests to heathland to weed-infested urban reserves (OEH, 2012a). It appears to depend on relatively dense surface cover and is often found close to water (OEH, 2012a). Very little is known about its ecology. It is a nocturnal insectivore, sheltering during the day in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks and hunting for insects and small vertebrates at night (OEH, 2012a).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Common Planigale has not been recorded in the Project area or surrounds and only one record exists for the wider area. Potential habitat for the species exists in the Project area. The Project would result in the removal of approximately 105 ha of potential foraging and breeding habitat for the Common Planigale in native vegetation (i.e. dry sclerophyll forest, grassy woodlands and wet sclerophyll forest) and a further 25 ha of cleared land that this species could potentially use (Figure C-31).

There is potential for the species to occur within the Project area, but it is unlikely a local population would be specifically reliant on the habitat that would be disturbed by the Project. The species occurs in a wide range of habitats, and is therefore likely to be capable of utilising the resources available within the Offset areas and nearby Conservation Areas. It is unlikely that the proposed action would have an adverse effect on the life cycle of the species such that a viable local population is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

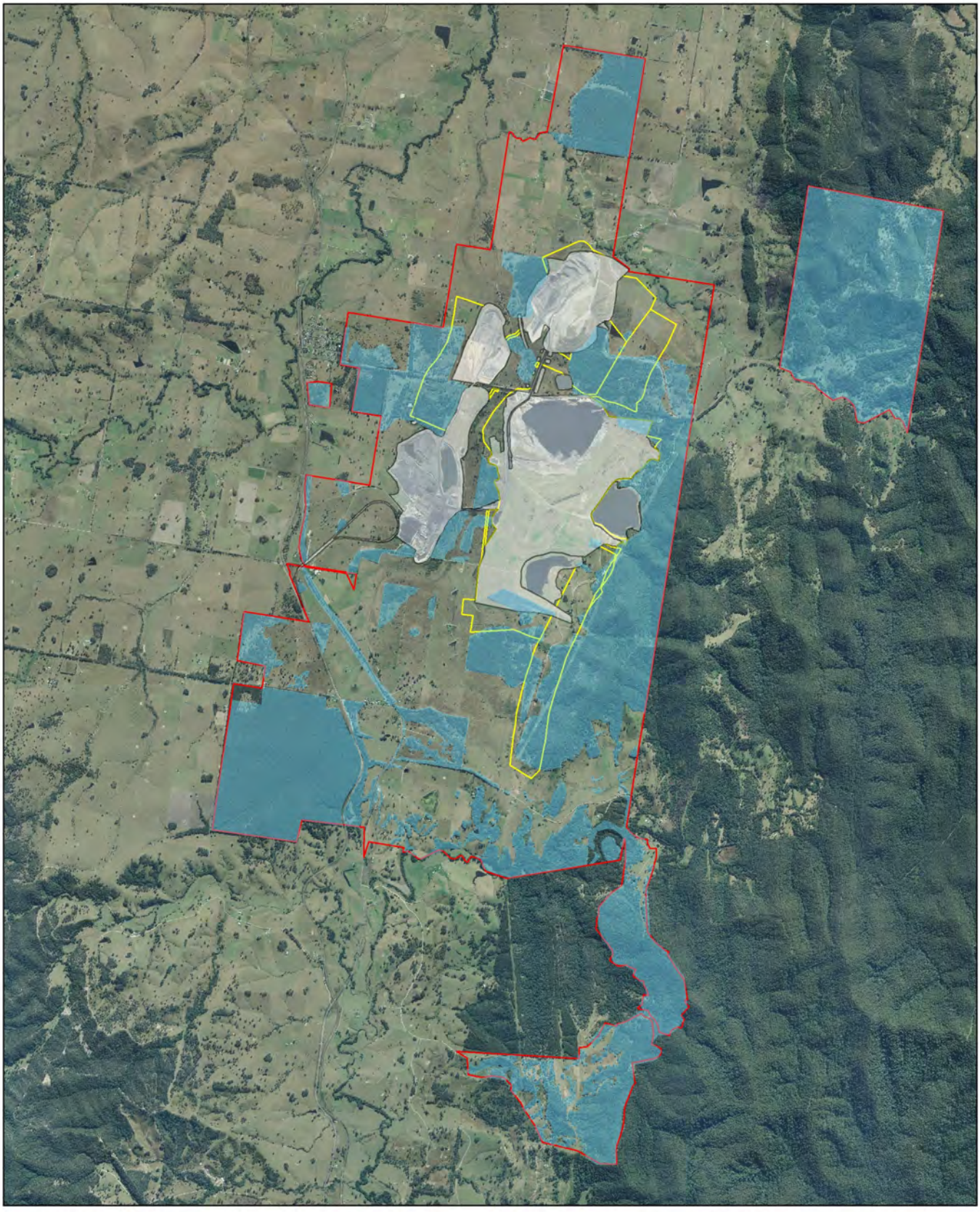


Figure C-31: Common Planigale - Potential Habitat

0 0.5 1 2 Kilometres

Notes: areas unmapped inside the study area are considered unlikely habitat where there is a low probability that the species would occur.

Legend

- Potential Habitat
- Approximate Extent of Existing/Approved Surface Development
- Approximate Extent of Additional Project Surface Development
- Study Area

N

AMBS

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, the Project would result in the removal of only a small area (approximately 105 ha of native vegetation and 25 ha of cleared land) of potential foraging and breeding habitat (i.e. dry sclerophyll forest, grassy woodland and wet sclerophyll forest). Smaller amounts of habitat may become degraded due to edge effects, but the impacts from this are expected to be minor in comparison to the direct habitat loss.
(ii) Potential habitat for this species would be removed as a result of the Project and may cause the temporary further isolation or fragmentation of habitat for this species.
(iii) Considering that only a relatively small amount of potential habitat would be cleared (approximately 130 ha), considerable suitable habitat occurs in the surrounding area, approximately 490 ha of potential habitat would be preserved and improved in the Offset areas and up to 435 ha of cleared land would be revegetated, it is considered that the habitat to be removed is unlikely to adversely impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for the Common Planigale has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan has been prepared for the species. OEH (2012a) makes a number of suggestions for the recovery of this species including, protecting areas of habitat from clearing and development and maintain adequate ground cover, especially near water (reduce burning impacts and life stock impacts), controlling foxes, feral cats and cane toads.

Considering only a small amount of potential habitat would be cleared, the offset would protect and enhance potential habitat, and the Project would include a feral animal management plan, the action proposed is not inconsistent with these suggested recovery actions.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes that are relevant to this species includes loss and fragmentation of habitat through clearing, disturbance of vegetation surrounding waterbodies, and predations by feral foxes and cats. In the short-term, the Project would result in a small increase in a key threatening process.

It is unlikely that this would have any significant adverse effect on this species considering the large amount of potential habitat in the surrounding area, the potential habitat that would be conserved in the Offset areas (530 ha), and the amount of additional habitat that would be created through revegetation of Offset areas (up to 435 ha). Further, post-mining landforms would be rehabilitated and revegetated. The Project includes a feral animal management plan, which would minimise any potential impacts to the species from predation due to foxes and cats.

Conclusion

It is anticipated that the Project would potentially impact on the Common Planigale due to the removal of potential foraging and breeding habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the species' is known to occur in a large range of habitats, including rainforest, eucalypt forest, heathland, marshland, grassland, and rocky areas, so is unlikely to be specifically reliant on the valley habitats that would be disturbed;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of grassy woodland, wet sclerophyll forest, dry sclerophyll forest, and an additional 25 ha of cleared land) of potential habitat within the Project area (Section 7);
- potential habitat is likely to occur in the surrounding area; and
- the Project would only temporarily fragment areas of potential habitat for the species, until revegetation programmes become established.

Further to the above, potential habitat in the Offset areas would be conserved and improved (490 ha of native vegetation composed of the equivalent and/or additional vegetation types that this species could utilise) (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7), and rehabilitated post-mining landforms would be revegetated.

Koala (Phascolarctos cinereus)

The Koala is listed as vulnerable on Schedule 2 of the TSC Act. The koala's current distribution is fragmented throughout eastern Australia. They occur from north-east Queensland to the Eyre Peninsula in South Australia. The distribution continues west of the Great Dividing Range, where it occurs along inland rivers. In NSW, Koalas occur predominantly on the central and north coasts. Some populations also occur in the Pillaga region and to the west of Gunnedah. While once abundant on the south coast, this species now only occurs in sparse and disjointed populations in the Eden-Narooma area. There are also populations at a number of locations on the Southern Tablelands (OEH, 2012a).

Koalas are most active in the first few hours after sunset but can most often be found resting in the forks of trees. Koalas are known to feed on the leaves of 66 species of eucalypt and seven non-eucalypt species. In a specific area, however, individuals will eat leaves from only a much smaller number of species with primarily and secondarily preferred species. Some preferred species in NSW include Red Gum (*Eucalyptus tereticornis*), Grey Gum (*E. punctata*), Monkey Gum (*E. cypellocarpa*) and Ribbon Gum (*E. viminalis*). In coastal areas, Tallowwood (*E. microcorys*) and Swamp Mahogany (*E. robusta*) are important food species, while in inland areas White Box (*E. albens*), Bimble Box (*E. populnea*) and River Red Gum (*E. camaldulensis*) are favoured.

One of the most important factors influencing the occurrence of koalas is the suite of tree species available. If primary food tree species are not present or occur in low density, koalas will rely on secondary food tree species, but the carrying capacity of the habitat (i.e. number of animals per hectare) is inevitably lower. Adequate floristic diversity is also important. Although primary and secondary food trees provide the bulk of a koala's diet, leaves from other species, including non-eucalypts, may provide a seasonal or supplementary dietary resource. The quality of habitat is also influenced by the presence of suitable shelter trees, particularly in harsh climates.

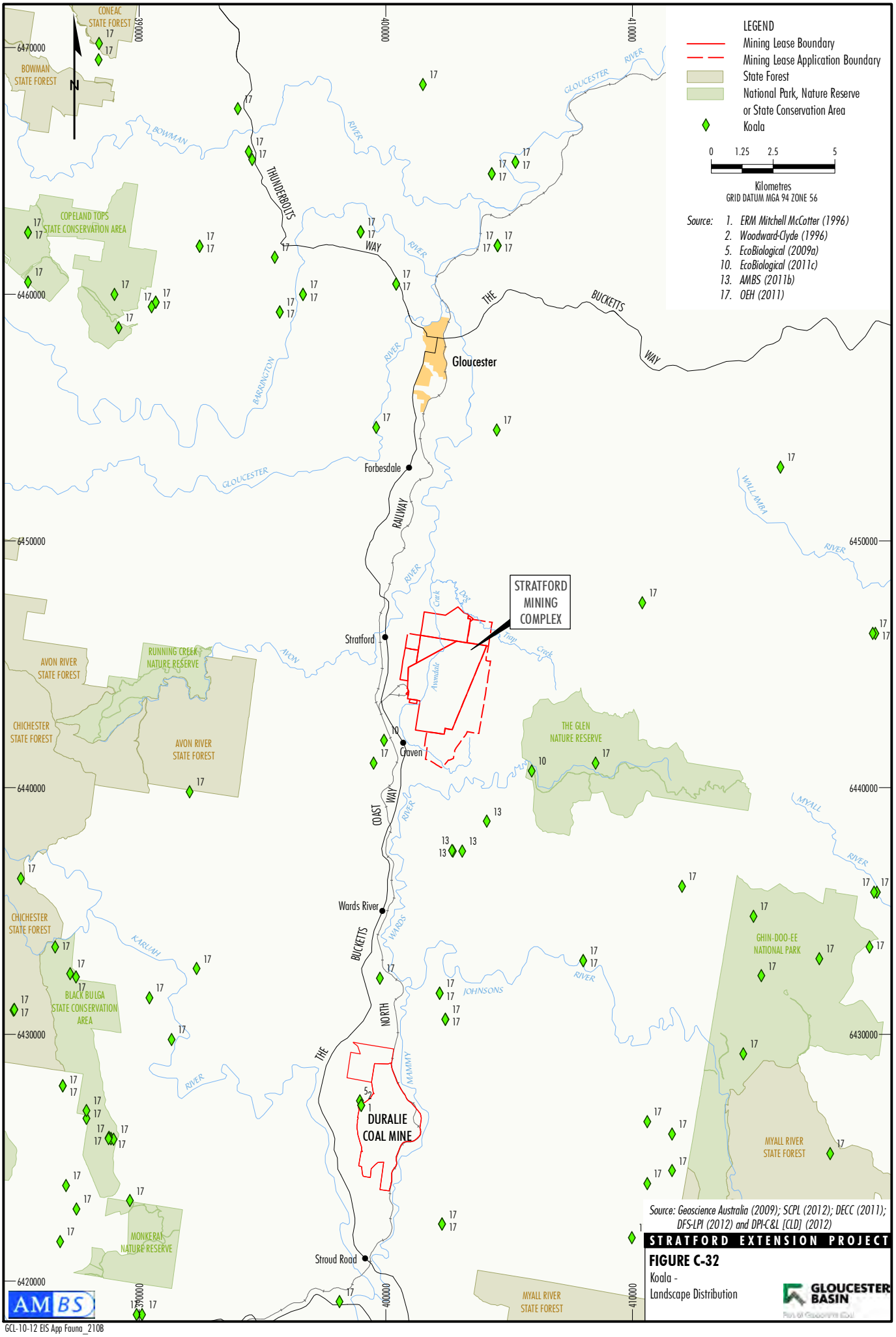
While Koalas are often found singularly, they actually live in social groups or breeding aggregations with a complex hierarchy of a dominant male, a small number of mature females and a number of juveniles of various ages. Males reach sexual maturity at approximately two years of age but they are prevented from breeding by the dominant male. Females also reach sexual maturity at about two years and then produce approximately one offspring per year. The young spend six months in their mothers pouch and then ride on their mother's back until reaching independence at about 12 months. Young females may stay in their mother's home range for two to three years but then disperse. Juvenile dispersal distances are typically from 1 to 11 km but dispersal distances of up to 50 km have been recorded.

Threats to Koalas include destruction of habitat through land clearing for development, agriculture and mining, particularly where they occur on high-nutrient soils. Roads through habitat create barriers to movement and can isolate individuals and populations, alter population dynamics, and prevent gene flow. Mortality from dog attacks also pose a threat to Koalas, as do fire, drought, road fatalities, and weed invasion. Infection by Chlamydia can also affect stressed populations.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The species has not been recorded in the Project area. Recent surveys have recorded individuals within and near Offset area 4, the western Voluntary Conservation Area, the Glen Nature Reserve (Figure 4b). Database records also exist for the greater locality (Figure C-32).

Potentially suitable foraging habitat is present throughout the Stratford Mining Complex (Figure C-33). The Project would remove a relatively small area of fragmented habitat for the species, approximately 130 ha (Figure C-33).



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-32

Koala - Landscape Distribution

AMBS

GLOUCESTER BASIN

GCL-10-12 EIS App Fauna_210B

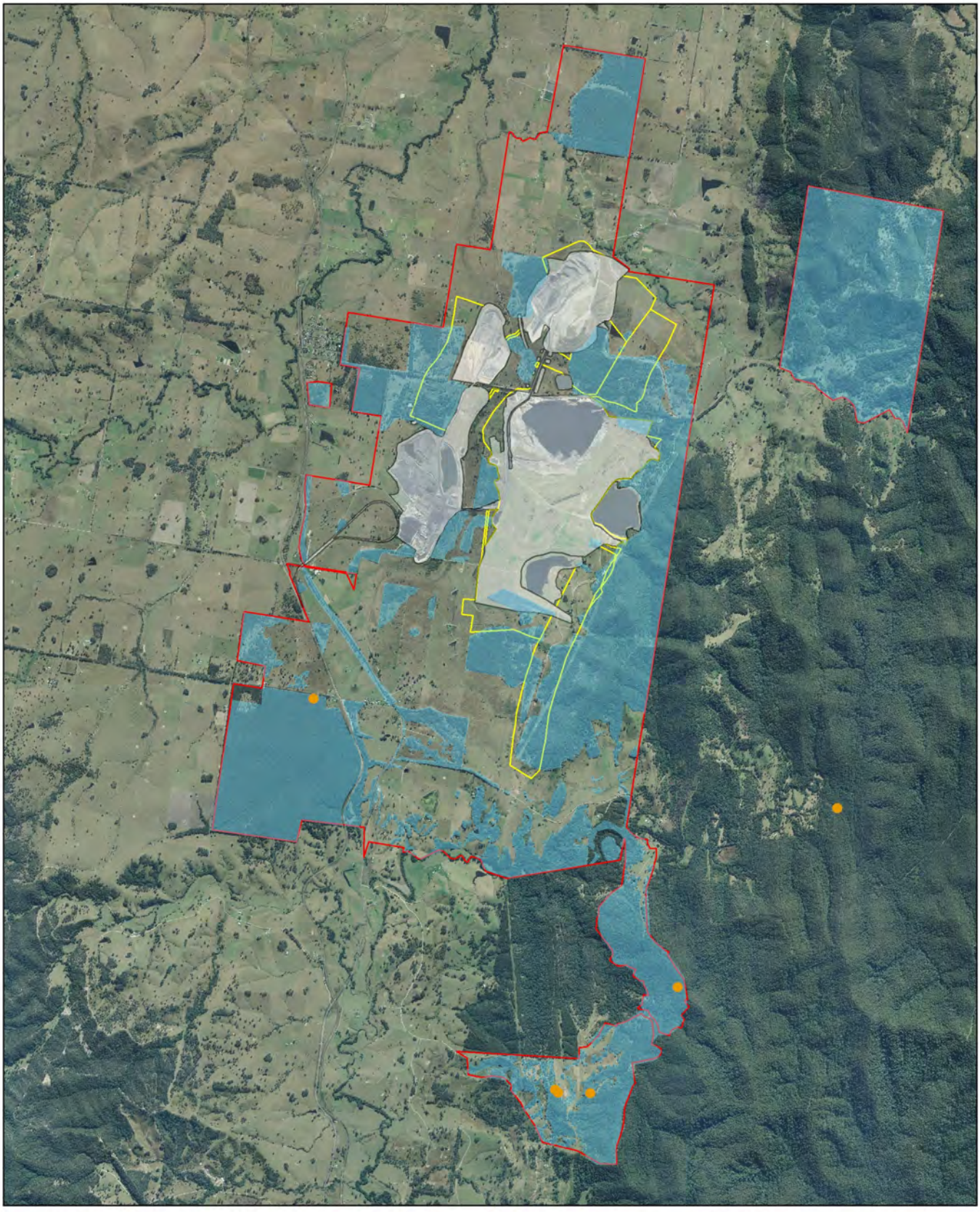


Figure C-33: Koala - Potential Habitat

This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and a further 25 ha of cleared land that could also be utilised by the species. This small loss of habitat is not expected to significantly affect the lifecycle of this species, since large patches of suitable habitat exist in the surrounding area and in the greater locality.

Given the above, the Project is unlikely to disrupt the lifecycle of the Koala "such that a viable local population of the species is likely to be placed at risk of extinction".

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, the Project would require the removal of a relatively small area of approximately 130 ha of habitat. This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and a further 25 ha of cleared land that could also be utilised by the species. Smaller amounts of habitat may be degraded from edge effect but the impacts are likely to be minor in comparison to the direct habitat loss.

(ii) The Project would result in the temporary fragmentation or isolation of potential habitat for this species. However the areas of habitat that would be impacted are fragmented, and do not constitute preferred habitat for the species in the study area. All records for the species occur within the Offset areas, Voluntary Conservation Area or the Glen Nature Reserve, and these are well connected within other remnants.

(iii) Given the relatively small amount of habitat that would be removed, and considering the larger areas of preferred habitat that is available outside the Project area and within the offset area, the proposed removal of habitat is unlikely to impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" of relevance to the Koala has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The recovery plan for the Koala (DECC 2008) includes two objectives that are relevant to the Project. These are 'to conserve koalas in their existing habitat' and 'to rehabilitate and restore koala habitat and populations'. Other actions that are recommended to facilitate the conservation and recovery of the species include retaining suitable habitat especially areas dominated by preferred feed-tree species. The Project would remove a relatively small area (approximately 130 ha [105 ha of native vegetation and 25 ha of cleared land that could be utilised by the species]) of potential habitat for the species and contribute to habitat fragmentation and reduction of patch size. However, the proposed Offset areas would contribute to the conservation and improvement of potential and known habitat (478 ha in native vegetation of equivalent or additional vegetation types) for the species in the region in the long-term (Section 7). Further, additional areas of potential habitat may be created through the revegetation of cleared land (up to 435 ha) and the rehabilitation and revegetation of post-mining landforms. Overall, the actions are not inconsistent with the objectives outlined above.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to this species include clearing of native vegetation (OEH, 2012a). The Project would result in the loss of approximately 130 ha of potential habitat (105 ha of native vegetation and 25 ha of cleared land that could be utilised by the species) and would result in increased fragmentation and decrease in patch size. In the short-term there may be a small increase in a key threatening process, however, considering the Project would not be impacting on preferred habitat in the study area, the relatively small scale impact is unlikely to result in the increase of a threatening process to the extent that the local population of the species may be affected.

Conclusion

It is anticipated that the Project would potentially impact on the Koala due to the removal of potential habitat. However, the Project is not likely to have a significant impact such that a local viable population would be placed at risk of extinction given:

- the species was not recorded in the Project area during any surveys in the study area;
- from a regional perspective, only a relatively small area of potential habitat would cleared (105 ha of potential habitat in native vegetation primarily composed of wet sclerophyll forest, grass woodland, and dry sclerophyll forest) and a further 25 ha of cleared land that could be utilised by this species (Section 7);
- the species has been recorded in several other locations outside the Project area (Figure 4b);
- there is substantial habitat for the species in the surrounding area, including the Glen Nature Reserve, Offset areas and Voluntary Conservation Area, where it is known to occur; and
- no known area of habitat would be fragmented or isolated as a result of the Project.

Further to the above, known and potential habitat in the Offset areas would be conserved and improved (478 ha of potential habitat in native vegetation composed of the equivalent and/or additional vegetation types that the species could utilise) (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land, some of which may provide potential habitat for the species in the future (Section 7). Further, post-mining landforms would be rehabilitated and revegetated.

Squirrel Glider (Petaurus norfolcensis)

The Squirrel Glider is listed as a vulnerable species in NSW under Schedule 2 of the TSC Act. The species is sparsely distributed along the east coast and immediate inland districts from western Victoria to north Queensland. The species is found inland as far as the Grampians in Victoria and the Pilliga and the Coonabarabran areas of NSW (Quin, 1995; OEH, 2012a). Suitable habitat also exists in the River Red Gum Forests and Yellow Box woodlands of the Murray Darling Basin (Quin, 1995).

The Squirrel Glider inhabits dry sclerophyll forest and woodland and is generally absent from rainforest and closed forest (Menkhorst *et al*., 1988). In NSW, potential habitat includes Box-Ironbark forests and woodlands in the west, the River Red Gum forests of the Murray Valley and the eucalypt forests of the northeast. Individuals have also been recorded in a diverse range of vegetation communities, including Blackbutt, Forest Red Gum and Red Bloodwood forests, Coastal Banksia heathland and Grey Gum/Spotted Gum/Grey Ironbark dry hardwood forests of the Central NSW Coast (Quin, 1995).

The Squirrel Glider requires abundant hollow-bearing trees and a mix of eucalypts, acacias and banksias. Within a suitable vegetation community at least one flora species should flower heavily in winter and one or more of the eucalypts should be smooth-barked (Menkhorst *et al*., 1988; Quin, 1995).

The Squirrel Glider is nocturnal and shelters in bowl-shaped, leaf lined nests in tree hollows (Suckling, 1995). Within a home range Squirrel Gliders will use multiple hollow bearing trees as den sites, Crane *et al.* (2010) reported an average of seven. This species lives in family groups of between 2 and 10, generally comprising of one male, at least two females and juveniles (Quin, 1995; Suckling, 1995). Births occur throughout the year and are likely to reflect the availability of food, particularly pollen and nectar. Females are capable of raising two litters in a year and young are thought to leave the nest at around 6 months. Juveniles remain in their natal range for approximately 1 year after emerging from the nest, with juvenile males experiencing aggression from the dominant male. Juvenile mortality following dispersal is high, but established individuals are thought to survive for up to 6 years (Quin, 1995).

Squirrel Gliders are agile climbers and can glide for more than 50 m in one movement. Nightly movements are estimated as being between 300 and 500 m. Home-ranges have been estimated to be between 0.65 and 8.55 ha and movements tend to be greater for males than females. The home-range of a family group is likely to vary according to habitat quality and availability of resources (Quin, 1995; Sharpe and Goldingay, 2007; van der Ree *et al.*, 2003).

The Squirrel Glider's diet varies seasonally and consists of nectar, pollen, flowers, acacia gum and insects, particularly caterpillars (Menkhorst and Collier, 1987). Xanthorrhoea and sap from the Yellow-bellied Glider's feeding scars may also be eaten. Smooth-barked Eucalypts are preferred as these eucalypts form hollows more readily than rough-barked and support a greater diversity of invertebrates (Quin, 1995). Squirrel Gliders forage in the upper and lower forest canopies and in the shrub understorey. During winter when other food resources are scarce the Squirrel Glider may obtain its energy from the winter flowers of the Coastal Banksia, Red Ironbark (*Eucalyptus fibrosa*), River Red Gum (*E. camaldulensis*), Grey Ironbark (*E. paniculata*), Spotted Gum (*Corymbia maculata*), Forest Red Gum (*E. tereticornis*) and, in some areas, Blackbutt (Quin, 1995). They appear to be sensitive to loss or failure of winter flowering tree species (van der Ree and Sucking, 2008; Sharpe, 2009). Sharpe (2009) found that an inadequate supply of nectar can cause increased mortality and reduce reproduction. Goldingay *et al.* (2006) detected 50% fewer Squirrel Gliders during a season when flowering was poor.

The management implication is that there is potential for the loss of one or two key tree species to threaten a Squirrel Glider population, even if the remaining habitat is unaffected (Sharpe and Goldingay, 2007).

Threatening factors for the Squirrel Glider is the steady attrition of quality and extent of habitat remnants due to removal of timber for both sawn products and firewood; lack of suitable hollows in most habitat remnants on the inland slopes; lack of regeneration of trees and shrubs due to grazing by stock, rabbits and inappropriate fire regimes; removal of habitat tree decline in rural lands and outbreaks of leaf-skeletonising caterpillars in riverine forests; and further coastal development in NSW and south-east Queensland.

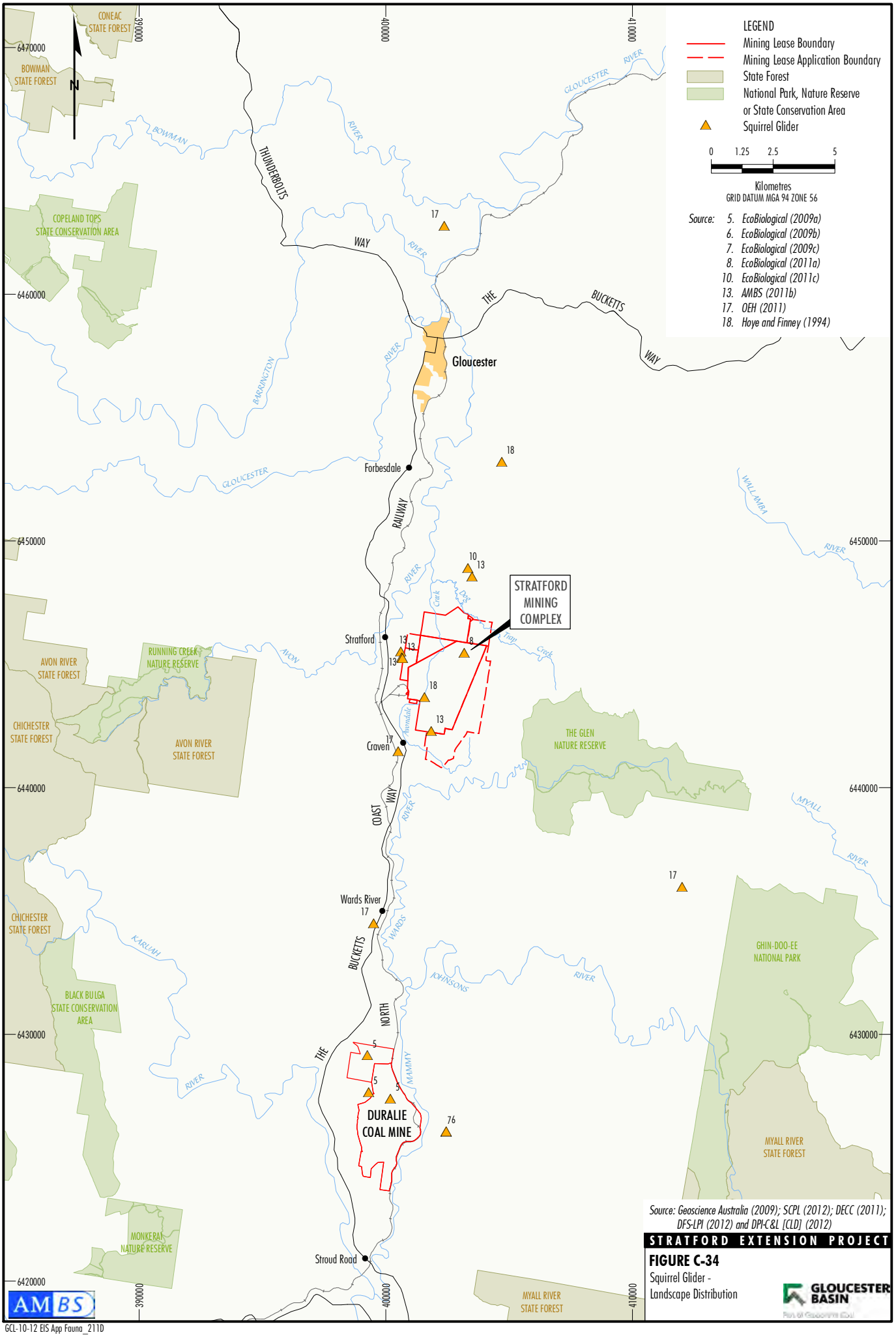
(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Squirrel Glider is known from nine records in or nearby the Project area, seven of which are relatively recent (Figures 4b and C-34). AMBS (2012) detected the species in three areas, these being: in the dry sclerophyll habitat west of the proposed Stratford East Open Cut; the small remnant west of the Project area (which is Crown land – approximately 18 ha); and in a larger remnant north of the Project area (approximately 70 ha) (Figure 4b). EcoBiological (2011) detected the species in the vicinity of the proposed Avon North Open Cut in 2007 (Figure 4b). There is also a record of the species from a linear strip of vegetation along the railway line adjacent to the Voluntary Conservation Area south-west of the Project area; however, this record is of a road-killed animal and dates from 1978 (OEH, 2012b [Bionet data, accessed 18.01.2012]) and the species was not recorded within the Voluntary Conservation Area itself during surveys by AMBS (2012).

The data indicate that there are four main areas of habitat within and around the Project area where the species has been reliably detected since 2007 (Figure C-35). These habitat areas have been fragmented for many years (Figures 7a to 7e); however, some level of connectivity is likely to have been maintained through linear habitats along watercourses and potentially through other wooded areas to the east of the Project area. There may also be some dispersal between the area to the north of the Project area and the habitats within the Project area; however, it appears unlikely that individuals from this patch would regularly utilise the habitats within the Project area. Therefore, it is likely that the local population includes the individuals in three of the main areas of potential habitat discussed above (west of the Stratford East Open Cut, at the site of the Avon North Open Cut and on the Crown land to the west of the Project area [Figure 4b]).

Potential habitat is predicted to occur east of the Project area and in the south eastern section of proposed Offset areas 3 and 4 (OEH, 2012a) (Figure C-35), although the species has not been recorded in these areas despite extensive survey effort (AMBS, 2012; EcoBiological, 2011). The Squirrel Glider has also been observed in the wider Gloucester Valley (Figure C-34), although the nearest records to those discussed above are some kilometres away.

The Project will impact on two of the three habitat areas discussed above (Figure C-35). This would include the loss of approximately half of the potential habitat patch affected by the proposed Avon North Open Cut and would further isolate the remaining part of this habitat area. The Project would also result in the temporary isolation of the habitat area west of the Stratford East Open Cut. In addition, there may have indirect impacts on the population within the Crown land through the loss of potential foraging habitat west of the Roseville West Pit Extension. The overall impact would be the loss of 93 ha of potential foraging and nesting habitat. The habitat area to the north of the Project would not be directly affected by the Project.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-34

Squirrel Glider - Landscape Distribution

AMBS

GLOUCESTER BASIN

GCL-10-12 EIS App Fauna_211D

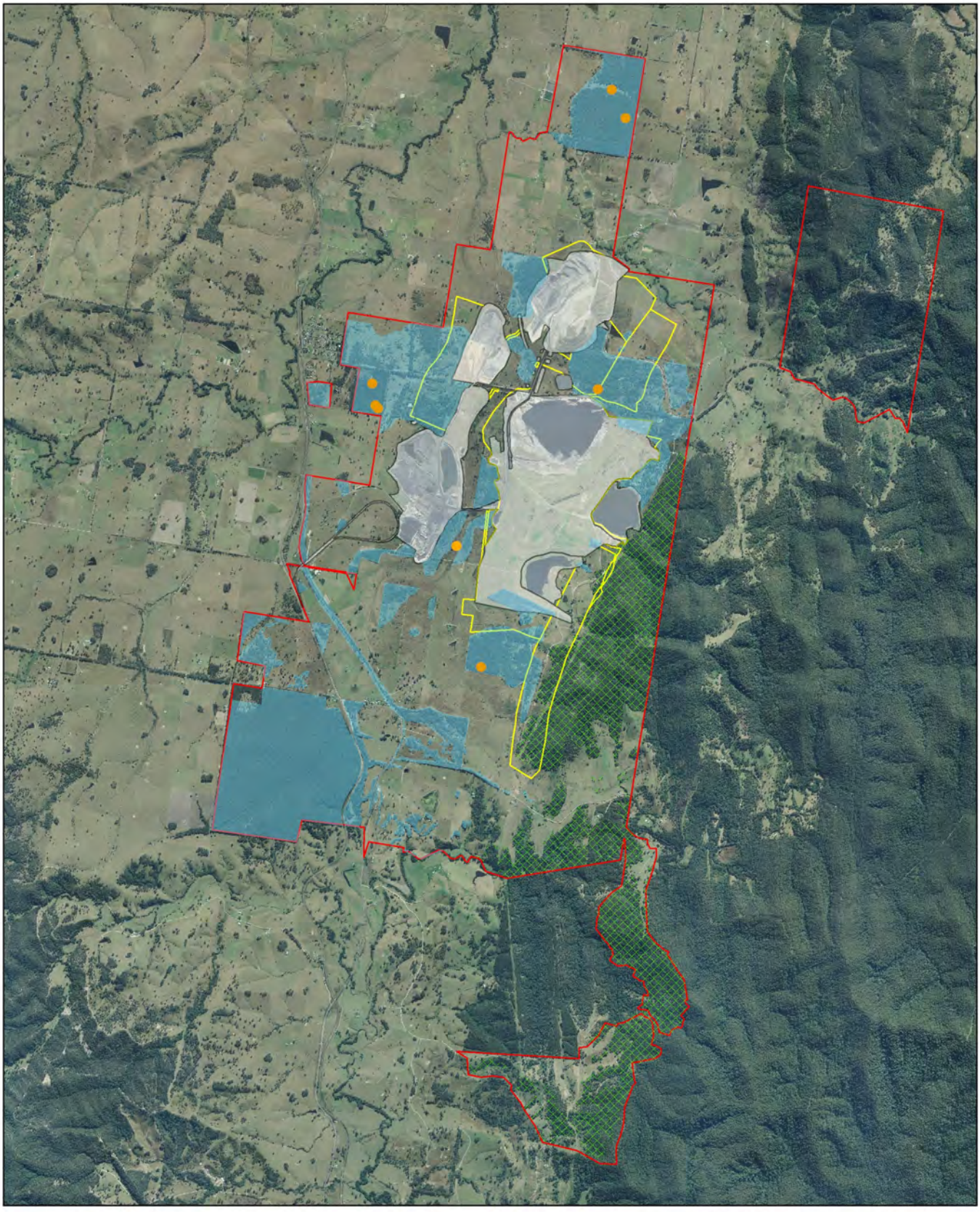


Figure C-35: Squirrel Glider - Potential Habitat

There is potential for the species to persist in the existing areas of known habitat, in particular the Crown land, although there is currently limited data available regarding the status of these populations (e.g. population viability, breeding and/or dispersal success, etc.). While there is evidence that Squirrel Gliders can persist in small habitat patches, there is no certainty that individuals or family groups would continue to persist in all of these small patches if they become further reduced and/or fragmented. However, on the basis of the evidence available it is considered reasonable to assume that Squirrel Gliders would persist in the short-term in the Crown land (and also in the area to the north, outside of the Project area).

It is therefore considered that the Project will impact on the Squirrel Glider population, but not to the extent that the complete extirpation of the population is likely. Nonetheless, if the species fails to persist in all of the known areas of habitat, the survival of the local population would become dependent on its persistence in one or two small areas and therefore at a higher risk from factors unrelated to the project (e.g. bushfire, poor flowering season). Therefore, there are a number of mitigation measures that would be adopted to lessen the impacts of the project and improve the likelihood that the population will persist in all known habitat areas in the short-term. These measures include a well-designed nest-box programme targeting the Squirrel Glider, installation of glider poles in appropriate areas, and ongoing radio-tracking of individuals to gain a greater understanding of their movements and habitat use within the area. Revegetation of parts of the area around existing habitat and the establishment of vegetated links between habitats will also be undertaken, although these improvements may take some years to be of value.

On the basis of the above it is considered that, while the Project will have direct impacts on the population in the short-term, these impacts are not likely to include the extirpation of the entire local population.

In the long-term, conservation and revegetation of areas within the proposed Offset area will provide approximately 490 ha of fauna habitat, of which approximately 144 ha currently contains potential Squirrel Glider habitat. Additional potential habitat would likely be created through the revegetation programme within the Offset areas and the Biodiversity Enhancement Area. These areas would eventually link some of the currently fragmented areas where this species is known to occur. There is therefore considerable potential to improve the security of the species in the locality in the long-term and there is also potential to provide linkages between potential habitat areas in the medium-term through planting of appropriate species and installation of glider poles.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) Approximately 93 ha of potential habitat would be removed as a result of the Project. The area of habitat available north of the Stratford Main Pit would be reduced to approximately half of its current extent as result of the Avon North Open Cut. Smaller areas of habitat may be degraded by edge effects but the impacts from this are likely to be minor in comparison to the direct habitat loss.

(ii) Habitats within and around the Project area are already highly fragmented. Two areas of known habitat are likely to become further fragmented as a result of the Project. The Avon North Open Cut would directly impact an area of known habitat and would result in approximately 25 ha of habitat becoming less connected to areas of potential habitat to the east. An area of known habitat west of the Stratford East Open Cut would become completely isolated from all vegetative connection to the east due to the Stratford East Open Cut. Future re-vegetation of Offset area 3 would, however, provide future connectivity between this habitat and other known habitat in the west.

(iii) The habitats to be removed or isolated comprise two of four areas of known habitat that occur in and around the Project area and are therefore important to a local population of the species. The long-term survival of the species in the locality is likely to be improved by the protection of habitat for the species in the Offset areas and revegetation works to reduce the current level of habitat fragmentation.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" for Squirrel Glider has been declared by the Minister for the Environment and none has been identified in the Gloucester LEP or relevant SEPP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan has been prepared for the species but OEH (2012a) recommends a number of recovery actions, including:

- retain den trees and recruitment trees (future hollow-bearing trees);
- retain food resources, particularly sap-feeding trees and understorey feed species such as Acacias and Banksias;
- replace top one or two strands of barbed wire on fences with regular wire in and adjacent to habitat;
- retain and protect areas of habitat, particularly mature or old growth forest containing hollow-bearing trees and sap-feeding trees; and
- in urban and rural areas retain and rehabilitate habitat to maintain or increase the total area of habitat available, reduce edge effects, minimise foraging distances and increase the types of resources available.

The loss of foraging and nesting habitat due to the Project is inconsistent with these recovery actions. Conversely, the proposed Offset areas would conserve and improve potential habitat for the species in perpetuity and are thus consistent with the suggested actions for the recovery of this species. While known and potential habitat occurs within the proposed Offset areas, the most extensive and well-connected habitat in which the species is known to occur within the area would be impacted by the Project through either direct removal or isolation from other habitat.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Clearing of native vegetation and loss of hollow bearing trees are both key threatening processes relevant to the Squirrel Glider. The Project constitutes both of these key threatening processes.

Conclusion

The Project would impact on the Squirrel Glider due to the removal and isolation of known areas of habitat. The Project is considered likely to have a significant impact on a local population of this species in the short-term, on the basis that:

- the local population is only known from three locations within the Project area and immediate surrounds; and
- the Project would remove areas of known and potential habitat (93 ha in native vegetation primarily composed of grassy woodland and dry sclerophyll forest), directly impacting on two of the known habitat areas and potentially indirectly impact on the third (Section 7).

These impacts, while potentially significant in the short-term, are not considered likely to result in the extirpation of the entire local population. Because the Squirrel Glider is currently persisting in a few relatively small patches, the offset strategy has the potential to improve the conservation of the local Squirrel Glider population in the medium to long-term.

Long-nosed Potoroo (Potorous tridactylus tridactylus)

The Long-nosed Potoroo is listed as vulnerable both in NSW under Schedule 2 of the TSC Act and nationally under the EPBC Act. This medium sized marsupial is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. In NSW, Long-nosed Potoroos have been seen at several locations but the only population for which there is detailed information is at Tyagarah where it was estimated that around 80 to 90 individuals exist. This population was considered to be insecure. The status and security of other NSW populations is uncertain. In NSW, this species is generally restricted to coastal heaths and forests east of the Great Dividing Range, where there is an annual rainfall exceeding 760 mm (OEH, 2012a; Department of Sustainability, Environment, Water, Population and the Arts [SEWPaC], 2012).

Long-nosed Potoroos inhabit coastal heaths and dry and wet sclerophyll forests. Their habitat may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. This species can tolerate open or patchy habitat provided there is dense vegetation available for cover nearby.

This species is mainly nocturnal, hiding by day in dense vegetation. During winter, however, these animals may forage during daylight hours. They often dig small holes in the ground in a similar way to bandicoots. The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of their diet but they also eat roots, tubers, insects and their larvae, and other soft-bodied animals in the soil.

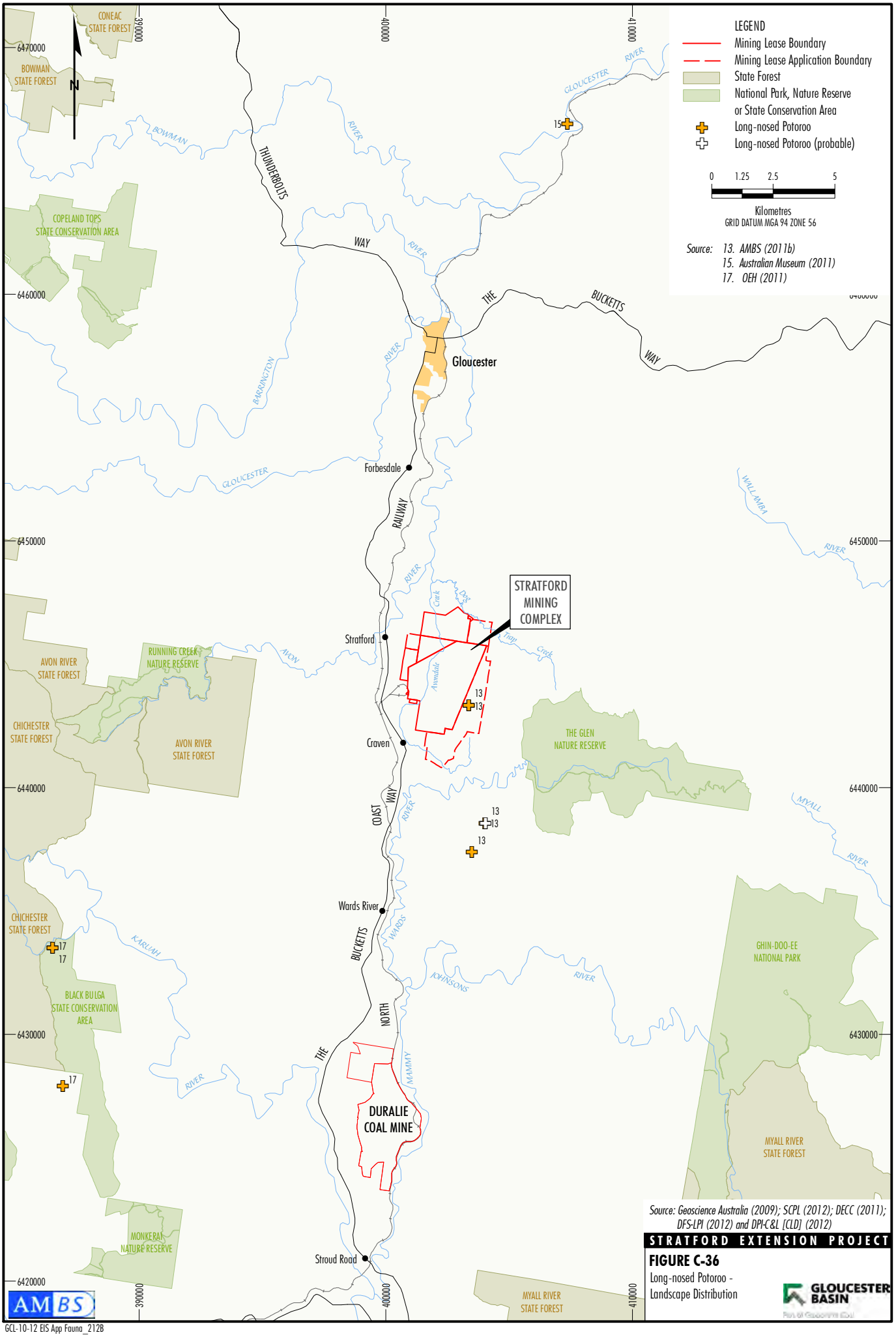
Individuals are mainly solitary, non-territorial and have home range sizes ranging between 2-5 ha.

Breeding occurs all year round both in captivity and in the wild (Bennett, 1987; Hughes, 1962) but breeding peaks typically occur in late winter to early summer. A single young is born after a gestation of 37 days, or 29 days from removal of pouch young. The young remain in the pouch for about 100–125 days. Sexual maturity is achieved at about 12 months. The Long-nosed Potoroo (SE Mainland) can live to 10 years.

The main threats to Long-nosed Potoroos are due to geographical isolation causing breeding difficulties. Such isolation comes about mainly through the loss of habitat and fragmentation. Isolation can also be caused by predation from foxes, dogs and cats, too frequent fires, and grazing by stock that reduces the density and floristic diversity of understorey vegetation. Other threats include logging regimes or other disturbances that reduce the availability and abundance of food resources, particularly hypogeous fungi, and ground cover.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Long-nosed Potoroo was recorded on three occasions during recent surveys (Figure 4b). One of these records was very close to the Project area, on the edge of the north-eastern end of the proposed Stratford East Open Cut (Figures 4b and C-36). This species was also recorded recently within the extent of the proposed Offset area 4 and just outside the extent of the proposed Offset area 4 (Figures 4b and C-36). Very close to this location, a fourth possible record based on hair analysis was recorded (Figure C-36).



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-36

Long-nosed Potoroo - Landscape Distribution

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The Project would remove approximately 37 ha of potential habitat for the Long-nosed Potoroo (i.e. mainly composed of wet sclerophyll forest and dry sclerophyll forest) (Figure C-37). From a regional perspective this is a relatively small area, and most of the habitat is within the valley which is unlikely to be preferred habitat in the study area.

The main impacts from the Project would be associated with the construction of the drainage diversion in the ranges to the east of the Stratford Waste Emplacement. This impact is likely to be only short-term and on relatively small scale, but it is possible that it could have an adverse effect on the life cycle of a small portion of the local population. However, considering more extensive areas of habitat exist in other locations, and the Offset areas would conserve and improve potential and known habitat for the species (e.g. Offset area 4), the disturbance is unlikely to place a viable local population of the species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would remove approximately 37 ha of potential Long-nosed Potoroo habitat (i.e. wet sclerophyll forest and dry sclerophyll forest). Smaller amounts of habitat may become degraded from edge effects, but the impact from this are expected to be minor in comparison to the direct habitat loss.

(ii) The construction of the drainage diversion on the eastern slope may cause a small amount of fragmentation within the habitat that exists there, but it is only likely to be temporary, as vegetation would be allowed to re-establish in and around the new construction.

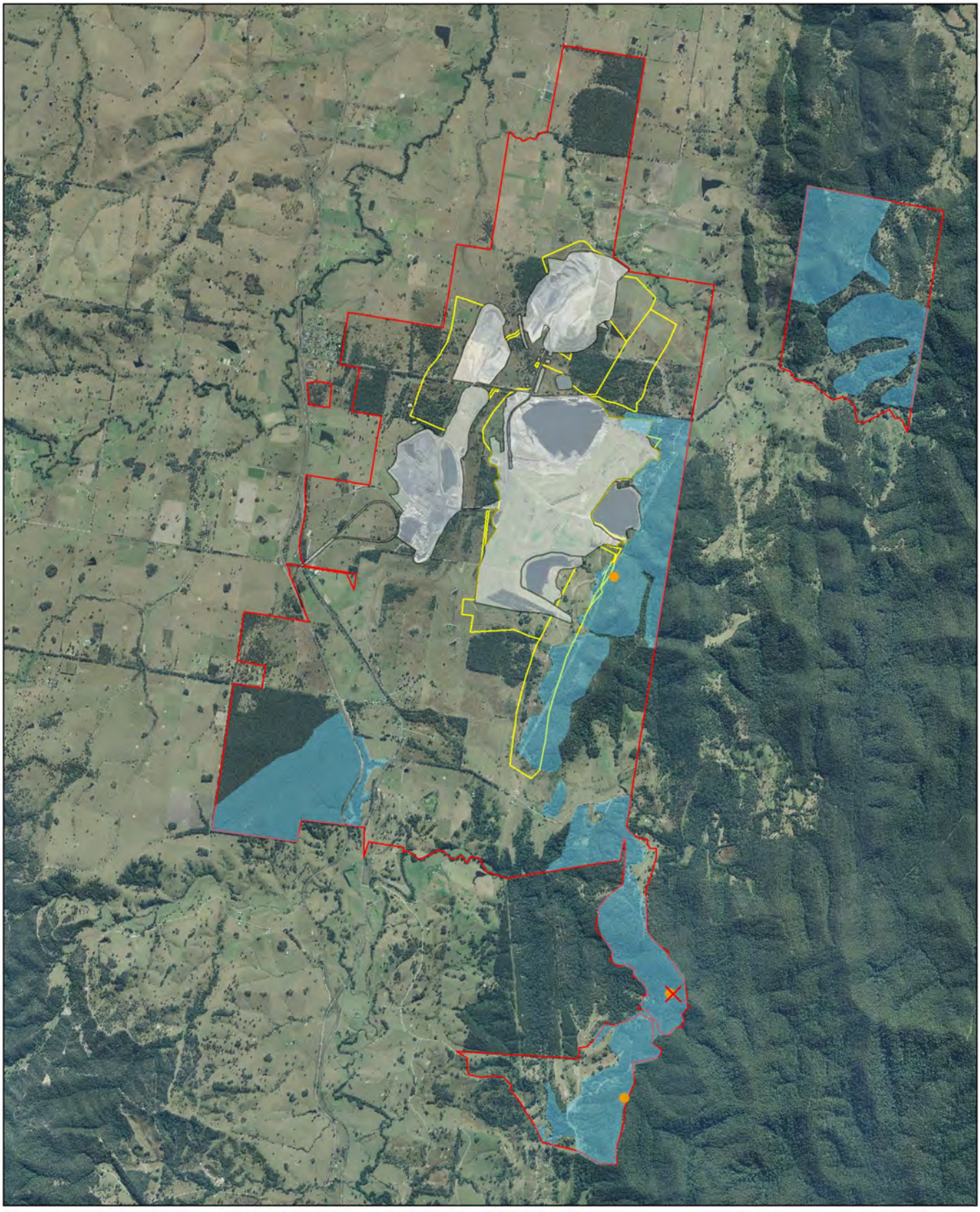


Figure C-37: Long-nosed Potoroo - Potential Habitat

(iv) The area of potential habitat that would be cleared is mostly from the edge of an area of potential habitat, while the drainage diversion would be constructed within known habitat. The loss of habitat from the edge is likely to be minor considering the area is relatively fragmented, and the drainage diversion would only be a short-term impact. Potential and known habitat for the species would be conserved and enhanced in the Offset areas (approximately 224 ha of equivalent and/or additional vegetation types, and an additional 10 ha of planted trees), including a location where the species has been recorded (Offset area 4). Therefore, the small amount of potential habitat that would be cleared as a result of the Project is unlikely to be important for the long-term survival of Long-nosed Potoroos population in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" of relevance to the Long-nosed Potoroo has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for Long-nosed Potoroos (OEH, 2012a). The OEH (2012a) suggests a number of recovery actions for this species, including undertaking fox, feral dog and cat control programmes, the application of fire regimes that maintain dense understorey vegetation cover, fencing areas of habitat to avoid grazing and trampling by domestic stock, and preventing domestic cats and dogs from roaming into areas of habitat. The Project would result in the removal of only a small area of potential habitat. Moreover, proposed Offset areas would provide habitat that would be conserved and enhanced in perpetuity. Grazing would be controlled, and feral predators would be controlled in these areas (Section 7). Overall, it is considered that the proposed action would not be inconsistent with the actions suggested for the recovery of this species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A key threatening process of relevance to the Long-nosed Potoroo includes the clearing of native vegetation and inappropriate fire regimes (OEH, 2012a). The Project would involve a short-term increase in a key threatening process through the clearing of approximately 37 ha of native vegetation. However, this is highly unlikely to constitute "a process that threatens, or may have the capability to threaten, the survival or evolutionary development" of the Long-nosed Potoroo, given the small area of potential habitat that would be disturbed, in comparison to the area that would be conserved and enhanced in the Offset areas (234 ha), including areas of known habitat. Further, revegetation programmes throughout the cleared land within the Offset areas (up to 435 ha) may provide additional potential habitat for the species in the future (Section 7). In addition, fire management suitable for the species would be undertaken as part of the Project in areas of known habitat.

Conclusion

It is anticipated that the Project would have an impact on the Long-nosed Potoroo considering that known habitat for the species would be directly impacted by the Project. In addition, the species is considered uncommon in area and occupies a small home range size (approximately 2 to 5 ha). Overall, the Project is unlikely to have a significant impact on the species such that a viable population would be placed at risk of extinction given:

- from a regional perspective, the Project would only remove a small area of approximately 37 ha of native vegetation, primarily composed of wet sclerophyll forest and dry sclerophyll forest, most of which would be removed only from the edge of an area of potential habitat (Section 7);
- direct impacts to known habitat for the species are only likely to be minimal and short-term, during construction of the drainage diversions in the eastern section of the Project area;
- areas of more suitable habitat occur in locations outside the Project area; and
- the proposed works would not isolate any significant area of known habitat from other areas of potential habitat for this species.

Further to the above, known and potential habitat for the species (224 ha of native vegetation composed of equivalent and/or additional vegetation types, and 10 ha of planted trees) would be conserved and improved in the region in the long-term due to the proposed Offset areas (Section 7). Additional potential habitat could be gained through the revegetation of cleared land in the Offset areas (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Grey-headed Flying-fox (Pteropus poliocephalus)

The Grey-headed Flying Fox is listed as vulnerable both in NSW under Schedule 2 of the TSC Act and nationally under the EPBC Act. The Grey-headed Flying-fox is Australia's only endemic flying fox. It occurs primarily along the eastern coastal plain from Bundaberg in Queensland, through NSW and south to eastern Victoria. A colony has also established in Melbourne. The species is broadly distributed, however, only a small proportion of its range is used at any one time, as the species selectively forages where food is available. As a result, patterns of occurrence and relative abundance within its distribution vary widely between seasons and between years. While this species is mainly found along the coast, they make regular movements over the Great Dividing Range to the western slopes of NSW and Queensland (OEH, 2012a; SEWPaC, 2012).

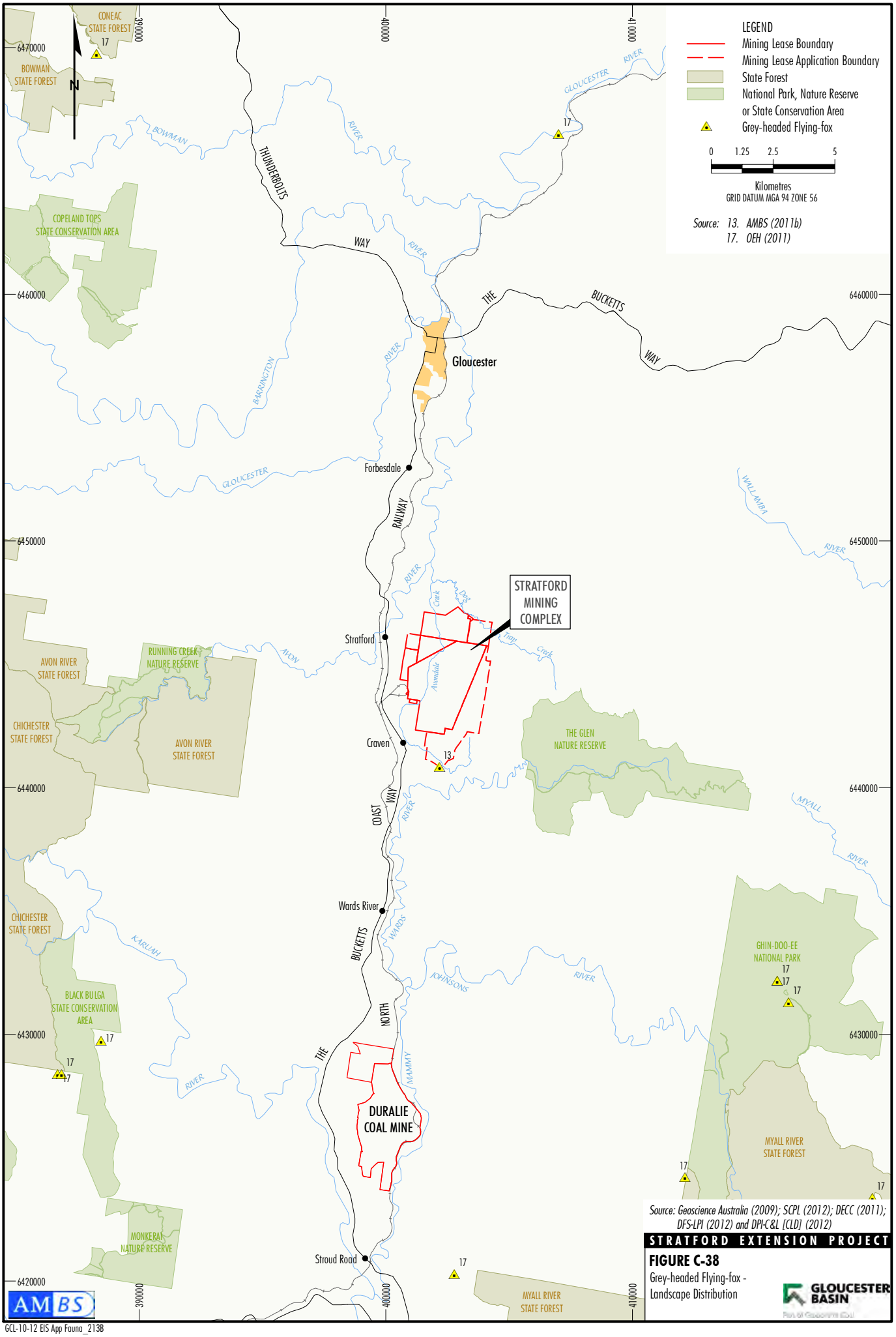
Historically, Grey-headed Flying-foxes were more widespread in Australia and numbers were estimated as being in the "many millions" (Ratcliffe, 1931). However, counts of flying foxes over the past decade suggest that the national population may have declined by up to 30% and that some local populations have declined by as much as 94%. It has also been estimated that the population will continue to decrease by at least 20% in the next three generations given the continuation of the current rate of habitat loss and culling.

This species requires foraging habitat and roosting sites. It feeds in the canopy on fruit, blossoms and nectar in rainforests, open forests, woodlands, *Melaleuca* spp. swamps and *Banksia* spp. woodlands. As such, it has an important ecosystem function by providing a means of seed dispersal and pollination for many indigenous tree species (Pallin, 2000). Grey-headed Flying-foxes also feed on introduced trees including commercial fruit crops. They congregate in large numbers at roosting sites (camps) that may be found in rainforest patches, *Melaleuca* spp. stands, mangroves, riparian woodland or modified vegetation in urban areas. Individuals generally exhibit a high fidelity to traditional camps and return annually to give birth and rear offspring. They forage opportunistically, often at distances up to 30 km from camps, and occasionally up to 60-70 km per night.

Grey-headed Flying-foxes are relatively long-lived, with the average age of reproductive animals being between six and 10 years. They have a low maximum rate of population growth for their size, conceiving only one young annually (Nelson, 1965). This slow growth rate is further affected by females' tendency to abort or abandon their young in response to environmental stress, such as food shortages or high temperatures.

The main threat to Grey-headed Flying-foxes in NSW is clearing or modification of native vegetation. This removes appropriate camp habitat and limits the availability of natural food resources, particularly winter-spring feeding habitat in north-eastern NSW. The urbanisation of the coastal plains of south-eastern Queensland and northern NSW has seen the removal of annually-reliable winter feeding sites, and this threatening process continues. In NSW less than 15% of potentially suitable forest for the Grey-headed Flying-fox occurs in conservation reserves; only 5% of roost sites are similarly reserved.

Potential foraging habitat for the Grey Headed-Flying Fox occurs throughout the study area, but the species has not be recorded in the Project area. This species was recorded south of the Project area within Offset area 3, and there are records from the wider region (Figures 4b and C-38).



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-38

Grey-headed Flying-fox - Landscape Distribution

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(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Project would remove approximately 133 ha of potential foraging habitat for the Grey-headed Flying Fox (105 ha of native vegetation [i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest]) and a further 28 ha of cleared land that could be utilised by the species (Figure C-39). It is unlikely that "a viable local population" of this species would be dependent upon this relatively small area to be removed. The Project would not remove or disturb any known campsite or colony of the Grey-headed Flying Fox and would not create a barrier to movements between campsites and foraging areas for this highly mobile and wide-ranging species. The Project is unlikely to disrupt the life cycle of the Grey-headed Flying Fox "such that a viable local population of the species is likely to be placed at risk of extinction".

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would remove approximately 133 ha of potential habitat for the Grey-headed Flying Fox (105 ha of native vegetation [i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest]) and a further 28 ha of cleared land that could be utilised by the species. Smaller amounts of habitat may become degraded due to edge effects but the impacts from this are expected to be minor in comparison to the direct habitat loss.

(ii) The Project is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Grey-headed Flying Fox given that:

- the Grey-headed Flying Fox is a highly mobile and wide-ranging species that undertakes substantial foraging movements and is capable of utilising modified landscapes; and
- the proposed vegetation clearance would not substantially isolate any area of potential foraging habitat.

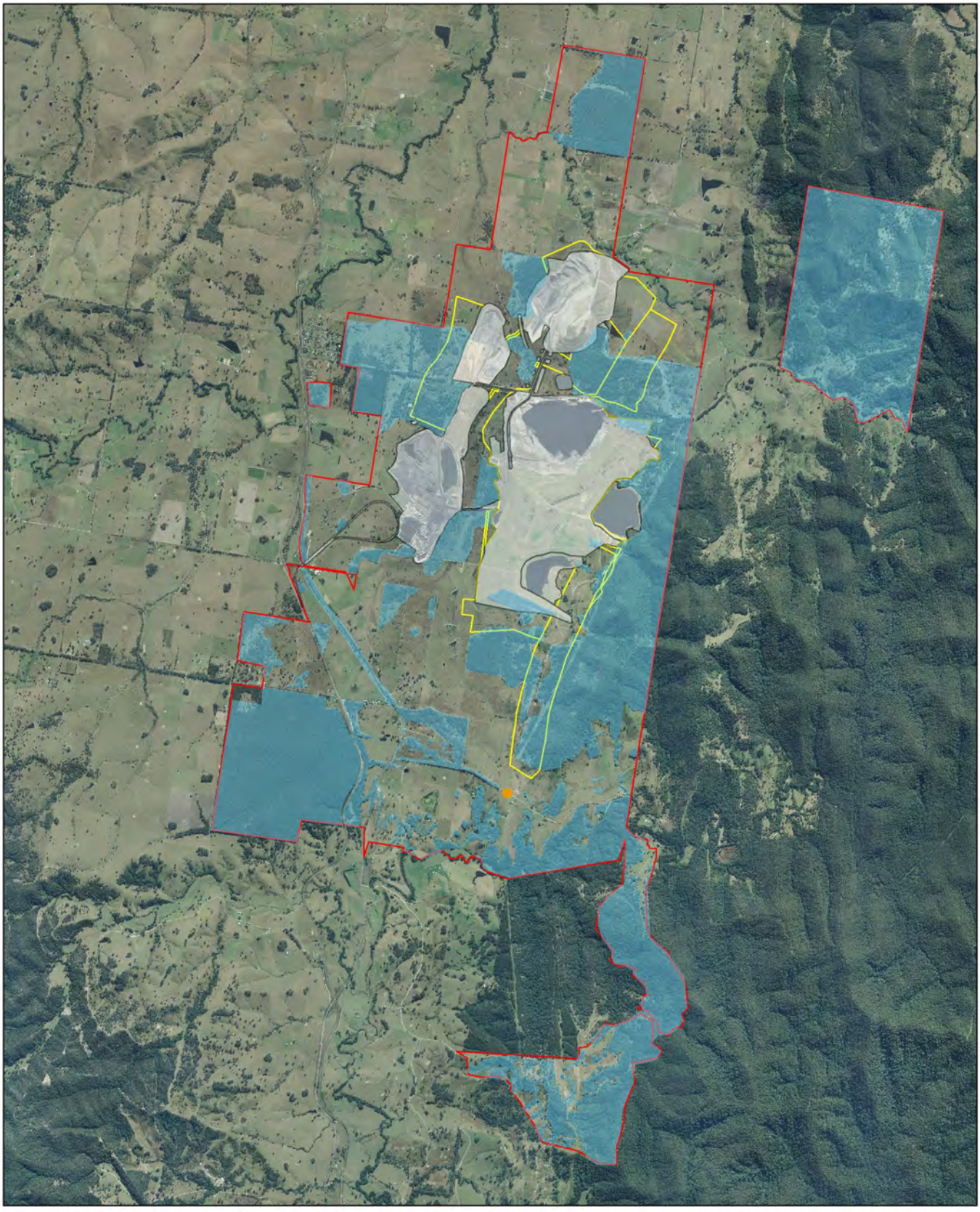


Figure C-39: Grey-headed Flying-fox - Potential Habitat

(iii) Given the high mobility of the Grey-headed Flying Fox, the wide-ranging foraging ecology of the species, and the extent of suitable habitat available for this species in the surrounding area, it is unlikely that a population of this species would be dependent upon this small area of native vegetation. Furthermore, the Project would not affect any known campsite or colony of this species and habitat would be conserved and improved in the Offset areas. Consequently, it is highly unlikely that the Project would involve the removal of vegetation critical to the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" of relevance to the Grey Headed Flying Fox has been declared by the Minister for the Environment or in any LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Grey Headed Flying Fox. The OEH (2012a) suggests a number of recovery actions, including the protection of roost sites, the avoidance of disturbance in September through November, and the identification and protection of key foraging areas. Only a relatively small amount of potential foraging habitat would be cleared as a result of the Project. No campsites would be disturbed, and thus the proposed action is not inconsistent with the suggested recovery measures for this species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Grey Headed Flying Fox include the clearing of native vegetation (OEH, 2012a), and in particular the clearing of critical winter foraging habitat.

The Project would involve the clearing of approximately 105 ha of native vegetation and remove another 28 ha of cleared land that could be utilised by the species, and thus may result in a small short-term increase in a key threatening process, however it is highly unlikely that this would have a significant adverse impact on the species considering:

- the area of potential foraging habitat for this species to be removed from the Project area is small in comparison to the large areas of potential habitat in the surrounding area;
- the proposed offset would ensure that potential habitat for the species would be conserved and improved in the region in the long-term (i.e. 490 ha of native vegetation and 40 ha of cleared land) (Section 7);
- areas of cleared land would be revegetated (up to 435 ha) potentially creating additional potential habitat for the species in the future;
- the absence of any camp site on the Stratford Mining Complex or in the locality; and
- the Project would not create a barrier to the movements between campsites and foraging areas of this highly mobile and wide-ranging species.

Conclusion

It is anticipated that the Project would potentially impact on the Grey-headed Flying-fox due to the removal of potential foraging habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the species has only rarely been recorded in the study area;
- from a regional perspective, only a relatively small area of potential habitat would cleared (105 ha of potential habitat in native vegetation [i.e. primarily composed of wet sclerophyll forest, grass woodland, and dry sclerophyll forest]) and a further 28 ha of cleared land that could be utilised by this species (Section 7);
- there is substantial potential habitat for this species in the surrounding area;
- the Project would not isolate an area of known habitat from currently interconnecting areas of potential habitat for this highly mobile and wide ranging species; and
- the Project would not impact on any known camp sites.

Further to the above, potential habitat for the species would be conserved and improved in the region in the long-term in the proposed Offset areas (490 ha of equivalent and/or additional vegetation types) and 40 ha of cleared land that the species could utilise (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land in the Offset areas (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Yellow-bellied Sheathtail-bat (Saccolaimus flaviventris)

The Yellow-bellied Sheathtail-bat is listed as a vulnerable species under Schedule 2 of the TSC Act. Endemic to Australia, it is a wide-ranging species occurring throughout tropical Australia with many records extending into south-eastern Australia (Churchill, 1998). It is a rare late summer-autumn visitor to southern Australia with most records reported between January and June (Churchill, 1998).

The Yellow-bellied Sheathtail-bat is found in a variety of habitats from wet and dry sclerophyll forests to open woodland, *Acacia* spp. scrubland, Mallee, grasslands and deserts. It roosts singly or in roosts of up to six, in tree-hollows and buildings, abandoned nests of Sugar Gliders and occasionally hanging from the outside walls of buildings in broad daylight (Churchill, 1998). In treeless areas it is known to utilise mammal burrows (OEH, 2012a). Its flight pattern is high and fast and it forages above the canopy, which is probably why this species is rarely captured in traps and nets. Foraging occurs is most habitats across its very wide range, both with and without trees (OEH, 2012a), and feeds on a variety of prey including grasshoppers, bugs, flying ants, and beetles, which comprise approximately 90% of their diet (Churchill, 1998). Breeding has been recorded from December to mid-March, when a single young is born (OEH, 2012a).

Key threatening processes relevant to the Yellow-bellied Sheathtail-bat include clearing of native vegetation and loss of hollow-bearing trees. Other threats include clearing and fragmentation of forest and woodland foraging habitat, and disturbance to roosting and summer breeding sites (OEH, 2012a). Pesticide and herbicide use may also reduce the availability of insects, and/or result in the accumulation of toxic residues in individuals' fat stores (OEH, 2012a).

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Yellow-bellied Sheathtail-bat has been recorded in the region on a single occasion (Richards, 2001), but the exact location is not known. The Project would result in the removal of approximately 133 ha of potential foraging and roosting habitat for the Yellow-bellied Sheathtail-bat (Figure C-40). This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 28 ha of cleared land that may be utilised by the species (Figure C-40). The habitat that would be removed also contains tree hollows that could be utilised by the species. The density of tree hollows within the Project area is mostly less than 10 hollows per hectare, except in two small patches where the tree hollows occur at a density of greater than 20 hollows per hectare (Figure 9). A portion of this habitat represents potential breeding, nesting, shelter and refuge habitat for this species.

It is not anticipated that the removal of this habitat would have an adverse effect on the life cycle of the species such that a viable local population would be placed at risk of extinction, given that considerable areas of more extensive habitat occurs in the surrounding area and that approximately 530 ha of potential habitat (490 of native vegetation and 40 ha of cleared land) would be conserved and enhanced in the proposed Offset areas.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

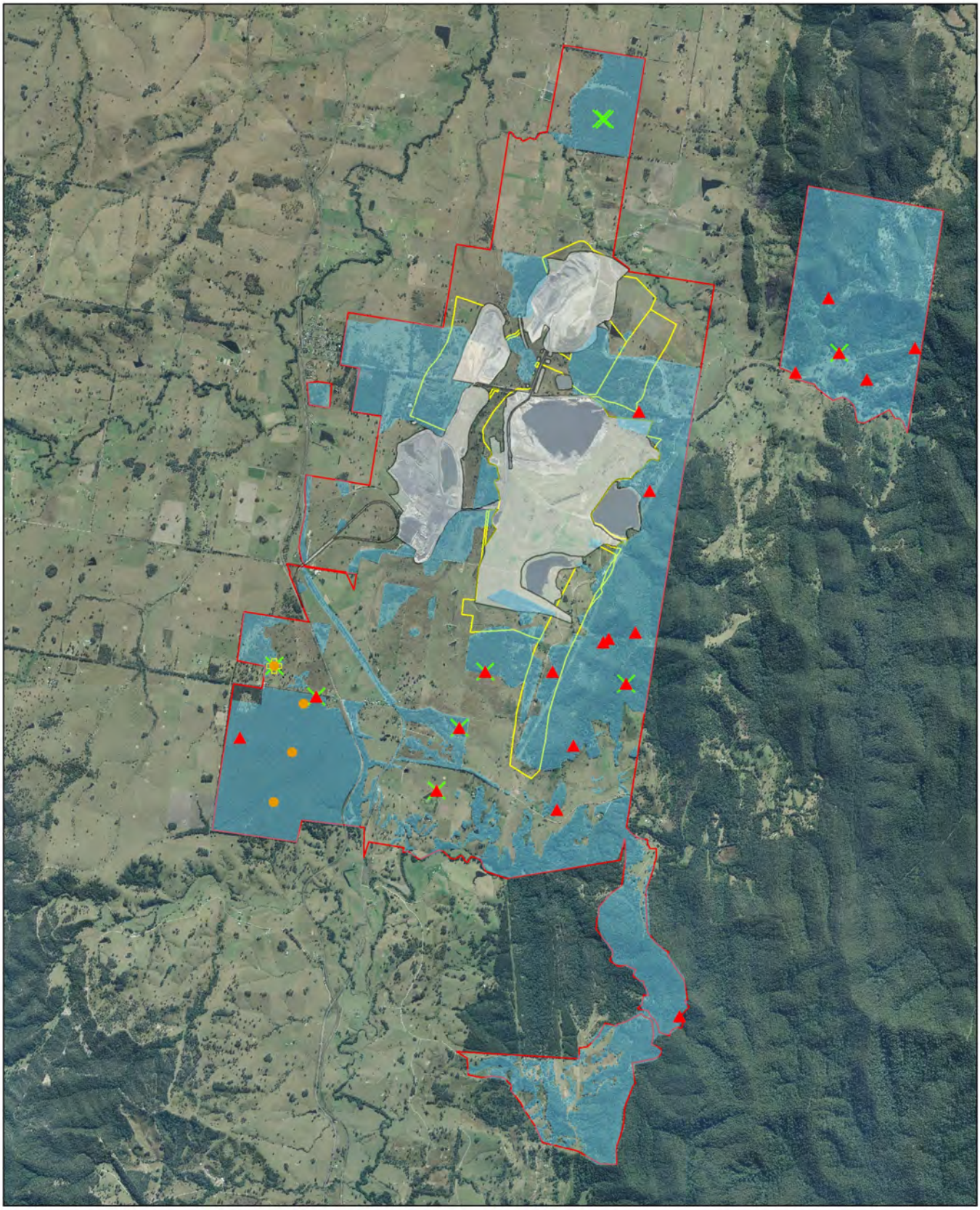


Figure C-40: Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail-bat - Potential Habitat

Notes: areas unmapped inside the study area are considered unlikely habitat where there is a low probability that the species would occur.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, a small area of approximately 133 ha of potential foraging and roosting habitat would be removed as a result of the Project. This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 28 ha of cleared land that may be utilised by the species. Smaller areas of habitat may become degraded from edge effects but these impacts are expected to be minor in comparison to the direct habitat loss.
(ii) No known area of habitat for this species would become isolated of fragmented as a result of the Project.
(iii) The amount of potential habitat that would be removed as a result of this Project is not anticipated to adversely impact on the long-term survival of this species in the locality given that more extensive and less fragmented habitat occurs in the surrounding area and that approximately 530 ha of potential habitat (490 of native vegetation and 40 ha of cleared land) would be protected and enhanced in the proposed Offset areas.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" of relevance to the Yellow-bellied Sheathtail-bat has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Yellow-bellied Sheathtail-bat. OEH (2012a) lists a number of actions to help recover this species, including attempting to ensure the largest hollow bearing trees, including dead trees and paddock trees are given highest priority for retention during land assessments. Considering the small area of potential habitat that would be removed, compared to the area of habitat that would be protected in the proposed Offset areas (530 ha), the Project is not inconsistent with these suggested actions. Further, cleared land within the Offset areas would be revegetated (up to 435 ha) potentially providing additional habitat in the future, and post-mining landforms would be rehabilitated and revegetated.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes that are relevant to this species include clearing of native vegetation and loss of hollow-bearing trees, both of which would occur as a result of the Project in the short-term. However, considering that substantial suitable habitat occurs in the surrounding area and that suitable habitat would be preserved in the Offset areas, it is not anticipated that the proposed action would have a significant adverse impact on the species. Further, areas of cleared land within the Offset areas would be revegetated, and nest boxes would be used to supplement tree hollows lost from the Project area.

Conclusion

It is anticipated that the Project would potentially impact on the Yellow-bellied Sheathtail-bat due to the removal of potential foraging and roosting habitat. However, the Project is unlikely to have a significant impact such that a local viable population would be placed at risk of extinction given:

- the species has not been recorded in the Project area during previous surveys;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and an additional 28 ha of cleared land) of potential foraging and roosting habitat (Section 7);
- potential habitat for this species is likely to occur in the surrounding area; and
- no known area of habitat would be fragmented or isolated as a result of the Project.

Further to the above, potential habitat for this species would be conserved and improved in the region in the long-term in the proposed Offset areas (490 ha of equivalent and/or additional vegetation types) and 40 ha of cleared land that the species could utilise (Section 7). Additional potential habitat would be gained through the revegetation of up to 435 ha of cleared land, some of which may provide potential habitat for the species in the future (Section 7). Post-mining landforms would also be rehabilitated and revegetated.

Eastern Freetail-bat (Mormopterus norfolkensis)

The Eastern Freetail-bat occurs from south-east Queensland to Bateman's Bay on the south coast of NSW and east of the Great Dividing Range (OEH, 2012b). It is listed as vulnerable under Schedule 2 of the TSC Act. There is a paucity of information concerning the species' general biology and ecological requirements and there has been limited research regarding the species dietary requirements and reproductive biology (Churchill, 1998; Duncan *et al*., 1999). Its preferred habitat is dry sclerophyll forest and woodlands (Alison and Hoye, 1995; NPWS, 1994) but individuals have been captured in riparian zones in rainforest and wet sclerophyll forest (Allison and Hoye, 1995).

Eastern Freetail-bats forage above the forest canopy or at forest edges (Allison, 1983). Roosting occurs mainly in tree hollows, but they will also roost under bark or in man-made structures (OEH, 2012a).

Threats to this species include the loss of hollow-bearing trees, loss of foraging habitat, and the application of pesticides in or adjacent to foraging areas (OEH, 2012a).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

This species has been recorded in several locations throughout the study area (Figures 4c and C-41). There is also a possible recent record using Anabat (Figure C-41). The Project would require the removal of approximately 133 ha of potential foraging and roosting habitat (Figure C-40). This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 28 ha of cleared land that may be utilised by the species (Figure C-40).

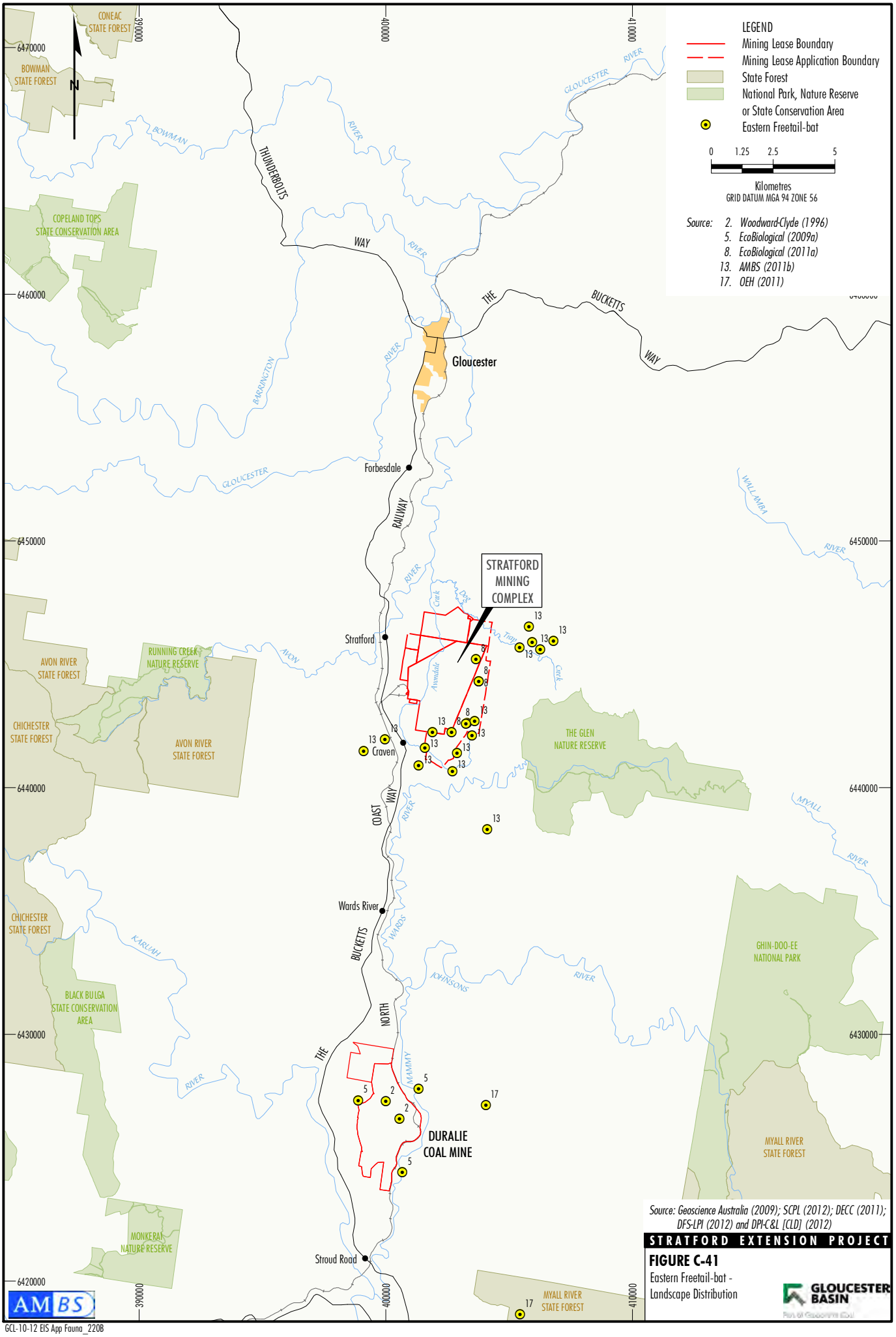
The habitat that would be removed also contains potential nesting hollows for the Eastern Freetail-bat. The density of tree hollow within the Project area is mostly less than 10 hollows per hectare, except in two small patches where the tree hollows occur at a density of greater than 20 hollows per hectare (Figure 9). A portion of this habitat represents potential nesting or refuge habitat for this species.

When considering the large areas of less fragmented potential habitat in the surrounding area, this species is unlikely to be reliant on the vegetation within the Project area that is to be removed. Therefore, the Project is unlikely to disrupt the lifecycle of the Eastern Freetail-bat "such that a viable local population of the species is likely to be placed at risk of extinction".

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-41

Eastern Freetail-bat - Landscape Distribution

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(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, the Project would require the removal of a relatively small amount (approximately 133 ha) of potential foraging habitat. This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 28 ha of cleared land that may be utilised by the species. Potential roosting hollows would also be removed. Smaller amounts of habitat could be degraded by edge effects but these impacts are likely to be minor in comparison to the direct habitat loss.

(ii) The Project may result in temporary fragmentation of potential habitat until revegetation programmes are established. However, Eastern Freetail-bats will forage several kilometres from their roost (Hoye *et al.*, 2008) so the impact from this may only be minor for this highly mobile species, and suitable habitat for the species exists in the surrounding area.

(iii) The Project would require the removal of approximately 133 ha of potential foraging habitat. This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 28 ha of cleared land that may be utilised by the species. Given the large areas of more extensive and less fragmented habitat that exist in the surrounding area and the habitat that would be conserved and improved in the proposed Offset areas (490 ha of native vegetation and 40 ha of cleared), the Project is unlikely to adversely impact the long-term survival of the species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" of relevance to the Eastern False Pipistrelle has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Eastern Freetail-bats and there have been no priority actions identified for this species (OEH, 2012a). Recovery information for this species includes the retention of foraging habitat and tree hollows and minimising the use of pesticides within or adjacent to areas where these bats occur. While, the Project would cause the loss of some native vegetation and potential roost sites, considering the large areas of more extensive and less fragmented habitat that occur nearby, and the area of known and potential habitat that would be conserved in the Offset areas (530 ha), the Project is not inconsistent with these suggested actions. Further, cleared land within the Offset areas would be revegetated (up to 435 ha) potentially providing additional habitat in the future, and post-mining landforms would be rehabilitated and revegetated.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Eastern Freetail-bat include the clearing of native vegetation and loss of hollow bearing trees (OEH, 2012a).

In the short-term, the Project would result in a small increase in these key threatening processes. However, considering that substantial suitable habitat occurs in the surrounding area and that suitable habitat would be conserved and enhanced in the Offset areas, it is not anticipated that the proposed action would have a significant adverse impact on the species. Further, areas of cleared land within the Offset areas would be revegetated, and nest boxes would be used to supplement tree hollows lost from the Project area.

Conclusion

It is anticipated that the Project would potentially impact on the Eastern Freetail-bat due to the removal of potential foraging and roosting habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- there are few records for the species from within the Project area;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and an additional 28 ha of cleared land) of potential foraging and roosting habitat (Section 7);
- there are numerous records for the species and potential habitat in locations outside the Project area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, known and potential habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Little Bentwing-bat (Miniopterus australis)

The Little Bentwing-bat is listed as vulnerable in NSW under Schedule 2 of the TSC Act. This species is found along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. The following information has been sourced from the OEH Threatened Species Profile for Little Bentwing-bats (OEH, 2012a).

Little Bentwing-bats inhabit moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. They are generally found in well-timbered areas. They roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters.

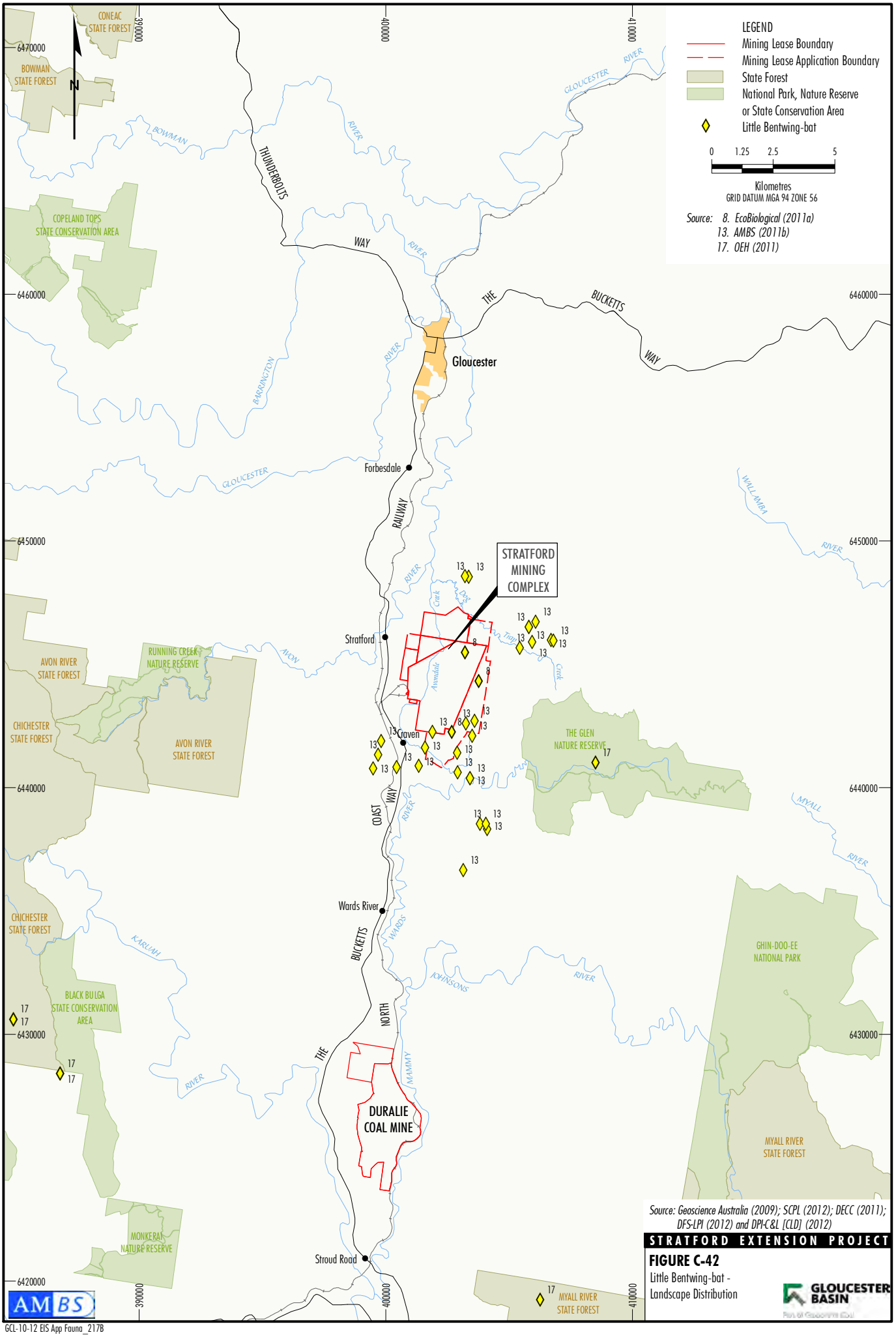
Little is known of the breeding biology of this species. Maternity colonies form in spring but only five nursery sites/maternity colonies are known in Australia. In NSW, the largest of these maternity colonies is in close association with a large maternity colony of Common Bentwing-bats (*Miniopterus schreibersii*) and it appears that the Little Bentwing-bat is dependent on the larger colony to provide the high temperatures needed to rear its young. Males and juveniles disperse in summer.

Threats to Little Bentwing-bats include predation from foxes and feral cats, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges. This species is also threatened by disturbance of colonies, especially in nursery or hibernating caves, destruction of caves that provide seasonal or potential roosting sites, changes to habitat, especially surrounding maternity/nursery caves and winter roosts and the use of pesticides.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

This species has been recorded from several locations throughout the study area (Figure 4c) and database records exist for the greater locality (Figure C-42). No maternity caves are likely to occur within the study area; only two rock crevices potentially suitable for roosting were observed within the Stratford Mining Complex, and these locations are not near the area of potential impact from the Project (Figure C-43). Suitable foraging habitat is present throughout the Project area (Figure C-43).

The Project would remove of a relatively small area of foraging habitat, approximately 133 ha (Figure C-43). This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and a further 28 ha of cleared land that may be utilised by the species (Figure C-43). The habitat that would be removed also contains tree hollows that could be used by the species. The density of tree hollow within the Project area is mostly less than 10 hollows per hectare, except in two small patches where the tree hollows occur at a density of greater than 20 hollows per hectare (Figure 9). A portion of this habitat represents potential shelter, roosting or refuge habitat for this species.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE C-42

Little Bentwing-bat - Landscape Distribution

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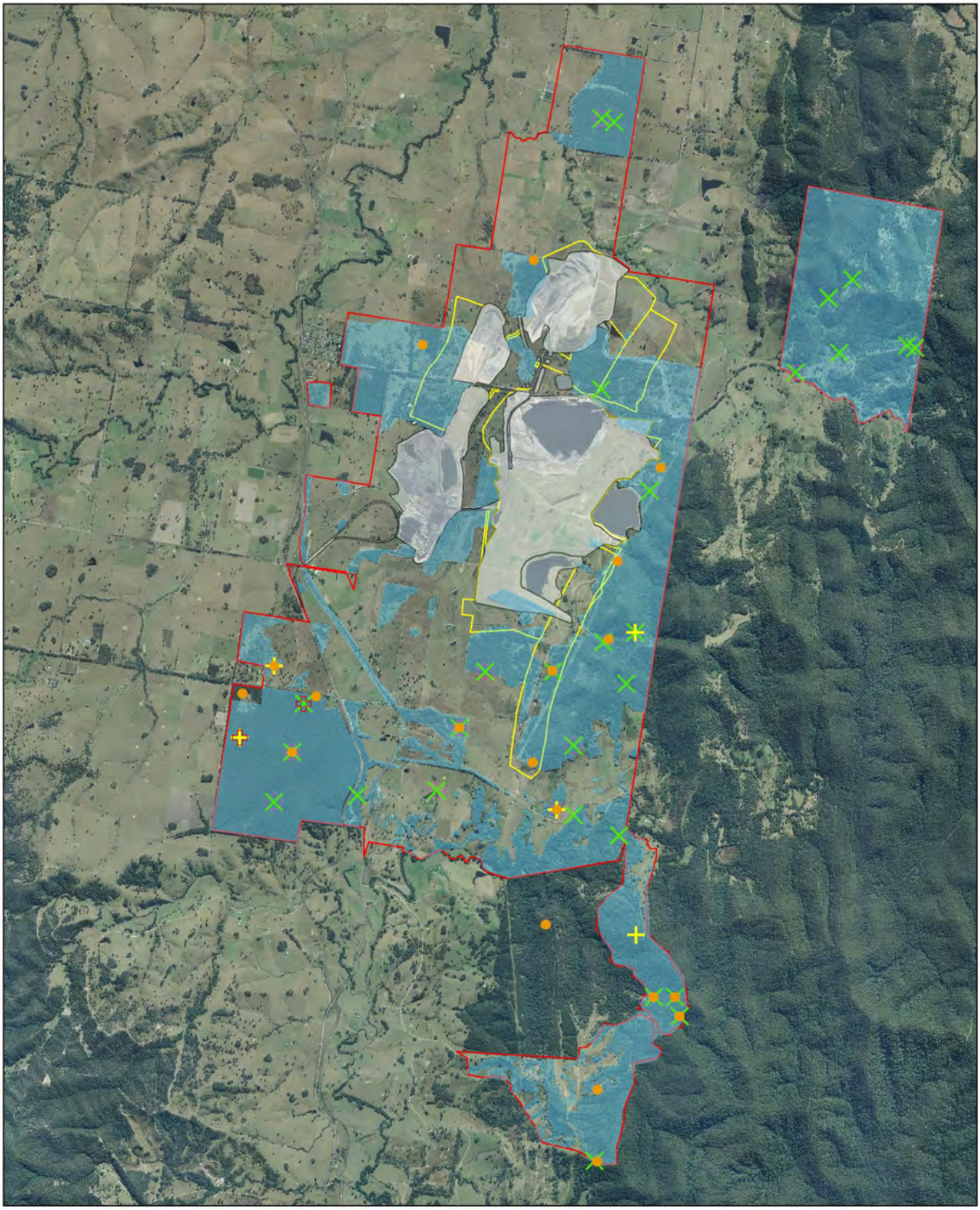


Figure C-43: Eastern Bentwing-bat, Little Bentwing-bat and Large-eared Pied Bat - Potential Habitat

Notes: areas unmapped inside the study area are considered unlikely habitat where there is a low probability that the species would occur.

It is unlikely that the Project would have a significantly adverse impact on the lifecycle of the species considering:

- it would not impact on habitat or areas close to maternity roosts;
- the Project is unlikely to impact on the accessibility of this species to any caves that may be undetected in the Stratford Mining Complex as the species is mobile;
- the Project would not result in the destruction of, or disturbance to, any primary roosting habitat; and
- the Offset areas would conserved and enhance known and potential habitat for the species in perpetuity (490 ha of native vegetation and 40 ha of cleared land).

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, the Project would remove of a relatively small area of foraging and roosting habitat, approximately 133 ha. This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and a further 28 ha of cleared land that may be utilised by the species. Smaller areas of habitat may be degraded from edge effects, but these impacts are likely to be minor in comparison to the habitat loss.

(ii) The Project would result in some fragmentation or isolation from other areas of habitat for this species. In the northern section of the mining site the patch of forest north or Stratford Main Pit would become isolated from the forested area to the east through the planned Avon North Open Cut. Similarly at the southern end of the mine the forest patch south of the Waste Emplacement Extension would get isolated from the woodland to the east through the Stratford East Open Cut.

(iii) Given the small amount of habitat that would be removed, the more extensive and less fragmented habitat that occurs in the surrounding area (including areas where the species has been recorded such as the Offset areas and Voluntary Conservation Area), and the high mobility of this species, it is highly unlikely that the habitat loss would significantly affect the species persistence in the locality Further, the Project would not impact upon accessibility to roosting caves or the suitable vegetation along the surrounding ridges.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" of relevance to the Little Bentwing-bat Bat has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Little Bentwing-bat. Steps that should be undertaken to facilitate the conservation and recovery of the species include retaining native vegetation and protect potential roost and maternity sites and immediate surrounds (OEH, 2012a). The Project does not impact on any known roost or maternity sites or the immediate vegetation around those. The Project would remove a small area (approximately 133 ha) of suitable foraging habitat of the species and contribute to habitat fragmentation. However, the proposed offset would contribute to the conservation and improvement of potential habitat for the species in the region in the long-term (Section 7).

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to this species include the clearing and fragmentation of native vegetation especially near potential roosting and maternity sites (OEH, 2012a).

The Project would result in the removal of approximately 133 ha of habitat (105 of native vegetation and 28 ha of cleared land that may be utilised by the species), which contains foraging habitat but is not near known roost or maternity sites. This species is not expected to be reliant on this vegetation, as similar habitat is abundant in the surrounding area. The species is highly mobile and is not expected to be significantly impacted by the small scale fragmentation of some suitable habitat resulting from the Project. Further, areas of potential habitat would be conserved and enhanced in the Offset areas, and cleared land would be revegetated (Section 7).

Conclusion

It is anticipated that the Project would potentially impact on the Little Bentwing-bat due to the removal of potential foraging and roosting habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the Project would not impact on any known maternity sites (e.g. caves);
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland, and dry sclerophyll forest and an additional 28 ha of clear land) of potential foraging and roosting habitat (Section 7);
- there are numerous records for the species and potential habitat in locations outside the Project area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, known and potential foraging and roosting habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Eastern Bentwing-bat (Miniopterus schreibersii oceanensis)

The Eastern Bentwing-bat is listed as vulnerable under Schedule 2 of the TSC Act. This species occupies a range of forested environments (including wet and dry sclerophyll forests), along the coastal portion of eastern Australia, and through the Northern Territory and Kimberley area (Churchill, 1998).

This species has a fast, level flight exhibiting swift shallow dives (Dwyer, 1995). It forages from just above the tree canopy, to many times the canopy height in forested areas, and will utilise open areas where it is known to forage at lower levels. Moths appear to be the main dietary component (Churchill, 1998).

This highly mobile species is capable of large regional movements in relation to seasonal differences in reproductive behaviour and winter hibernation (Gilmore and Parnaby, 1994). It is reliant on large nursery caves for the rearing of its young, which occurs between October and February (Churchill, 1998), with substantial numbers of bats (up to 150,000 individuals) occupying a common nursery cave during the breeding season. They often return to the same nursery site on an annual basis.

The Eastern Bentwing-bat primarily roosts in caves, although it has also been recorded in mines, culverts, stormwater channels and buildings (Churchill, 1998), and occasionally tree-hollows. It occupies a number of roosts within specific territorial ranges usually within 300 km of the maternity cave (Churchill, 1998), and may travel large distances between roost sites (Dwyer, 1995).

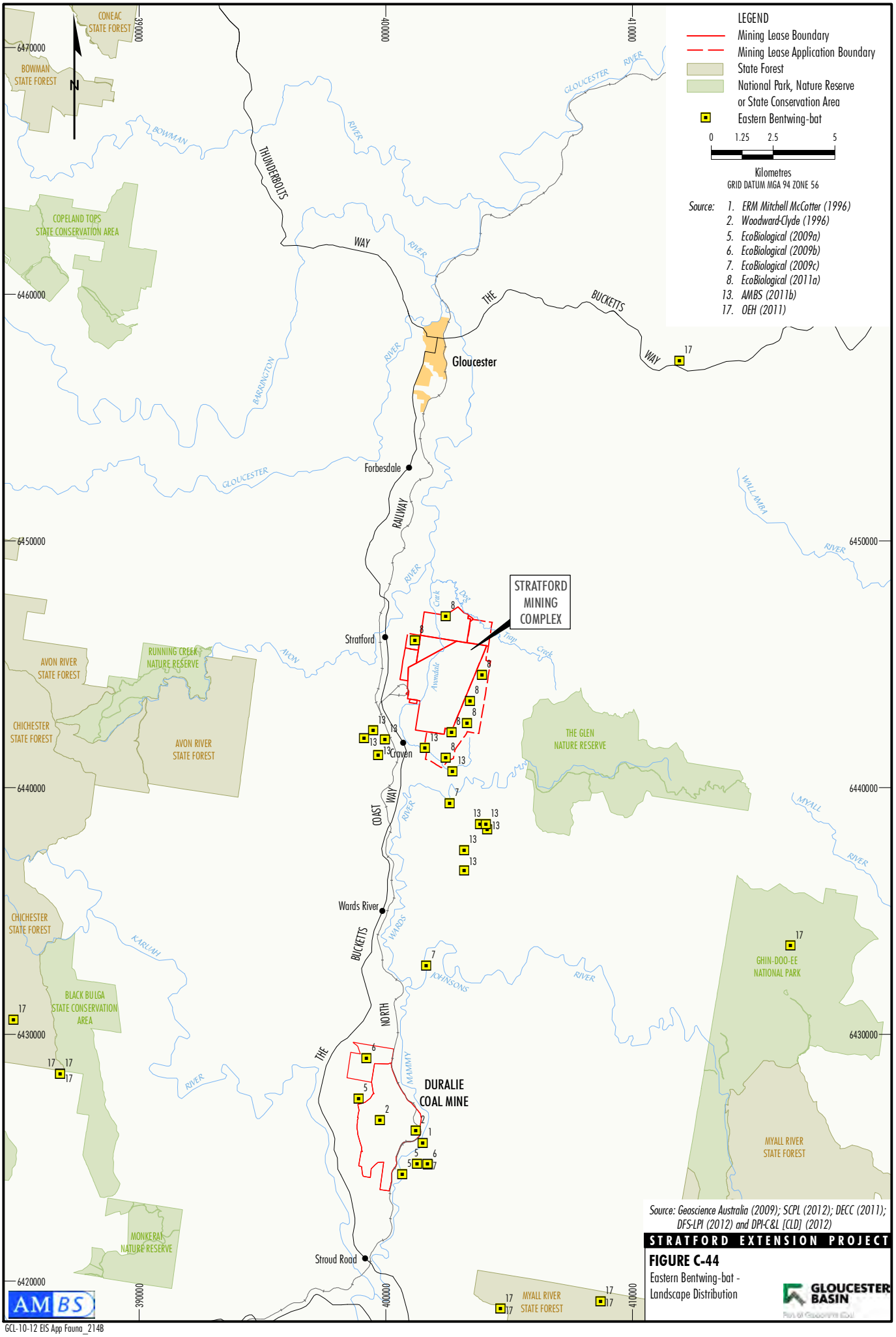
The Eastern Bentwing-bat is threatened by a number of processes including loss of foraging habitat, damage to or disturbance of roosting caves (particularly during winter or breeding), application of pesticides in or adjacent to foraging areas, and predation by feral cats and foxes (OEH, 2012a).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

This species was recorded during surveys in the study area (physical and voice identification) (Figure 4c) and in the greater locality (Figure C-44). Database records exist also for the greater locality (Figure C-44). Only two rock crevices potentially suitable for roosting were observed within the Stratford Mining Complex, and these locations are not near the area of potential impact from the Project (Figure C-44). Potential foraging habitat exists within the Project area (Figure C-43). The proposed removal of a relatively small area, approximately 133 ha, of foraging habitat (this includes 105 ha of native vegetation [i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest] and a further 28 ha of cleared land that may be used by the species) is not expected to significantly affect the lifecycle of this species, since:

- it would not impact on habitat or areas close to maternity roosts;
- the Project is unlikely to impact on the accessibility of this species to any caves that may be undetected in the Stratford Mining Complex as the species is mobile and readily flies above the tree tops; and
- the Project would not result in the destruction of, or disturbance to, any primary roosting habitat.

The Project is unlikely to disrupt the lifecycle of the Eastern Bentwing-bat “such that a viable local population of the species is likely to be placed at risk of extinction”.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

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FIGURE C-44

Eastern Bentwing-bat - Landscape Distribution

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(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, the Project would require the removal of a relatively small area of potential habitat (approximately 133 ha). Smaller areas of habitat may become degraded from edge effects but these impacts are expected to be minor in comparison to the direct habitat loss.

(ii) The Project would result in some fragmentation or isolation from other areas of habitat for this species. In the northern section of the mining site the patch of forest north or Stratford Main Pit would become isolated from the forested area to the east through the planned Avon North Open Cut. Similarly at the southern end of the mine the forest patch south of the Waste Emplacement Extension would get isolated from the woodland to the east through the Stratford East Open Cut.

(iii) Given the widespread distribution within the greater locality and high mobility of this species and its usage of forested and open areas as foraging habitat, it is highly unlikely that the relatively small areas of forest that would be removed, become fragmented or isolated would significantly affect the species, population or ecological community in the locality. Particularly when considering the large area of more extensive and less fragmented habitat that is available in the surrounding area. The Project would not impact upon accessibility to roosting caves or the suitable vegetation along the surrounding ridges. The removal of this habitat is unlikely to impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No “critical habitat” of relevance to the Eastern Bentwing-bat has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Eastern Bentwing-bat. Steps that should be undertaken to facilitate the conservation and recovery of the species include retaining native vegetation and protect potential roost and maternity sites and immediate surrounds. The Project does not impact on any known roost or maternity sites or the immediate vegetation around those (OEH, 2012a). The Project would remove a small area (approximately 133 ha) of suitable foraging and roosting habitat. This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and a further 28 ha of cleared land that may be utilised by the species. This process would contribute to the fragmentation of some of the remaining habitat. However, the proposed offset would contribute to the conservation and improvement of potential habitat for the species in the region in the long-term, as well as revegetation of cleared land and post-mining landforms (Section 7).

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to this species include the clearing and fragmentation of native vegetation (OEH, 2012a).

The Project would result in a short-term increase in a key threatening process. However, this species is not expected to be reliant on the small area of habitat, as it is non-specific in its foraging habitat requirements and utilises open and forested areas. Due to its broad foraging habitat requirements its high mobility and its readiness to cross open areas the species is not expected to be significantly impacted by the small scale fragmentation of some suitable habitat resulting from the Project. Further, the proposed offset would contribute to the conservation and improvement of potential habitat for the species in the region in the long-term, as well as revegetation of cleared land and post-mining landforms (Section 7).

Conclusion

It is anticipated that the Project would potentially impact on the Eastern Bentwing-bat due to the removal of potential foraging habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- there are few records for the species from within the Project area;
- the Project would not impact on any known maternity sites (e.g. caves), with impacts likely to be limited to loss of potential foraging habitat;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland, and dry sclerophyll forest and an additional 28 ha of clear land) of potential foraging habitat (Section 7);
- there are numerous records for the species and potential habitat in locations outside the Project area, including the Offset areas and Voluntary Conservation Area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, potential foraging habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7).

Large-eared Pied Bat (Chalinolobus dwyeri)

The Large-eared Pied Bat is listed as vulnerable both in NSW under Schedule 2 of the TSC Act and nationally under the EPBC Act. This small to medium sized bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands and to Ulladulla along the coast. In NSW, it is generally rare with a very patchy distribution. There are scattered records from the New England Tablelands and North West Slopes (OEH, 2012a; SEWPaC, 2012).

The Large-eared Pied Bat roosts in the entrances of caves, in crevices in cliffs, in old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*). This species is typically found in dry open forest and woodland close to roosting sites at low to mid-elevation. These bats have relatively short broad wings, indicating manoeuvrable flight, and they probably forage for small, flying insects below the forest canopy.

Both males and females are sexually mature at one year of age and females have relatively low fecundity, producing just one or two young per year. It is uncertain whether mating occurs early in winter or in spring. Females have been recorded raising young in maternity roosts of 20 to 40 individuals from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years and are likely to hibernate through the coolest months (OEH, 2012a). This species has also been recorded in well-timbered areas containing gullies.

The most important threat to the Large-eared Pied Bat is disturbance and damage to primary nursery sites by animals, particularly Goats (*Capra hircus*) and humans. Many suitable roost caves in the Pilliga have been used by Goats and/or other animals and these are not used by the bats.

Land clearing or timber harvesting in or around roosts has the potential to affect foraging resources and fragment surrounding vegetation. This is likely to be particularly detrimental in the vicinity of maternity roosts where pregnant and lactating females need sufficient food resources to raise young.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

This species was possibly recorded during surveys at the Stratford Mining Complex (voice identification) (Figure 4d) and database records exist for the greater locality.

Only two rock crevices potentially suitable for roosting were observed within the Stratford Mining Complex, and these locations are not near the area of potential impact from the Project (Figure C-43). Potential foraging habitat is present throughout the Project area. The Project would remove of a relatively small area of approximately 133 ha of foraging habitat (Figure C-43), including 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 28 ha of cleared land that may be utilised by the species (Figure C-43). The removal of this habitat is not expected to significantly affect the lifecycle of this species, since:

- it would not impact on habitat or areas close to maternity roosts;
- the Project is unlikely to impact on the accessibility of this species to any caves that may be undetected in the Stratford Mining Complex as the species is mobile; and
- the Project would not result in the destruction of, or disturbance to, any primary roosting habitat.

The Project is unlikely to disrupt the lifecycle of the Large-eared Pied Bat “such that a viable local population of the species is likely to be placed at risk of extinction”.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, the Project would require the removal of a relatively small area, approximately 133 ha of foraging habitat. This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 28 ha of cleared land that may be utilised by the species. Smaller areas of habitat may become degraded due to edge effects, but this impact is only likely to be minor in comparison to the direct habitat loss.

(ii) The Project would result in some fragmentation or isolation from other areas of habitat for this species. In the northern section of the mining site the patch of forest north or Stratford Main Pit would become isolated from the forested area to the east through the planned Avon North Open Cut. Similarly at the southern end of the mine the forest patch south of the Waste Emplacement Extension would get isolated from the woodland to the east through the Stratford East Open Cut.

(iii) Given the widespread distribution of possible records (call identification) within the high mobility of this species, it is highly unlikely that the relatively small areas of forest that would be removed, become fragmented or isolated would significantly affect the species, population or ecological community in the locality. Particularly when considering the large area of more extensive and less fragmented habitat that is available in the surrounding area. The Project would not impact upon accessibility to roosting caves or the suitable vegetation along the surrounding ridges. The removal of this habitat is unlikely to impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No “critical habitat” of relevance to the Large-eared Pied Bat has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Large-eared Pied Bat. Steps that should be undertaken to facilitate the conservation and recovery of the species include retaining native vegetation and protect potential roost and maternity sites and immediate surrounds (OEH, 2012a). The Project does not impact on any known roost or maternity sites or the immediate vegetation around those. The Project would remove a small area (approximately 133 ha) of suitable foraging habitat of the species and contribute to habitat fragmentation. However, the proposed offset would contribute to the conservation and improvement of potential habitat for the species (approximately 530 ha of native vegetation and cleared land) in the region in the long-term, and existing areas of cleared land would be revegetated (up to 435 ha) (Section 7).

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to this species include the clearing and fragmentation of native vegetation especially near potential roosting and maternity sites (OEH, 2012a).

The Project increase a key threatening process in the short-term, through the clearing of approximately 105 ha of native vegetation and 28 ha of cleared land that may be utilised by the species. These areas contains foraging habitat but are not near known roost or maternity sites. A local population (were one to exist) is not likely to be reliant on this habitat, as more extensive and less fragmented habitat is abundant in the surrounding area. The species is highly mobile is not expected to be significantly impacted by the small scale fragmentation of some suitable habitat resulting from the Project. Further, habitat would be conserved and enhanced in the Offset areas, and cleared land would be revegetated (Section 7).

Conclusion

It is anticipated that the Project would potentially impact on the Large-eared Pied Bat due to the removal of potential foraging habitat. However, the Project is unlikely to have a significant impact on the species such that a local viable population would be placed at risk of extinction given:

- the species has not been recorded from within the Project area, and only possibly recorded from the study area;
- the Project would not impact on any known roosting habitat (e.g. caves), with impacts likely to be limited to loss of potential foraging habitat;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of dry sclerophyll forest, wet sclerophyll forest and grassy woodland, and an additional 28 ha of clear land) of potential foraging habitat (Section 7);
- potential habitat for this species is likely to occur in the surrounding area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, potential foraging habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated

Southern Myotis (Myotis macropus)

The Southern Myotis is listed as vulnerable on Schedule 2 of the TSC Act. Following a recent taxonomic revision, the Large Footed Myotis is now more often referred to as the Southern Myotis (*Myotis macropus*) when it occurs in NSW. This species is considered to be widespread throughout the coastal regions of eastern and northern Australia, ranging from the Kimberley in Western Australia to Victoria and South Australia (Churchill, 1998). It is relatively common in tropical areas but uncommon further south (NPWS, 1994), and rare in Victoria (Menkhorst and Lumsden, 1995). Whilst regarded as having a primarily coastal distribution (rarely found more than 100 km inland), it does occur further inland along major rivers (Churchill, 1998). It is listed as vulnerable under Schedule 2 of the TSC Act.

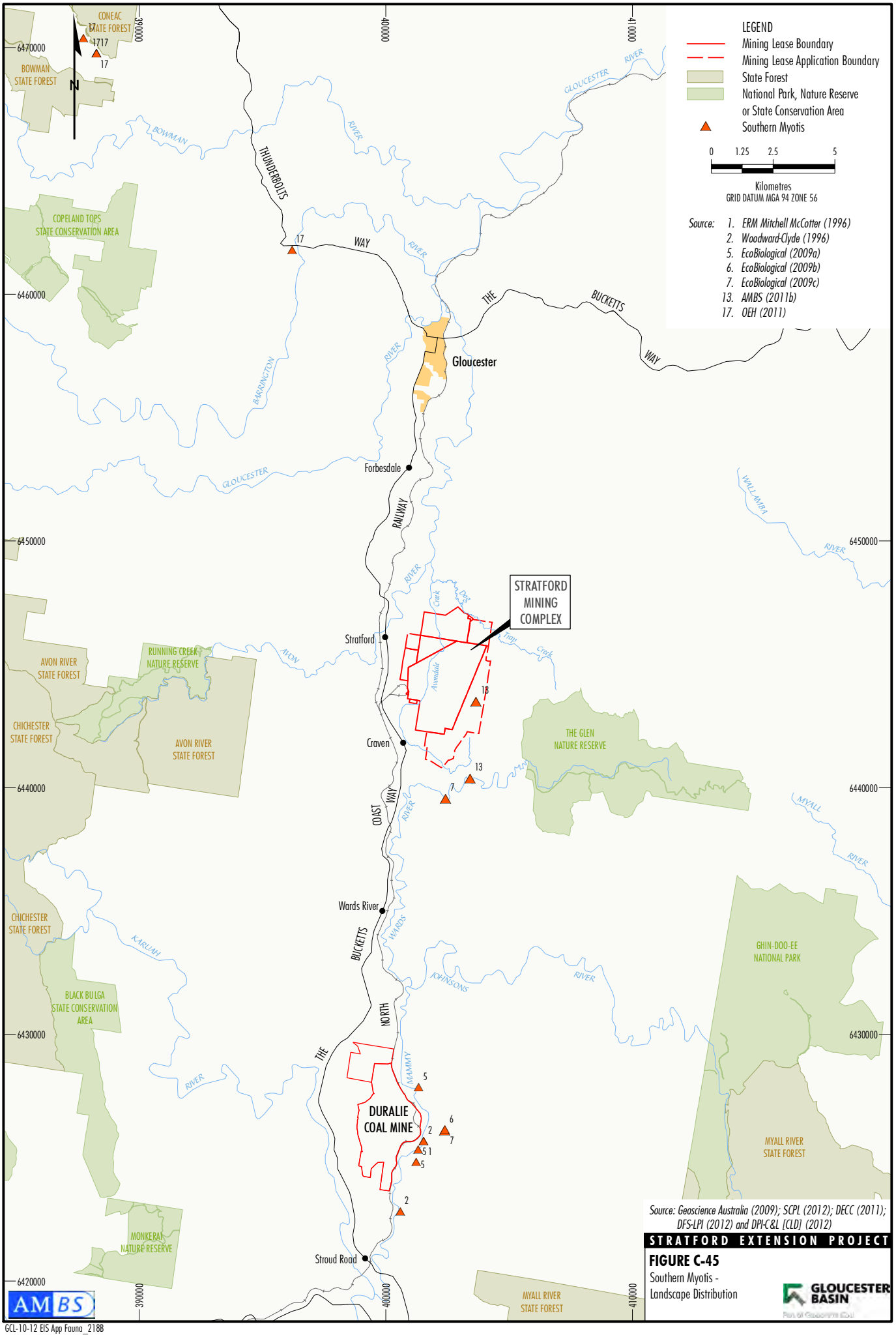
This species has been recorded in mangroves, paperbark swamps and in a range of forest and woodland habitats (Churchill, 1998). Large-footed Myotis are cave dwellers but are also known to roost in tree hollows, under bridges, in clumps of vegetation, buildings, mine tunnels and stormwater drains (Menkhorst and Knight, 2001; Churchill, 1998). Roosts are usually in groups of 10-15, in close proximity to water over which the bats forage (Campbell, 2009). The large feet and hind claws are used to rake the water surface for insects and small fish (Law and Urquhart, 2000), and Large-footed Myotis are known to forage in small groups of three or four (Churchill, 1998). This species is also capable of foraging aerially (Menkhorst and Knight, 2001). In NSW females have one young each year usually in November or December (OEH, 2012a).

This species is threatened by a number of processes including the loss or disturbance of roosting sites, clearing adjacent to foraging areas, application of pesticides in or adjacent to foraging areas, and reduction in stream water quality affecting food resources (OEH, 2012a).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The species has not been recorded within the Project area, but there are records in or near Offset area 3 (Figure 4c and C-45). Possible records from Anabat surveys also exist in the study area (Figures 4d and C-45). There would be no loss of foraging habitat for the Southern Myotis due to the Project but potential roosting sites may be lost (Figure C-46). The Project would remove only a relatively small area, approximately 133 ha, of potential habitat for roost sites for Southern Myotis (Figure C-46). This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and a further 28 ha of cleared land that may be utilised by the species (Figure C-46). The density of tree hollows within the Project areais mostly less than 10 hollows per hectare, except in two small patches where the tree hollows occur at a density of greater than 20 hollows per hectare (Figure 9). A portion of this habitat represents potential refuge habitat for this species. However, the Southern Myotis is not expected to be reliant on these for survival, given that considerable areas of more extensive and less fragmented habitat occurs in the surrounding areas, and that approximately 489 ha of potential habitat would be conserved and enhanced in the proposed Offset areas. These areas are likely to contain a higher density of hollow bearing trees.

Consequently, the Project is unlikely to disrupt the lifecycle of the Southern Myotis “such that a viable local population of the species is likely to be placed at risk of extinction”.



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

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FIGURE C-45

Southern Myotis - Landscape Distribution

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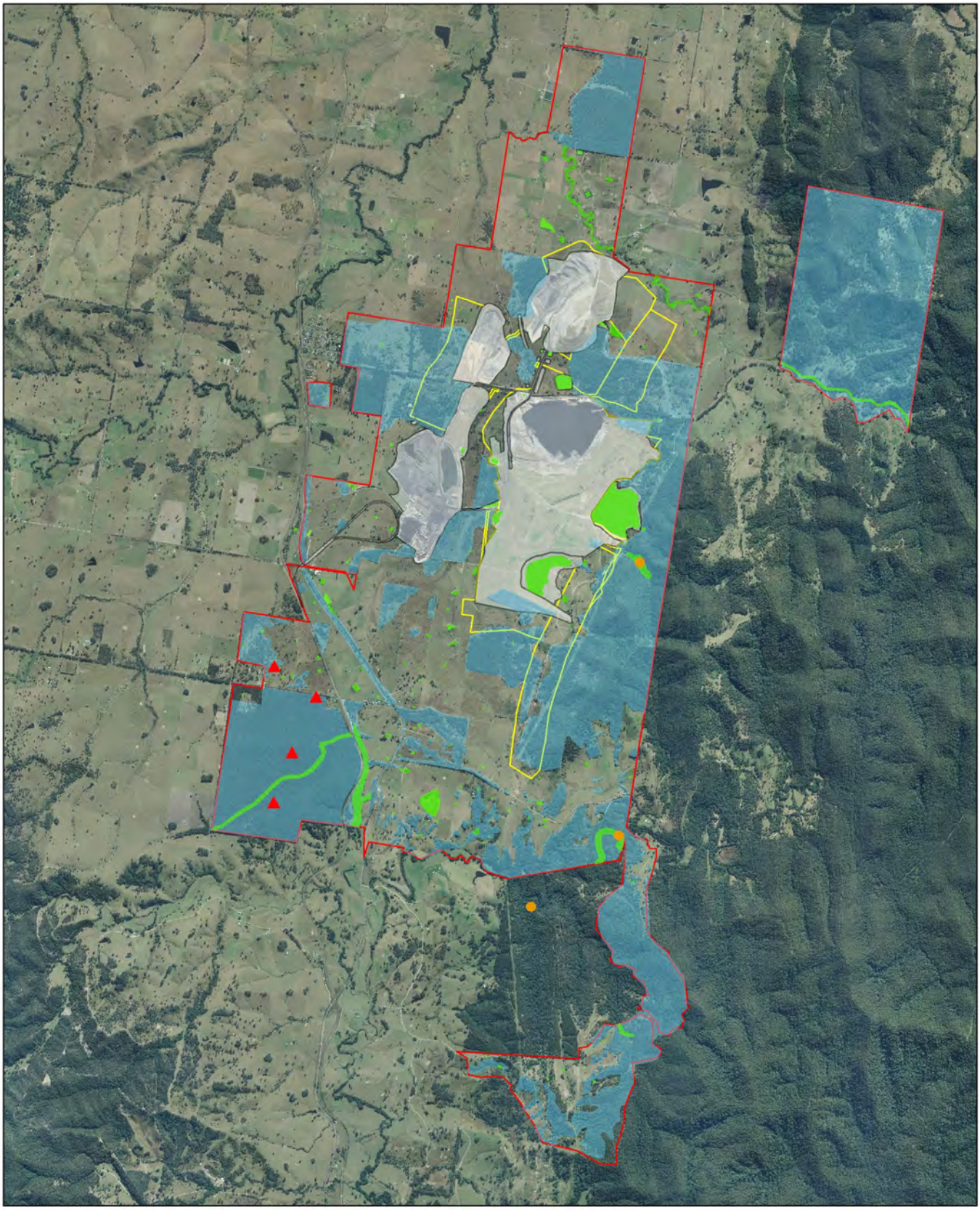


Figure C-46: Southern Myotis - Potential Habitat

Notes: areas unmapped inside the study area are considered unlikely habitat where there is a low probability that the species would occur.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, the Project would require the removal of a relatively small (approximately 133 ha) area of potential habitat, which may contain roost sites for Southern Myotis. This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and a further 28 ha of cleared land that may be utilised by the species. No foraging habitat would be removed as a result of the Project. Smaller areas of habitat may become degraded from edge effects but these impacts are expected to be minor in comparison to the direct habitat loss.

(ii) The Project is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Southern Myotis.

(iii) The Project would require the removal of approximately 133 ha of potential habitat for the species which may contain roost sites for the Southern Myotis. This area is unlikely to be important habitat for the Southern Myotis on a local or regional basis, given the large areas of more extensive and less fragmented habitat that exist in the surrounding area. Furthermore, roost sites for the Southern Myotis generally occur close to large waterbodies in which they forage, such as major rivers and swamps. The Offset areas would conserve and improve areas of known habitat for the species (approximately 489 ha) in perpetuity. Therefore, the loss of habitat is unlikely to have a significant impact on the long-term survival of the species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No “critical habitat” of relevance to the Southern Myotis has been declared by the Minister for the Environment or in any LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Southern Myotis. Suggested recovery measures for this species includes the retention of vegetation along streams, rivers and other waterbodies, and the protection of roosting sites (OEH, 2012a). The vegetation around known areas of foraging habitat would not be impacted by the Project.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Southern Myotis include the clearing of native vegetation, loss of hollow bearing trees, and the alteration to natural flow regimes (OEH, 2012a).

The Project would result in the removal of 133 ha (of habitat 105 ha of native vegetation and 28 ha of cleared land) for the species and the loss of a small number of hollow-bearing trees. However, considering that the Offset areas would conserve and enhance known and potential habitat for the species (489 ha), and additional areas would be revegetated (up to 435 ha), the impact of these key threatening processes is only likely to be minor and short-term. Further, the Project is unlikely to significantly alter the flow regimes of potential or known foraging habitat in the study area.

Conclusion

It is anticipated that the Project would potentially impact on the Southern Myotis due to the removal of potential roosting habitat. However, the Project is unlikely to have a significant impact such that a local viable population would be placed at risk of extinction given that:

- the species has not been recorded from within the Project area;
- the Project is unlikely to impact any areas of potential foraging habitat (i.e. waterbodies);
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and an additional 28 ha of clear land) of potential roosting habitat (Section 7);
- there are records for the species outside the Project area, and potential habitat for this species is likely to occur in the surrounding area; and
- the Project is unlikely to fragment areas of known habitat for this highly mobile and wide ranging species.

Further to the above, potential roosting habitat (489 ha equivalent and/or additional vegetation types) and known foraging habitat for this species would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha) of cleared land would be revegetated throughout the Offset areas, some of which may provide potential roosting habitat for the species in the future (Section 7). Post-mining landforms would also be rehabilitated and revegetated.

Greater Broad-nosed Bat (Scoteanax rueppellii)

The Greater Broad-nosed Bat is listed as vulnerable under Schedule 2 of the TSC Act. It occurs along the east-coast of Australia inhabiting moist gullies and river systems from the Atherton Tableland in Queensland to southern NSW. The distributional stronghold of the Greater Broad-nosed Bat is regarded as the north-east of NSW (NPWS, 1994) particularly in the gullies and river systems draining the Great Dividing Range (Hoye and Richards, 1995).

The Greater Broad-nosed Bat is found in a variety of habitats from dry woodland to tall, wet forests and does not occur at altitudes above 500 m (Hoye and Richards, 1995), except in the very north of its range where it has been recorded at 780 m (Churchill, 1998). Because it has limited manoeuvrability and is a noticeably slow flier, it is suited to open eucalypt woodlands and forests. This species roosts in tree-hollows, tree branches and in the roofs of old buildings. It feeds on slow flying prey (such as large moths) but will also feed on ground beetles that are 'hawked' within 20 m of the ground along rows of trees which line creeks and small rivers and the edges of patches of woodland in otherwise cleared paddocks (Churchill, 1998). The Greater Broad-nosed Bat is also known to eat other small bats, including the threatened Little Bentwing-bat (*Miniopterus australis*), especially when captured together in harp traps or mist nets.

This species is threatened by a number of processes including land clearing (resulting in the loss of foraging habitat and hollow-bearing trees), disturbance to roosting and summer breeding sites, pesticide and herbicide use (reducing the availability of insects and/or resulting in the accumulation of toxic residues in individuals' fat stores), and changes to water regimes impacting on food resources (OEH, 2012a).

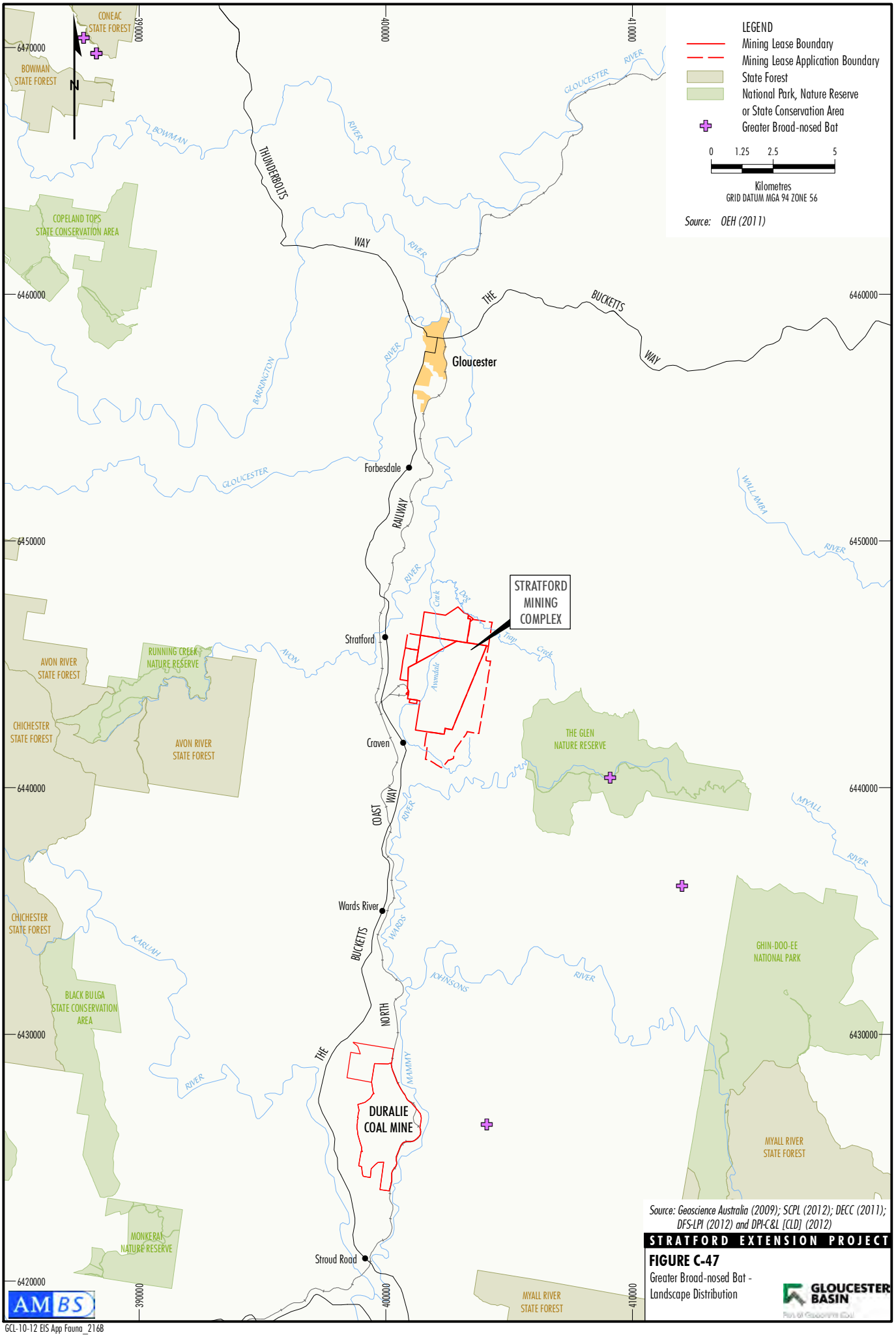
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

There are possible records for the species in the study area and few records from the wider locality (Figure C-47). Potential roosting and foraging habitat for the Greater Broad-nosed Bat occurs within the Project area and surrounds (Figure C-40).

Approximately 133 ha of potential foraging and roosting habitat would be removed as part of the Project (Figure C-40). This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and 28 ha of cleared land that may be utilised by the species (Figure C-40). The habitat that would be removed also contains potential nesting hollows for the Greater Broad-nosed Bat. The density of tree hollows within the Project area is mostly less than 10 hollows per hectare, except in two small patches where the tree hollows occur at a density of greater than 20 hollows per hectare (Figure 9). A portion of this habitat represents potential refuge habitat for this species.

Consequently, the Project has the potential to adversely impact this species through loss of foraging habitat and the loss of potential roosting hollows.

There are large areas of more extensive and less fragmented habitat in the surrounding area, and potential habitat would be conserved and enhanced in the Offset areas (approximately 490 ha of native vegetation and 40 ha of cleared land), so this species is unlikely to be reliant on the vegetation that is to be removed. Therefore, the life cycle of the Greater Board-nosed Bat is unlikely to disrupted by the Project "such that a viable local population of the species is likely to be placed at risk of extinction".



Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

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FIGURE C-47

Greater Broad-nosed Bat - Landscape Distribution

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b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, the Project would remove only a small amount of habitat, including removal of some potential roosting hollows and approximately 105 ha of potential foraging habitat. Smaller areas of habitat may become degraded from edge effects but these impacts are expected to be minor in comparison to the direct habitat loss.
(ii) No known area of habitat for this species would become isolated of fragmented. The project may temporarily fragment potential habitat until revegetation programmes are established.
(iii) The amount of potential habitat that would be removed as a result of this Project is not anticipated to adversely impact on the long-term survival of this species in the locality given that more extensive and less fragmented habitat occurs in the surrounding area and that approximately 530 ha of potential habitat (490 of native vegetation and 40 ha of cleared land) would be protected and enhanced in the proposed Offset areas.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No “critical habitat” of relevance to the Greater Broad-nosed Bat has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Greater Broad-nosed Bat and, at this stage, no priority actions have been identified for this species. Recovery information for this species includes the retention of hole-bearing native vegetation, maintaining vegetation around roost sites, retaining young trees for future roost sites and assessing sites for connectivity across the broader landscape (OEH, 2012a). While, the Project would cause the loss of some native vegetation and potential roost sites, and some fragmentation, but considering the large areas of less fragmented habitat that occur nearby, the potential habitat that would be conserved and enhanced in the Offset areas, and the areas of cleared land that would be revegetated in the Offset areas (up to 435 ha) (Section 7), the action is not considered to be inconsistent with the objectives outlined above.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Greater Broad-nosed Bat include the clearing of native vegetation and loss of hollow bearing trees (OEH, 2012a).

The Project would result in the removal of approximately 133 ha of habitat (105 ha of native vegetation and 28 ha of cleared land) and the loss of some hollow-bearing trees. While this would result in a small reduction in the available foraging and roosting resources for the Greater Broad-nosed Bat in the region, this species is unlikely to be reliant on the potentially affected resources considering the large areas of available habitat in the surrounding area.

Conclusion

It is anticipated that the Project would potentially impact on the Greater Broad-nosed Bat due to the removal of potential foraging and roosting habitat. However, the Project is unlikely to have a significant impact such that a local viable population would be placed at risk of extinction given:

- the species has not been recorded from within the Project area;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and an additional 28 ha of cleared land) of potential foraging and roosting habitat (Section 7);
- less fragmented and more extensive habitat for this species is likely to occur in the surrounding area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, potential habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Eastern False Pipistrelle (Falsistrellus tasmaniensis)

The Eastern False Pipistrelle is listed as vulnerable under Schedule 2 of the TSC Act. This wide-ranging species is endemic to Australia, occurring along the south-east coast with records from South-eastern Queensland, NSW, Victoria and Tasmania.

Preferred habitat is usually sclerophyll forests from the Great Dividing Range to the coast, while in Tasmania they are found in wet sclerophyll and coastal Mallee (Churchill, 1998). They generally prefer wet habitats where trees are more than 20 m high. Roosting occurs in hollow trunks of eucalypt trees, usually in single sex colonies, but they have been recorded roosting in caves under loose bark and occasionally in old wooden buildings (Churchill, 1998). Their flight pattern is high and fast, often with sudden darting changes in direction and they forage above or just within the tree canopy. On the mainland they feed on a variety of prey including moths, rove beetles, weevils, plant bugs, flies and ants. Whereas in Tasmania they predominantly eat beetles, moths and bugs (Churchill, 1998). Females are pregnant in late spring to early summer, with single young being born in December (Churchill, 1998). Lactation continues through January and February (Churchill, 1998).

This species is threatened by a number of processes including loss of trees for foraging and hollow-bearing trees for roosting, disturbance to winter roosting and breeding sites, and application of pesticides in or adjacent to foraging areas (OEH, 2012a).

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

This species has possibly been detected near the Stratford Mining Complex in a previous survey using Anabat (Figure 4d). There are potential roost sites and foraging habitat within the Project area (Figure C-40).

The Project would result in the removal of approximately 133 ha habitat (Figure C-40). This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and a further 28 ha of cleared land that could be utilised by the species (Figure C-40). The habitat that would be removed also contains potential nesting hollows for the Eastern False Pipistrelle. The density of tree hollows in the Project area is mostly less than 10 hollows per hectare, except in two small patches where the tree hollows occur at a density of greater than 20 hollows per hectare (Figure 9). A portion of this habitat represents potential refuge habitat for this species.

Consequently, the Project has the potential to adversely impact this species through loss of foraging habitat and the loss of potential roosting hollows. However, the preferred habitat of the Eastern False Pipistrelle is wet high-altitude forests (Law *et al.*, 2008) and as such much of the habitat that would be removed as part of the Project is considered marginal for this species. Also, large areas of suitable habitat are present in the surrounding area. As such this species is unlikely to be reliant on the vegetation that is to be removed. Consequently, the Project is unlikely to disrupt the lifecycle of the Eastern False Pipistrelle "such that a viable local population of the species is likely to be placed at risk of extinction".

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not Applicable

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not Applicable

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) The Project would result in the removal of approximately 133 ha habitat. This includes 105 ha of native vegetation (i.e. wet sclerophyll forest, grassy woodland and dry sclerophyll forest) and a further 28 ha of cleared land that could be utilised by the species. The habitat that would be removed also contains potential tree hollows for the Eastern False Pipistrelle. Smaller amounts of habitat may be degraded due to edge effects, but this impact is expected to be minor compared to the habitat loss.

(ii) The Project is unlikely to result in an area of known habitat becoming isolated from other habitat for the Eastern False Pipistrelle. Given that the Eastern False Pipistrelle is a strong-flying bat which feeds predominantly above the canopy or in large openings (Phillips, 1995), the Project is unlikely to further isolate any area of foraging habitat for this wide-ranging and mobile species.

(iii) The Project would require the removal of approximately 133 ha of mostly marginal habitat. This area could not be regarded as important habitat for the Eastern False Pipistrelle on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding area and the habitat that would be conserved and improved in the proposed offsets (490 ha of native vegetation and 40 ha of cleared land). The preferred habitat of the Eastern False Pipistrelle is wet high-altitude forests (Law *et al.*, 2008) and as such much of the habitat that would be removed as part of the Project is considered marginal for this species, and unlikely to be important for the long-term survival of a population in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No “critical habitat” of relevance to the Eastern False Pipistrelle has been declared by the Minister for the Environment or in the Gloucester LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Eastern False Pipistrelle and, at this stage, no priority actions have been identified for this species. Recovery information for this species includes the retention of native vegetation that is floristically and structurally diverse, the minimisation of the use of pesticides within or adjacent to areas where these bats occur and the protection of roost sites from disturbance. The Project would cause the loss of some native vegetation and potential roost sites. However, the Offset areas would conserved and enhance approximately 530 ha of potential habitat for the species, and cleared land would be revegetated (up to 435 ha), some of which may also provide habitat in the future (Section 7). The Project is not considered to be inconsistent with the objectives outlined above.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Eastern False Pipistrelle include the clearing of native vegetation and loss of hollow bearing trees (OEH, 2012a).

In the short-term, the Project would result in the removal of approximately 133 ha habitat and the loss of some hollow bearing trees. However, considering that more extensive and less fragmented habitat occurs in the surrounding area and that suitable habitat would be preserved in the Offset areas, it is not anticipated that the proposed action would have a significant adverse impact on the species. Further, areas of cleared land within the Offset areas would be revegetated, and nest boxes would be used to supplement tree hollows lost from the Project area.

Conclusion

It is anticipated that the Project would potentially impact on the Eastern False Pipistrelle due to the removal of potential foraging and roosting habitat. However, the Project is unlikely to have a significant impact such that a local viable population would be placed at risk of extinction given:

- the species has not been recorded from within the Project area;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of wet sclerophyll forest, grassy woodland and dry sclerophyll forest, and an additional 28 ha of cleared land) of potential foraging and roosting habitat (Section 7);
- the habitat that would be removed is unlikely to constitute preferred habitat, and potential habitat for this species is likely to occur in the surrounding area; and
- the Project is unlikely to fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, potential habitat for this species (490 ha of equivalent and/or additional vegetation types and 40 ha of cleared land) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

Eastern Cave Bat (Vespadelus troughtoni)

The Eastern Cave Bat is listed as vulnerable under Schedule 2 of the TSC Act. The species is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, NSW. There are records from the New England Tablelands and the upper north coast of NSW. The western limit of their distribution appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the Australian Capital Territory.

While very little information is available on the biology of this uncommon species, they are known to roost in caves and they are usually found in dry open forest and woodland with a close proximity to cliffs or rocky overhangs. They have also been occasionally found along cliff-lines in wet eucalypt forest and rainforest. Eastern Cave Bats have also been recorded roosting in disused mine workings and in farm sheds (Law and Chidel, 2007). This species has been found in colonies of up to 500 individuals but can occur in much smaller colonies of 6 to 60 (Australian Museum, 2011).

The reproductive biology, feeding ecology and behaviour are poorly understood in this species. However, in rural landscapes, Eastern Cave Bats appear to require the presence of native vegetation in close proximity to roosts to provide foraging habitat (Law *et al*., 2005).

Threats to the Eastern Cave Bat includes clearing and fragmentation of dry eucalypt forest and woodland, particularly those in close proximity to cliffs and other areas containing suitable roosting and maternity sites. The loss of suitable feeding habitat near roosting and maternity sites as a result of timber harvesting and inappropriate fire regimes also pose a threat. Pesticides and herbicides may also reduce the availability of invertebrates, or result in the accumulation of toxic residues in individuals' fat stores. Other potential threats include damage to roosting and maternity sites from mining operations, and recreational activities such as caving. There is also a strong likelihood that unrecorded populations could be unintentionally affected by land management actions. Eastern Cave Bats are also likely to be preyed upon by cats and foxes.

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

This species was possibly recorded during surveys near the Stratford Mining Complex (voice identification) (Figure 4d) and database records exist for the greater locality.

Only two rock crevices potentially suitable for roosting were observed within the Stratford Mining Complex, and these locations are not near the area of potential impact from the Project (Figure C-48). Suitable foraging habitat is present throughout the Stratford Mining Complex (Figure C-48). The vegetation present in the proposed impact area however is unlikely to represent primary foraging habitat the type of which would be close to roosting and maternity caves. The proposed removal of a relatively small area, approximately 131 ha of habitat (105 ha of native vegetation, i.e. grassy woodland and dry sclerophyll forest and a further 26 ha of cleared land) (Figure C-48) is not expected to significantly affect the lifecycle of this species, since:

- it would not impact on any prime foraging habitat or areas close to maternity roosts;
- the Project is unlikely to impact on the accessibility of this species to any caves that may be undetected in the Stratford Mining Complex as the species is mobile and readily flies above the tree tops; and
- the Project would not result in the destruction of, or disturbance to, any primary roosting habitat.

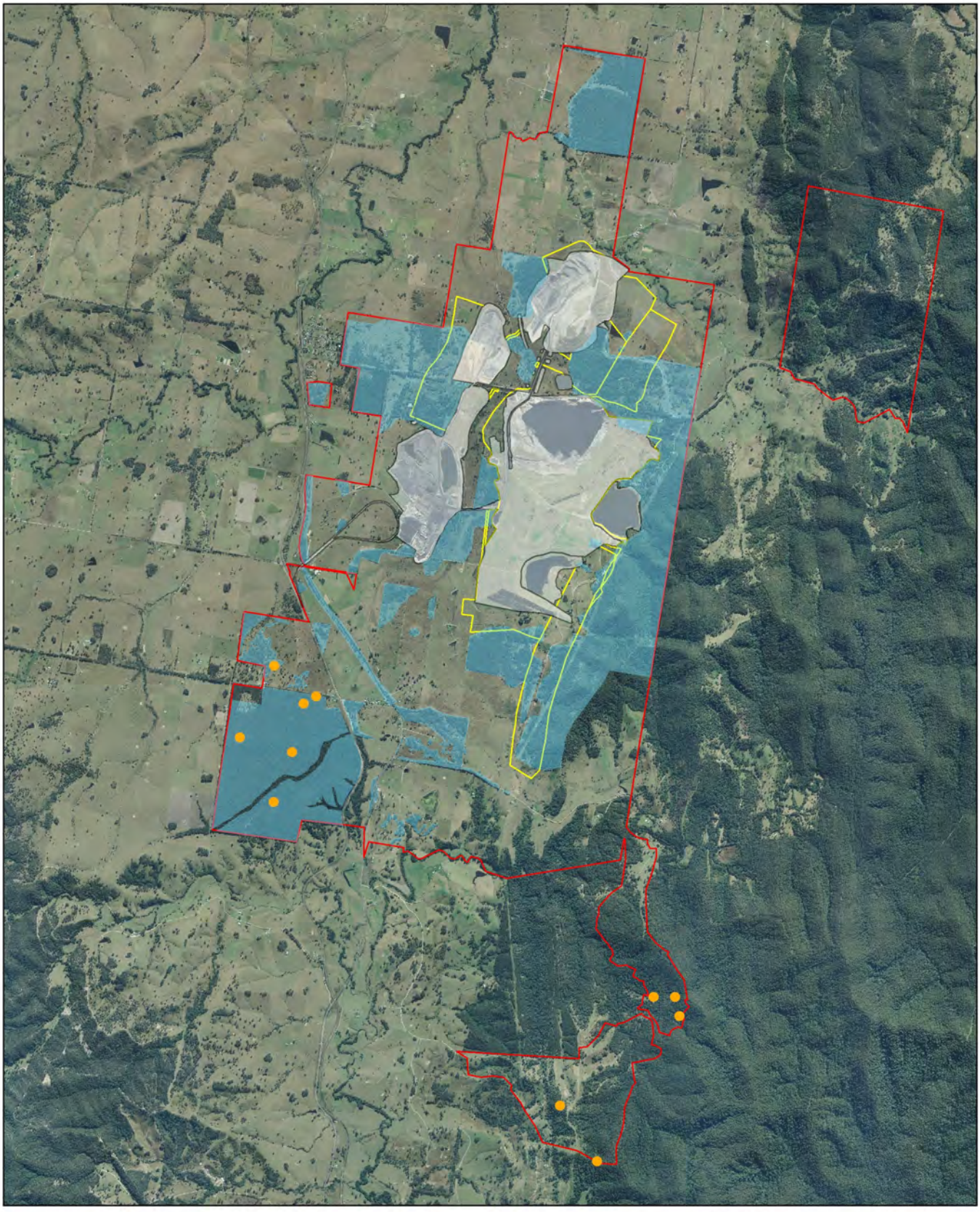

Figure C-48: Eastern Cave Bat - Potential Habitat

The Project is unlikely to disrupt the lifecycle of the Eastern Cave Bat "such that a viable local population of the species is likely to be placed at risk of extinction".

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

(d) in relation to the habitat of a threatened species, population or ecological community:
(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

(i) From a regional perspective, the Project would require the removal of a relatively small area, approximately 131 ha of potential habitat. This includes 105 ha of native vegetation (i.e. grassy woodland and dry sclerophyll forest) and a further 26 ha of cleared land that may be utilised by the species. Smaller areas of habitat may be degraded due to edge effects, but these impacts are considered minor compared to the direct habitat loss.

(ii) The Project would result in the temporary fragmentation or isolation from other areas of habitat for this species, until revegetation programmes are established. In the northern section of the mining site the patch of forest north or Stratford Main Pit would become isolated from the forested area to the east through the planned Avon North Open Cut. Similarly at the southern end of the mine the forest patch south of the Waste Emplacement Extension would get isolated from the woodland to the east through the Stratford East Open Cut.

(iii) Given the widespread distribution within the greater locality and high mobility of this species, it is highly unlikely that the relatively small areas of forest that would be removed, become fragmented or isolated would significantly affect the species, population or ecological community in the locality. Particularly when considering the large area of more extensive and less fragmented habitat available in the surrounding area. The Project would not impact upon accessibility to roosting caves or the suitable vegetation along the surrounding ridges. The removal of this habitat is unlikely to impact on the long-term survival of this species in the locality.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No "critical habitat" of relevance to the Eastern Cave Bat has been declared by the Minister for the Environment or in any LEP.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Eastern Cave Bat. Steps that should be undertaken to facilitate the conservation and recovery of the species include avoiding damage or disturbance to known roosting and maternity sites and protect known and potential habitat from clearing and isolation, particularly dry open forest and woodland around cliffs, rock overhangs (OEH, 2012a).

No habitat near maternity caves or cliffs would be disturbed. The proposed offset would contribute to the conservation and improvement of potential habitat for the species in the region in the long-term (243 ha of native vegetation), and cleared land would be revegetated, some of which may provide additional habitat in the future (Section 7).

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to this species include the clearing and fragmentation of native vegetation (OEH, 2012a).

The Project would result in the clearing of approximately 131 ha of potential foraging habitat (105 ha of native vegetation and 26 ha of cleared land that may be utilised by the species). A local population (were one to exist) is not likely to be reliant on this vegetation, as its preferred foraging habitat is located in the vicinity of roost and maternity caves and apart from two rock crevices which are unlikely to provide adequate depth, suitable caves were not found in the Stratford Mining Complex.

Conclusion

It is anticipated that the Project would potentially impact on the Eastern Cave Bat due to the removal of potential foraging habitat. However, the Project is unlikely to have a significant impact such that a local viable population would be placed at risk of extinction given that:

- the species has not been recorded from within the Project area;
- the Project would not impact on any known maternity sites (e.g. caves), with impacts likely to be limited to loss of potential foraging habitat;
- from a regional perspective, the Project would only remove a small area (105 ha of native vegetation primarily composed of grassy woodland and dry sclerophyll forest, and an additional 26 ha of clear land) of potential foraging habitat (Section 7);
- potential habitat for this species is likely to occur in the surrounding area; and
- the Project would only temporarily fragment areas of potential habitat for this highly mobile and wide ranging species.

Further to the above, potential foraging habitat for this species (243 ha of equivalent and/or additional vegetation types) would be conserved and improved in the region in the long-term in the proposed Offset areas (Section 7). Additional areas (up to 435 ha of cleared land) would be revegetated throughout the Offset areas, some of which may provide potential habitat for the species in the future (Section 7), and post-mining landforms would be rehabilitated and revegetated.

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Appendix D: EPBC Act significance tests

Swift Parrot (Lathamus discolour)

The Swift Parrot is listed as an endangered species in New South Wales (NSW) on Schedule 1 of the *Threatened Species Conservation Act* 1995 (TSC Act) as well as nationally on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Swift Parrot population is estimated to number less than 2,500 mature individuals. Within the parrot's breeding range the area of occupancy is less than 500 square kilometers (km^2) and the population has a severely fragmented distribution. A continuing decline in the number of mature individuals and in habitat extent and quality is projected unless action is taken to address the threats to the species (Swift Parrot Recovery Team, 2001).

The Swift Parrot breeds only in Tasmania and migrates to mainland Australia in autumn. Birds disperse widely across southeastern Australia. Until recently it was believed that in NSW, Swift Parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region. However, evidence is gathering that the forests on the coastal plains from southern to northern NSW are also extremely important (Swift Parrot Recovery Team, 2001). Swift Parrots return to Tasmania in early august with most of the population arriving by mid-September.

During winter it is semi-nomadic, foraging for lerps and nectar and pollen in winter-flowering eucalypts such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*) (NSW Office of Environment and Heritage [OEH], 2012). Commonly used lerp-infested trees include Grey Box (*E. microcarpa*), Grey Box (*E. moluccana*) and Blackbutt (*E. pilulari*). The fruits and seeds of native and exotic plants are eaten in suburban environments.

Woodlands and forests within the parrot's over-wintering range and its restricted breeding distribution have been fragmented and substantially reduced by land clearance for agriculture and urban and coastal development. Forestry operations and firewood collection have also altered the age structure of forests, resulting in the loss of older trees that provide a major food resource as well as hollows for nesting (Swift Parrot Recovery Team, 2001). The Swift Parrot also suffers from high mortality during the breeding season through collisions with man-made structures such as windows, wire mesh fences and vehicles (especially where such obstacles are in close proximity to suitable habitat) (OEH, 2012). The Swift Parrot is threatened by a number of factors on the mainland, including loss of habitat through clearing for agriculture, and urban and industrial development (OEH, 2012). Collisions with wire netting fences, windows and cars, during the breeding season and winter migration also pose a threat.

This species has not been recorded in the study area but was recorded previously on a single occasion approximately 15 kilometres (km) from the study area (Figure C-8).Potential foraging habitat for the Swift Parrot occurs within the study area (Figure C-9).

Potential impacts to the Swift Parrot are likely to be restricted to a small loss of potential foraging habitat.

Significance of Impacts on the Species

Criterion 1: lead to a long-term decrease in size of a population;
The Project would involve the clearing of approximately 105 hectares (ha) of potential foraging habitat, and no breeding habitat would be disturbed. Considering the extensive foraging habitat that exists adjacent to the study area, it is unlikely that the Project would have an adverse effect on any populations of this species.

Criterion 2: reduce the area of occupancy of the species;
The area of occupancy for this species is unlikely to be affected given that extensive foraging habitat exists outside the study area and that potential habitat that will be conserved and improved in the proposed Offset areas.

Criterion 3: fragment an existing population into two or more populations;
The highly mobile nature of this species means that the Project would not be a barrier to migration and that no populations will be fragmented.

Criterion 4: adversely affect habitat critical to the survival of a species;
No critical habitat has been identified for this species. The Project would not involve the removal of any breeding habitat and extensive foraging habitat is present outside the study area, as such, it is unlikely that any critical habitat will be adversely affected.

Criterion 5: disrupt the breeding cycle of a population;
The Swift Parrot breeds in Tasmania during spring and summer before migration to the Australian mainland in winter (OEH, 2012). The removal of a small area of possible foraging habitat is unlikely to disrupt the breeding cycle of this species, especially considering the large areas of foraging habitat which exist adjacent to the study area, and the potential habitat that will be conserved and improved in the proposed Offset areas.

Criterion 6: modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
The clearing of a relatively small area of potential habitat as part of the Project would be unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, especially considering the large areas of potential habitat which exist adjacent to the study area and that potential foraging habitat will be conserved and enhanced in the proposed Offset areas. Further, additional areas of potential foraging will be created through the revegetation programme.

Criterion 7: result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat;
Predation by feral animals is not recognised as a threat within the recovery plan for this species (Swift Parrot Recovery Team, 2001). It is unlikely that there would be an increase in invasive species as a result of the Project at a scale that would affect the foraging habitat for this species. Further, a feral management programme would be implemented as part of the Project.

Criterion 8: introduce disease that may cause species to decline; or
Disease is not recognised as a current threat to this species and it is unlikely that the Project would introduce disease to this species.

Criterion 9: interfere with the recovery of the species
A recovery plan has been prepared for the Swift parrot, which identifies the following six recovery actions:
Action 1. Identify the extent and quality of foraging habitat
Action 2. Manage swift parrot habitat at a landscape scale
Action 3. Reduce the incidence of collisions
Action 4. Population and habitat monitoring

Action 5. Community education and information
Action 6. Manage the recovery process through a recovery team

The level of land clearing that would occur as a result of the Project (105 ha of native vegetation and 28 ha of cleared land) is unlikely to interfere with the recovery actions set for the Swift Parrot given that there are extensive tracts of bushland present immediately adjacent to the study area, and that potential foraging habitat will be conserved and improved in the proposed Offset areas (490 of native vegetation and 40 ha of cleared land). Additional areas of habitat would also be created through the revegetation of cleared land (up to 435 ha) in the Offset areas.

Conclusions
The Project would be unlikely to significantly impact upon the Swift Parrot given that:

- from a regional perspective the Project would involve a small area of habitat loss relative to the extensive tracts of bushland which occur immediately adjacent to the study area;
- no breeding habitat would be disturbed;
- the proposed Offset areas will result in potential habitat for this species being conserved and improved in perpetuity; and
- cleared land within the Offset areas would be revegetated (up to 435 ha).

Regent Honeyeater (Anthochaera Phrygia)

The Regent Honeyeater is listed as a critically endangered species under Schedule 1 of the TSC Act. It is also listed as an endangered species and as a migratory species on a national scale under the EPBC Act.

The range of this species has declined dramatically. Its distribution is extremely disjointed and the population is believed to contain fewer than 1,500 individuals (NSW National Parks and Wildlife Service [NPWS], 1999). There are only three known key breeding regions remaining: northeast Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region (OEH, 2012). In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. However, in some years non-breeding flocks converge on flowering coastal woodlands and forests (OEH, 2012).

Two habitat types are of particular importance for the Regent Honeyeaters. Most records of the species have come from box-ironbark eucalypt associations and it seems to prefer wetter, more fertile sites within these associations, such as along creek flats, broad river valleys and lower slopes. Along streams in NSW, riparian forests of River She-oak (*Casuarina cunninghamia*) are also important for feeding and breeding. The other major environment regularly utilised by Regent Honeyeaters, perhaps largely as a drought refuge, is wet lowland coastal forest dominated by Swamp Mahogany (*Eucalyptus robusta*) or Spotted Gum (*E. maculata*) (Menkhorst *et al.*, 1999).

These woodlands have significantly large numbers of mature trees, high canopy cover and an abundance of mistletoes (OEH, 2012). A recent study identified the typical breeding habitat in remnant native vegetation occupied by Regent Honeyeaters in the Bunderra-Barraba region as linear, well-connected woodland patches surrounded by cleared grazing land (Oliver and Lollback, 2010).

Colour-banding of Regent Honeyeater has shown that the species can undertake large-scale nomadic movements in the order of hundreds of kilometres. However, the exact nature of these movements is still poorly understood. It is likely that movements are dependent on spatial and temporal flowering and other resource patterns.

Nectar comprises the main diet of Regent Honeyeaters, with 16 species of eucalypt and two species of mistletoe browsed. However, three species of eucalypt make up the predominant nectar sources: Red Ironbark (*Eucalyptus sideroxylon)*, White Box (*Eucalyptus albens*) and Yellow Box (*Eucalyptus melliodora*) (Webster and Menkhorst, 1992). Lerps and honeydew comprise a large proportion of the diet when nectar is scarce. Other insects comprise a smaller dietary component but are important for nestlings (OEH, 2012).

Breeding occurs between July and January in Box-Ironbark and temperate woodlands and riparian gallery forest dominated by River She-oak (OEH, 2012). Nests are frequently located in Red Ironbark and River Red Gum but may also be in other eucalypts, mistletoe clumps and casuarinas (OEH, 2012). The nest constructed of bark, grass, twigs and wool is built solely by the female who also incubates the two to three eggs. Subsequent care for the nestlings is shared between both parents.

This species is threatened by a number of processes including fragmentation and degradation of habitat, key habitat tree species and remnant woodlands from clearing for agricultural, residential development, and timber gathering, particularly fertile Yellow Box-White Box-Blakely's Red Gum woodlands (OEH, 2012). Overgrazing suppresses the regeneration of overstorey tree species and shrub species, with Riparian gallery forests being particularly impacted upon (OEH, 2012). Other threats include competition from larger aggressive honeyeaters (e.g. Noisy Miners, Noisy Friarbirds, Red Wattlebirds), and egg/nest predation by native birds (OEH, 2012).

There is potential foraging habitat for the species (Figure C-21), but there are no records for the species in the locality. It is only likely to occur as a very rare vagrant.

Criterion 1: **lead to a long-term decrease in size of a population;**
The Project involves the clearing of 105 ha of possible foraging habitat. In relation to the extensive foraging habitat that exists adjacent to the study area, and the potential habitat that would be conserved and improved in the proposed Offset areas (490 ha), it is unlikely to affect any populations of this species.

Criterion 2: reduce the area of occupancy of the species;
The area of occupancy for this species is unlikely to be affected given that the species was not recorded during the current survey and that extensive foraging habitat exists outside the study area.

Criterion 3: fragment an existing population into two or more populations;
The highly mobile nature of this species means that the Project would not be a barrier to migration and that no populations will be fragmented.

Criterion 4: adversely affect habitat critical to the survival of a species;
No critical habitat has been identified for this species. Three key breeding areas are known, and none are close to the Project area. As the Project would not involve the removal or disturbance of any key breeding habitat and extensive foraging habitat is present outside the study area, it would be unlikely that any important habitat will be adversely affected.

Criterion 5: disrupt the breeding cycle of a population;
In NSW, the distribution of the Regent Honeyeater is mainly confined to two breeding areas, and surrounding fragmented woodlands, in the Capertee Valley and the Bundarra-Barraba region (OEH, 2012). In some years, non-breeding flocks converge on flowering coastal woodlands and forests (OEH, 2012). The removal of a small area of possible forging habitat as a result of the Project is unlikely to disrupt the breeding cycle, especially considering the large areas of foraging habitat which exist adjacent to the study area and the potential habitat that would be conserved and improved in the proposed Offset areas. Further, additional habitat would be created through revegetation of cleared land (up to 435 ha) in the Offset areas.

Criterion 6: modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
The clearing of a relatively small area of potential foraging habitat would be unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, especially considering the large areas of potential habitat which exist adjacent to the study area and the potential habitat that would be conserved and improved as a result of the proposed offset area. Further, additional habitat would be created through revegetation of cleared land (up to 435 ha) in the Offset areas, which may benefit the species in the future.

Criterion 7: result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat;
Predation by feral animals is not recognised as a threat to the Regent Honeyeater and it is unlikely that there will be an increase in invasive species as a result of the Project at a scale that will affect the foraging habitat for this species. Nonetheless, the Project would include a feral animal control programme.

Criterion 8: introduce disease that may cause species to decline; or
Disease is not recognised as a current threat to this species and it is unlikely that the Project will introduce disease to this species.

Criterion 9: interfere with the recovery of the species
No recovery plan has been prepared for the Regent Honeyeater, but there are a number of suggested recovery actions outlined in the OEH species profile for this species (OEH, 2012). Of these recovery actions three are relevant to the Project:

- No loss of mature key nectar tree species and minimise the removal of mistletoes at key sites.
- Protect and enhance key breeding and foraging habitats.
- Encourage natural regeneration and increase the remnant size of known and potential Regent Honeyeater habitats.

The small clearing proposed as part of the development is unlikely to interfere with the recovery actions set for the Regent Honeyeater, given that no key nectar tree species were observed in the study area, and the clearing will not impact on any known key breeding or foraging areas. In addition, potential habitat for this species would be conserved and improved in the Offset areas, and additional habitat would be created through the revegetation of cleared lands.

Conclusions
The Project would be unlikely to significantly impact upon the Regent Honeyeater given that:

- the Project would not impact on any known key breeding areas;
- no key nectar feed trees would be removed;
- from a regional perspective, the area of vegetation proposed to be removed is considered minimal in comparison to the large areas of available habitat in the surrounding area;
- the proposed Offset areas would conserve and improve potential habitat for the species in perpetuity; and
- cleared land within the Offset areas would be revegetated (up to 435 ha).

Spotted-tailed Quoll (Dasyurus maculatus)

The Spotted-tailed Quoll is listed as a vulnerable species under Schedule 2 of the TSC Act (OEH, 2012) as well as endangered on the EPBC Act. It occupies a range of environments within a disjunct distribution along the east coast of Australia, extending from south-eastern Queensland through NSW and Victoria to Tasmania. This species is found in a variety of habitats, including sclerophyll forest and woodlands, coastal heathlands and rainforests (Dickman and Read, 1992; Edgar and Belcher, 1995). Occasional sightings are made in open country, grazing lands, rocky outcrops and other treeless areas.

Prey items include gliders and possums, small wallabies, rats, birds, bandicoots, rabbits, insects and carrion. Although mainly terrestrial, the Spotted-tailed Quoll is an agile climber and may raid possum and glider dens and prey on roosting and fledgling birds. Nesting occurs in rock shelters, hollow logs, caves or tree hollows and they use numerous dens within the home range. Estimates of home ranges vary from 800 ha to 20 km^2 and individuals may move several kilometres in a night. It is a highly mobile species and there are numerous records of overnight movements of several kilometres (Edgar and Belcher, 1995). Breeding occurs from April to July with an average litter size of five (Edgar and Belcher, 1995).

The Spotted-tailed Quoll is threatened by a number of processes including loss, fragmentation and degradation of habitat through clearing of native vegetation and subsequent development, logging and frequent fire (Edgar and Belcher, 1995; Dickman and Read, 1992). The loss of large hollow logs and other potential den sites (Scotts, 1992) is a major problem, as well as competition for food and predation by foxes and cats (Edgar and, Belcher 1995; Dickman and Read, 1992). Cats may also spread parasitic protozoan epidemics to Quolls (Edgar and Belcher, 1995; Dickman and Read, 1992). Persecution by humans is still an issue, because humans perceive Quolls as a predator on stock and poultry (Edgar and Belcher, 1995; Dickman and Read, 1992). Baiting of dingoes may result in direct poisoning of Spotted-tailed Quolls but may also change the relative abundance of predator. Reducing dingo numbers favours foxes which compete with quolls (Edgar and Belcher, 1995; Dickman and Read, 1992).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Criterion 1: lead to a long-term decrease in size of a population;
The Project would result in the removal of a relatively small amount (105 ha) of potential foraging habitat (Figure C-28), and a number of hollow bearing trees, which could potentially provide den sites for this species. However, the areas of potential habitat that would be impact are unlikely to be preferred habitat, given the existing levels of fragmentation and the low abundance of old growth features. More suitable habitat is likely to occur east of the Project area. Given the large home ranges of this species and that extensive habitat exists adjacent to the study area, including in the proposed Offset areas (457 ha), the clearing of a relatively small area of potential habitat is unlikely to lead to a long-term decrease in the size of a population.

Criterion 2: reduce the area of occupancy of the species;
The area of occupancy for this species is unlikely to be affected given that the species was not recorded during the current survey and that extensive less fragmented habitat exists outside the study area, including in the proposed Offset areas.

Criterion 3: fragment an existing population into two or more populations;
The Project would be unlikely to create any additional barriers to migration for any local populations. Two areas of potential habitat would be further fragmented as a result of the proposed Avon North Open Cut and the Stratford East Open Cut. However, this species has not been recorded in those areas despite recent surveys, and are unlikely to constitute preferred habitat for the species. Therefore, the Project is not likely to fragment existing populations of this species.

Criterion 4: adversely affect habitat critical to the survival of a species;
No critical habitat has been identified for this species. The relatively small area (105 ha) of potential habitat that would be cleared as a result of the Project is unlikely to be critical to the survival of the species given the large areas of less fragmented potential habitat that occur outside the study area, including in the proposed Offset areas (457 ha).

Criterion 5: disrupt the breeding cycle of a population;
The removal of a relatively small area of potential habitat, which does not include any known den sites, would be unlikely to disrupt the breeding cycle of this species, especially considering the large areas of potential foraging habitat which exist adjacent to the study area. Old growth features of a size suitable for the species are uncommon within the Project area. In addition, potential den habitat (e.g. large logs) would be relocated to suitable areas as part of the impact mitigation measures.

Criterion 6: modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
The clearing of a relatively small area of potential habitat as a result of the Project is unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, especially considering the large areas of less fragmented potential habitat which exist adjacent to the study area, including better quality habitat in the proposed Offset areas (457 ha).

Criterion 7: result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat;
Competition for food and predation by foxes and cats are recognised as harmful to this species (Edgar and Belcher, 1995; Dickman and Read, 1992). It is unlikely that there would be an increase in cats or foxes as a result of the Project. Nonetheless, a pest management strategy is part of the management measures for the Project.

Criterion 8: introduce disease that may cause species to decline; or
Cats may spread parasitic protozoan epidemics to Quolls (Edgar and Belcher, 1995; Dickman and Read, 1992). It is unlikely that the Project would result in an increased number of cats within the study area considering a pest management strategy is proposed as part of the management strategy for the Project.

Criterion 9: interfere with the recovery of the species
No recovery plan has been prepared for the Spotted-tailed Quoll. It is unlikely that the removal of the small area of potential habitat would substantially interfere with the recovery of this species given the large areas of potential habitat which exists outside the study area, and the potential habitat that would be conserved and enhanced in perpetuity proposed Offset areas. Further, additional habitat would be created through revegetation of cleared land (up to 435 ha) in the Offset areas, which may benefit the species in the future.

Conclusions
The Project would be unlikely to significantly impact upon the Spotted-tailed Quoll given that:

- the species has not been recorded in the Project area;
- from a regional perspective, only a relatively small area of potential habitat will be removed in comparison to the less fragmented potential habitat that exists adjacent to the Project area;.
- potential habitat would be conserved and improved in the Offset areas in perpetuity; and
- cleared land within the Offset areas would be revegetated (up to 435 ha), which may benefit the species in the future.

Long-nosed Potoroo (Potorous tridactylus tridactylus)

The Long-nosed Potoroo is listed as vulnerable both in NSW under Schedule 2 of the TSC Act and nationally under the EPBC Act. This medium sized marsupial is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. In NSW, Long-nosed Potoroos have been seen at several locations but the only population for which there is detailed information is at Tyagarah where it was estimated that around 80-90 individuals exist. This population was considered to be insecure. The status and security of other NSW populations is uncertain. In NSW, this species is generally restricted to coastal heaths and forests east of the Great Dividing Range, where there is an annual rainfall exceeding 760 millimetres (mm) (OEH, 2012).

Long-nosed Potoroos inhabit coastal heaths and dry and wet sclerophyll forests. Their habitat may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. This species can tolerate open or patchy habitat provided there is dense vegetation available for cover nearby.

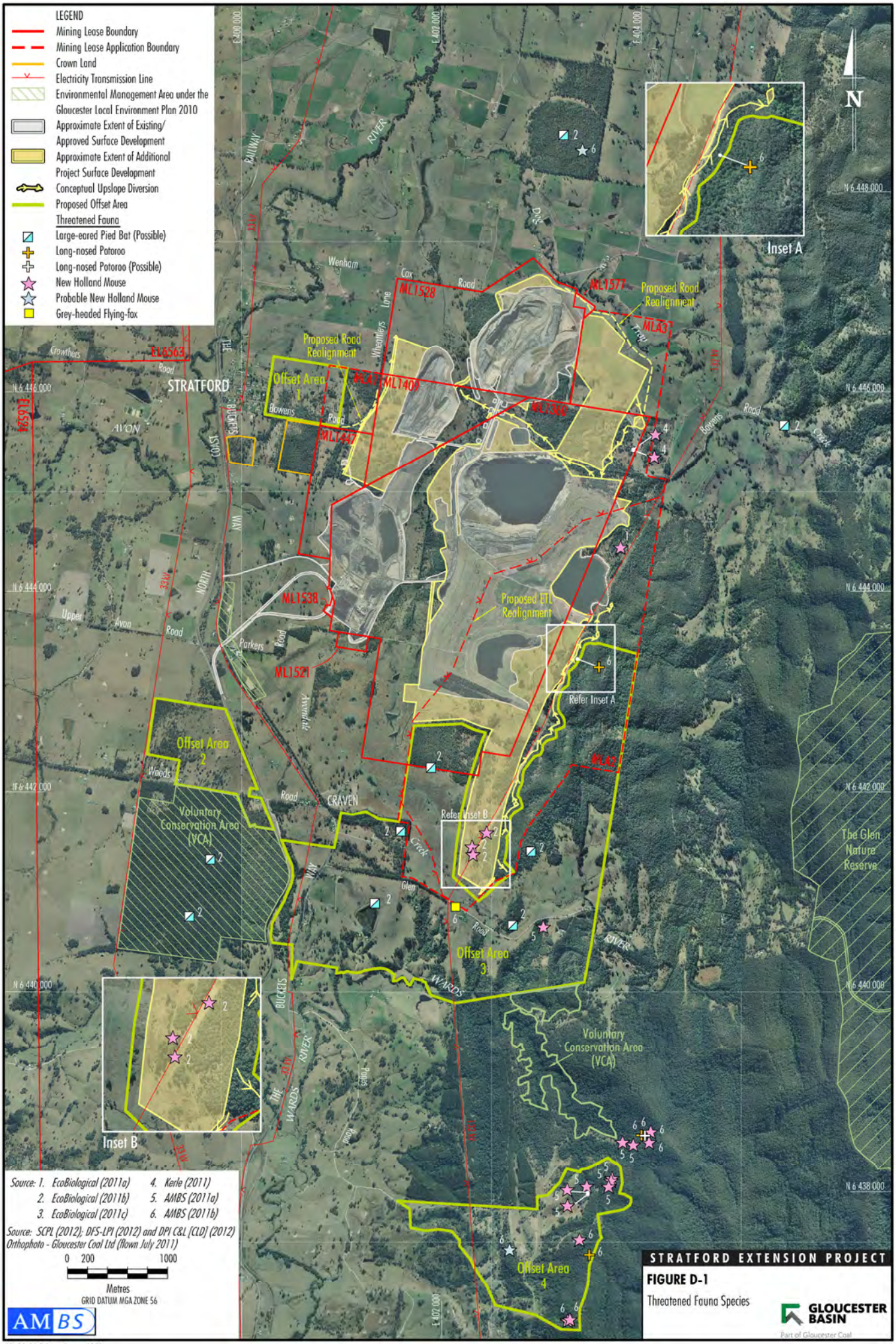
This species is mainly nocturnal, hiding by day in dense vegetation. During winter, however, these animals may forage during daylight hours. They often dig small holes in the ground in a similar way to bandicoots. The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of their diet but they also eat roots, tubers, insects and their larvae, and other soft-bodied animals in the soil.

Individuals are mainly solitary, non-territorial and have home range sizes ranging between 2-5 ha.

Breeding occurs all year round both in captivity and in the wild (Bennett, 1987; Hughes, 1962), but breeding peaks typically occur in late winter to early summer. A single young is born after a gestation of 37 days, or 29 days from removal of pouch young. The young remain in the pouch for about 100–125 days. Sexual maturity is achieved at about 12 months. The Long-nosed Potoroo (SE Mainland) can live to 10 years.

The main threats to Long-nosed Potoroos are due to geographical isolation causing breeding difficulties. Such isolation comes about mainly through the loss of habitat and fragmentation from land clearing and residential and industrial development. Isolation can also be caused by predation from foxes, dogs and cats, too frequent fires, and grazing by stock that reduces the density and floristic diversity of understorey vegetation. Other threats include logging regimes or other disturbances that reduce the availability and abundance of food resources, particularly hypogeous fungi, and ground cover.

Three records of the Long-nosed Potoroo were collected during recent surveys (Figures 4b and D-1), including one very close to the Project area, on the edge of the north-eastern end of the proposed Stratford East Open Cut. A second record occurs within Offset area 4 and a third record occurs close to Offset area 4 (Figures 4b and D-1). Very close to the latter location, a fourth possible record based on hair analysis was recorded (Figures 4b and D-1). The main impacts to the species would be a small loss in foraging habitat due to the Stratford East Open Cut and short-term disturbance and possible habitat loss due to the drainage diversions on the eastern slope (total approximately 37 ha).



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An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Criterion 1: lead to a long-term decrease in the size of an important population
The long-nosed Potoroo can tolerate foraging habitat that may be open and patchy but relies on dense patches of vegetation for shelter. Such habitat exists on slopes of the hills to the east of the Project area where the species was recorded (Figure C-37). The Project would remove a relatively small proportion of potential foraging habitat for the species, along the eastern and southern edge of the proposed Stratford East Open Cut. The drainage diversion lines that would be established on the slope east of the mine area to prevent water from flowing into the mine pit are likely to traverse known Long-nosed Potoroo habitat. Home ranges of the Long-nosed Potoroo have been reported as 2-5 ha and the disturbance to habitat created by the construction of the surface water diversion could affect an individual or individuals if it traverses their home range. The extent of the effect on individuals and in turn on the population depends on the size of the impact area and the persistence of the disturbance. The construction of the drainage diversion would be short-term, and once off. If the diversion line revegetates quickly and then represents a comparably suitable habitat as before the disturbance then the effect is likely to be minimal. In the worst case scenario the disturbance of the habitat through the proposed diversion lines may lead to the loss of individuals from the local population.

The Project would therefore remove a relatively small area of potential habitat along the edge of the area of known habitat for this species to the east of the Project area and would create a temporary disturbance and possibly some minor loss of habitat through that area for the construction of the surface water drainage line. These impacts are expected to be relatively minor, although there is some potential that individuals would be affected. The majority of the habitat in this area would be retained. Given this, and the fact that the species has been recorded in other locations well outside the Project area, including one in the Offset areas, it is considered that the Project is not likely to lead to a long-term decrease in the size of an important population. The Offset areas will conserve habitat for this species in perpetuity, and the Project would include measures to control of foxes and cats. The revegetation of cleared land (up to 435 ha) may also increase the available habitat for the species in the future.

Criterion 2: reduce the area of occupancy of an important population
The area of occupancy for this species is unlikely to be affected in the long-term. Short-term reduction in occupancy may result from the short-term disturbance through the construction of the drainage diversion lines on the slopes east of the proposed Stratford East Open Cut. As these areas revegetate the area of occupancy is likely to return to previous levels. Suitable habitat exists outside the Project area and known habitat for the species would be conserved and enhanced within the other Offset areas (especially Offset area 4). The revegetation of cleared land (up to 435 ha) may also increase the available habitat for the species in the future.

Criterion 3: fragment an existing important population into two or more populations;
The Project would only remove habitat from the edge of areas of potential habitat, so would be unlikely to fragment a population. The drainage diversions would dissect known habitat, but this impact is only of a small scale and short-term in duration. It would not be to the extent that it would create any barriers to movement. The Project is therefore unlikely to fragment any populations into two or more populations.

Criterion 4: adversely affect habitat critical to the survival of a species
No critical habitat has been identified for this species. The small area of habitat that would be cleared, and the area that would be disturbed as part of the installation of water diversion lines is unlikely to be critical to the survival of the species given the areas of known and potential habitat in the greater locality, including the Offset areas.

Criterion 5: disrupt the breeding cycle of a population;
The removal and disturbance of a relatively small area of habitat is unlikely to disrupt the breeding cycle of this species, given the disturbance from the establishment of the drainage diversions would be short-term and once off. Overall, the breeding cycle of population would be unlikely to be disrupted.

Criterion 6: modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
The removal of a relatively small area (37 ha) of potential habitat is unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, considering the areas of known and potential habitat which exist in the greater locality and in the Offset areas (234 ha).

Criterion 7: result in invasive species that that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
Predation by introduced predators, including the Red Fox (*Vulpes vulpes*), Cat (*Felis catus*) and Dog (*Canis familiaris*) is a threat to the Long-nosed Potoroo (OEH, 2012). It is unlikely that there would be an increase in cats, foxes or dogs as a result of the Project. The control of cats, foxes and dogs as part of the management of the proposed Offset areas is likely to benefit the species.

Criterion 8: introduce disease that may cause species to decline; or
A disease affecting the Long-nosed Potoroo is not listed as a threat to this species. The Project is the extension of an existing mine and is not expected to introduce new pathogens to the population.

Criterion 9: interfere substantially with the recovery of the species
No recovery plan has been prepared for the Long-nosed Potoroo. It is unlikely that the removal of the small area of potential habitat would substantially interfere with the recovery of this species given the availability of known and potential suitable habitat in the greater locality and the establishment of Offset areas which are likely to benefit the conservation and recovery of the species.

Conclusions
The Project would be unlikely to significantly impact upon the Long-nosed Potoroo given that:

- from a regional perspective, only a small area of habitat would be removed or disturbed (37 ha);
- the area of habitat that would be removed is along the edge of the habitat for the species;
- the area that would be disturbed for the surface water diversions is relatively small and the disturbance is likely to be relatively minor and of short duration;
- the species occurs in at least two other locations to the south-east of the Project area, including one location within the Offset areas;
- known and potential habitat would be conserved and improved in the Offset areas in perpetuity; and
- cleared land within the Offset areas would be revegetated (up to 435 ha), which may benefit the species in the future.

Grey-headed Flying-fox (Pteropus poliocephalus)

The Grey-headed Flying Fox is listed as vulnerable both in NSW under Schedule 2 of the TSC Act and nationally under the EPBC Act. The Grey-headed Flying-fox is Australia's only endemic flying fox. It occurs primarily along the eastern coastal plain from Bundaberg in Queensland, through NSW and south to eastern Victoria. A colony has also established in Melbourne. The species is broadly distributed, however, only a small proportion of its range is used at any one time, as the species selectively forages where food is available. As a result, patterns of occurrence and relative abundance within its distribution vary widely between seasons and between years. While this species is mainly found along the coast, they make regular movements over the Great Dividing Range to the western slopes of NSW and Queensland (OEH, 2012).

Historically, Grey-headed Flying-foxes were more widespread in Australia and numbers were estimated as being in the "many millions" (Ratcliffe, 1931). However, counts of flying foxes over the past decade suggest that the national population may have declined by up to 30% and that some local populations have declined by as much as 94%. It has also been estimated that the population will continue to decrease by at least 20% in the next three generations given the continuation of the current rate of habitat loss and culling.

This species requires foraging habitat and roosting sites. It feeds in the canopy on fruit, blossoms and nectar in rainforests, open forests, woodlands, Melaleuca swamps and Banksia woodlands. As such, it has an important ecosystem function by providing a means of seed dispersal and pollination for many indigenous tree species (Pallin, 2000). Grey-headed Flying-foxes also feed on introduced trees including commercial fruit crops. They congregate in large numbers at roosting sites (camps) that may be found in rainforest patches, Melaleuca stands, mangroves, riparian woodland or modified vegetation in urban areas. Individuals generally exhibit a high fidelity to traditional camps and return annually to give birth and rear offspring. They forage opportunistically, often at distances up to 30 km from camps, and occasionally up to 60-70 km per night.

Grey-headed Flying-foxes are relatively long-lived, with the average age of reproductive animals being between six and 10 years. They have a low maximum rate of population growth for their size, conceiving only one young annually (Nelson, 1965). This slow growth rate is further affected by females' tendency to abort or abandon their young in response to environmental stress, such as food shortages or high temperatures.

The main threat to Grey-headed Flying-foxes in NSW is clearing or modification of native vegetation. This removes appropriate camp habitat and limits the availability of natural food resources, particularly winter-spring feeding habitat in north-eastern NSW. The urbanisation of the coastal plains of south-eastern Queensland and northern NSW has seen the removal of annually-reliable winter feeding sites, and this threatening process continues. In N.S.W less than 15% of potentially suitable forest for the Grey-headed Flying-fox occurs in conservation reserves; only 5% of roost sites are similarly reserved.

While licences are issued to cull limited numbers of Grey-headed Flying-foxes, large numbers of bats are killed using uncontrolled methods such as shooting and electrocution. The impact of these uncontrolled methods has not been measured but is likely to be greatest in those years when natural food is scarce. Also, culling has a disproportionate impact on lactating and pregnant females.

The species is also threatened by direct harassment via shooting at roosts, the destruction of camps and by being possible carriers for viral pathogens. Grey-headed Flying-foxes also face potential competition and hybridisation from Black Flying-foxes (*Pteropus alecto*) which are extending their range south into northern NSW (Webb and Tidemann, 1995). Colonisation of northern NSW by *P. alecto* may be assisted by their flexible reproduction and their dispersal from largely intact northern habitats into more fragmented habitat in the south.

Potential foraging habitat for the Grey Headed-Flying Fox occurs within the study area and approximately 105 ha of this vegetation would be cleared (Figure C-39). This species was recorded in the study area in a recent survey (Figures 4b and D-1) and in the wider region on several occasions in the past (Figure C-38).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will meet any of the following criteria:

Criterion 1: lead to a long-term decrease in size of an important population of a species;
No campsites for this species were recorded in the study area and this species is likely to only use the area for occasional foraging. Given that extensive foraging habitat exists adjacent to the study area, and habitat will be conserved and improved in the proposed offsets (490 ha), the Project is unlikely to affect any populations of this species.

Criterion 2: reduce the area of occupancy of an important population;
The area of occupancy is unlikely to be affected for any populations given that no campsites have been recorded within the study area and that extensive foraging habitat exists outside the study area.

Criterion 3: fragment an existing important population into two or more populations;
The highly mobile nature of this species means that the Project would not be a barrier to migration and that no populations would be fragmented.

Criterion 4: adversely affect habitat critical to the survival of a species;
As the Project would not involve the removal or disturbance of any campsites and would be unlikely to create a barrier to migration, it is unlikely that habitat critical to the survival of this species would be adversely affected.

Criterion 5: disrupt the breeding cycle of an important population;
No current or known historical campsites would be removed or disturbed. The Project would not disrupt the breeding cycle of any population

Criterion 6: modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
As no campsites would be removed or disturbed, and extensive foraging habitat exists outside the study area, the Project would be unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. Extensive areas of potential habitat occur adjacent to the Project area, and potential habitat would be conserved and improved as a result of the proposed offset area. Further, additional habitat would be created through revegetation of cleared land (up to 435 ha) in the Offset areas, which may benefit the species in the future.

Criterion 7: result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
Predation by feral animals is not recognised as a key threatening process for this species, and it is unlikely that the Project would result in any invasive species becoming established in the study area. Nonetheless, a feral animal control programme would be implemented as part of the Project.

Criterion 8: introduce disease that may cause the species to decline; or
Disease is not listed as a threat to this species. The Project would be unlikely to introduce a disease that may cause this species to decline.

Criterion 9: interferes substantially with the recovery of the species
No detailed recovery plan has been prepared for this species. As no campsites would be removed or disturbed, and extensive foraging habitat exists outside the study area, the Project would be unlikely to interfere with the recovery of this species.

Conclusions
The Project is unlikely to have a significant impact upon the Grey-headed Flying Fox considering that:

- no campsites would be removed or disturbed;
- from a regional perspective, only a small amount of foraging habitat would be removed;
- large areas of foraging habitat exists adjacent to the study area;
- potential habitat will be conserved and improved in the offset area in perpetuity; and
- cleared land within the Offset areas would be revegetated (up to 435 ha).

Large-eared Pied Bat (Chalinolobus dwyeri)

The Large-eared Pied Bat is listed as vulnerable both in NSW under Schedule 2 of the TSC Act and nationally under the EPBC Act. This small to medium sized bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands and to Ulladulla along the coast. In NSW, it is generally rare with a very patchy distribution. There are scattered records from the New England Tablelands and North West Slopes.

The Large-eared Pied Bat roosts in the entrances of caves, in crevices in cliffs, in old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*). This species is typically found in dry open forest and woodland close to roosting sites at low to mid-elevation. These bats have relatively short broad wings, indicating manoeuvrable flight, and they probably forage for small, flying insects below the forest canopy.

Both males and females are sexually mature at one year of age and females have relatively low fecundity, producing just one or two young per year. It is uncertain whether mating occurs early in winter or in spring. Females have been recorded raising young in maternity roosts of 20 to 40 individuals from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years and are likely to hibernate through the coolest months (OEH, 2012). This species has also been recorded in well-timbered areas containing gullies.

The most important threat to the Large-eared Pied Bat is disturbance and damage to primary nursery sites by animals, particularly Goats (*Capra hircus*) and humans. Many suitable roost caves in the Pilliga have been used by Goats and/or other animals and these are not used by the bats.

Land clearing or timber harvesting in or around roosts has the potential to affect foraging resources and fragment surrounding vegetation. This is likely to be particularly detrimental in the vicinity of maternity roosts where pregnant and lactating females need sufficient food resources to raise young.

Suitable foraging habitat is present throughout the study area (Figure C-43) and possible records of bats based on call identification have been made throughout the study area during surveys (Figures 4d and D-1). Database records also exist for the greater locality.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Criterion 1: **lead to a long-term decrease in size of a population;**
Potential impacts to the species are likely to be limited to a small loss in potential foraging habitat (approximately 105 ha). The Project would not impact on habitat or areas close to maternity caves, and is unlikely to impact on the accessibility of this species to any caves that may be undetected in the study area as the species is mobile. Extensive foraging habitat exists adjacent to the study area and potential habitat would be conserved and improved in the proposed Offset areas (530 ha [comprising 490 ha of native vegetation and 40 ha of cleared land]).

It is unlikely, therefore that the Project would lead to a long-term decrease in the size of any populations of this species

Criterion 2: reduce the area of occupancy of the species;
Considering that a large amount of area would be conserved in the proposed Offset areas and the relatively small amount of potential habitat that would be cleared, the area of occupancy for this species is unlikely to be affected. Further, additional areas of foraging habitat would be created through revegetation of areas of cleared land (up to 435 ha).

Criterion 3: fragment an existing population into two or more populations;
While the species was possibly recorded in the area that would become further fragmented as a result of the Stratford East Open Cut, the mobility of this species should ensure that no populations become fragmented as a result of the Project.

Criterion 4: adversely affect habitat critical to the survival of a species;
No critical habitat has been identified for this species. As the Project would not involve the removal of any key breeding habitat, and extensive foraging habitat is present outside the study area, it would be unlikely that any important habitat will be adversely affected.

Criterion 5: disrupt the breeding cycle of a population;
The Project will not result in the destruction of or disturbance to any primary roosting habitat and will not impact on habitat or areas close to maternity roosts. The Project is also unlikely to affect this species' ability to access any additional caves that may occur but were not detected during the study. Therefore, it is unlikely that the breeding cycle of any population will be disrupted.

Criterion 6: modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
The clearing of a relatively small area of potential foraging habitat (105 ha) would be unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, especially considering the large areas of potential habitat which exist adjacent to the study area and the potential habitat that would be conserved and improved as a result of the proposed offset area (530 ha).

Moreover, no roosting habitat or maternity sites will be disturbed as a result of the Project. Further, additional habitat would be created through revegetation of cleared land (up to 435 ha) in the Offset areas, which may benefit the species in the future.

Criterion 7: result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat;
It is unlikely that there will be an increase in invasive species as a result of the Project at a scale that will affect the foraging habitat for this species. The occurrence of feral animals may in fact be reduced as a result of pest control in the Offset areas.

Criterion 8: introduce disease that may cause species to decline; or
Disease is not recognised as a current threat to this species and it is unlikely that the Project will introduce disease to this species.

Criterion 9: interfere with the recovery of the species
There is currently no recovery plan or threat abatement plan for the Large-eared Pied Bat. OEH (2012) recommends steps that should be undertaken to facilitate the conservation and recovery of the species. These include retaining native vegetation and protecting potential roost and maternity sites and immediate surrounds (OEH, 2012). The Project does not impact on any known roost or maternity sites or the immediate vegetation around those sites. The Project will remove a small area (approximately 105 ha) of potential foraging habitat for the species and will contribute to habitat fragmentation. However, the proposed offset will conserve and improve potential habitat for the species in the region in the long-term (Section 7), and additional areas of habitat would be created through revegetation of cleared land (up to 435 ha).

Conclusions
The Project is unlikely to impose a significant impact on the Large-eared Pied Bat given that:

- no known roosting sites (e.g. caves) would be impacted;
- from a regional perspective, only a relatively small area of foraging habitat for the species would be removed (105 ha);
- no barriers to movement for this highly mobile species would be created;
- substantial potential habitat for this species will be conserved and enhanced in the Offset areas (490 ha); and
- cleared land within the Offset areas would be revegetated (up to 435 ha), which may benefit the species in the future.

New Holland Mouse (Pseudomys novaehollandiae)

The New Holland Mouse has a distribution which includes Tasmania, Victoria, NSW and south-eastern Queensland, mostly in coastal areas (Kemper and Wilson, 2008). The species has been recorded in heathlands, woodlands, open forest, shrubland, grassland and paperbark swamps on sandy, loamy or rocky soils (Wilson and Laidlaw, 2003; Kemper and Wilson, 2008). They are nocturnal, constructing burrows for daytime refuge and tend to occupy home ranges of 0.5-1.5 ha (males and females) (Kemper and Wilson, 2008). The breeding season is late winter to early spring, with abundances reaching their highest in autumn and lowest in spring (Kemper and Wilson, 2008).

In Victoria the New Holland Mouse appears to be an omnivore with an opportunistic feeding strategy. Wilson and Bradtke (1999) found the species consumed considerable amounts of dicotyledon leaf (27%), fungi (19%), invertebrate (17%) and seed (14%). Similar results were reported by Norton (1987). Cockburn (1980) but obtained a higher proportion of seeds in the diet. In NSW, Thomson (1980) found seed accounted for 76% of the diet. This was influenced by season, with almost 100% seed consumed during late spring and summer, compared with 49% during late winter to early spring (Thomson, 1980).

Most research on the species has been undertaken on coastal populations, for which very specific habitat preferences have been described. In general, coastal populations appear to prefer heathlands or woodlands with a heathy understorey, sandy substrates, sparse ground litter, high floristic diversity and an abundance of leguminous shrubs (Kemper, 1991; Lock and Wilson, 1999; Kemper and Wilson, 2008). The species shows a preference for flat areas with north easterly aspect, which is possibly related to suitability of habitat for burrowing (Kemper and Wilson, 2008). However, Wilson and Laidlaw (2003) found the New Holland Mouse could occupy a variety of different habitats and suggested the species is not restricted to heathlands with a high diversity of sclerophyllous shrubs.

Presence of the species has been related to vegetation structure, in particular vegetation density at 20-30 centimetres (cm) and 60-70 cm, and the total cover of vegetation (Wilson *et al*., 2005), although other authors have also reported low dense vegetation less than 1 metre (m) (Kemper, 1991), 50 cm (Fox and Fox, 1978), or 20 cm (Lock and Wilson, 1999) to be important.

Populations have been shown to recolonise regenerating burnt areas after 1-2 years, and rehabilitated sand mined areas after 4-5 years. Populations tend to increase as vegetation regenerates after fire, clearing and sandmining, reaching maximum densities after two to six years (Kemper, 1990; Fox and Fox, 1978, 1984; Fox and McKay, 1981, Fox, 1982; Twigg *et al*., 1989; Wilson, 1991).

Little research has been undertaken on inland populations. Van Dyck and Lawrie (1997) formally described the first record for the New Holland Mouse from Queensland, in habitat which differed markedly from known published records. The species was recorded approximately 100 km from the coast at an altitude of 560 m, in tall open forest lacking a dense shrub layer and in an advanced seral stage. Van Dyck and Lawrie (1997) also subsequently reviewed other accounts of the New Holland Mouse from NSW, for which the habitat type also contrasted markedly with known information for the species:

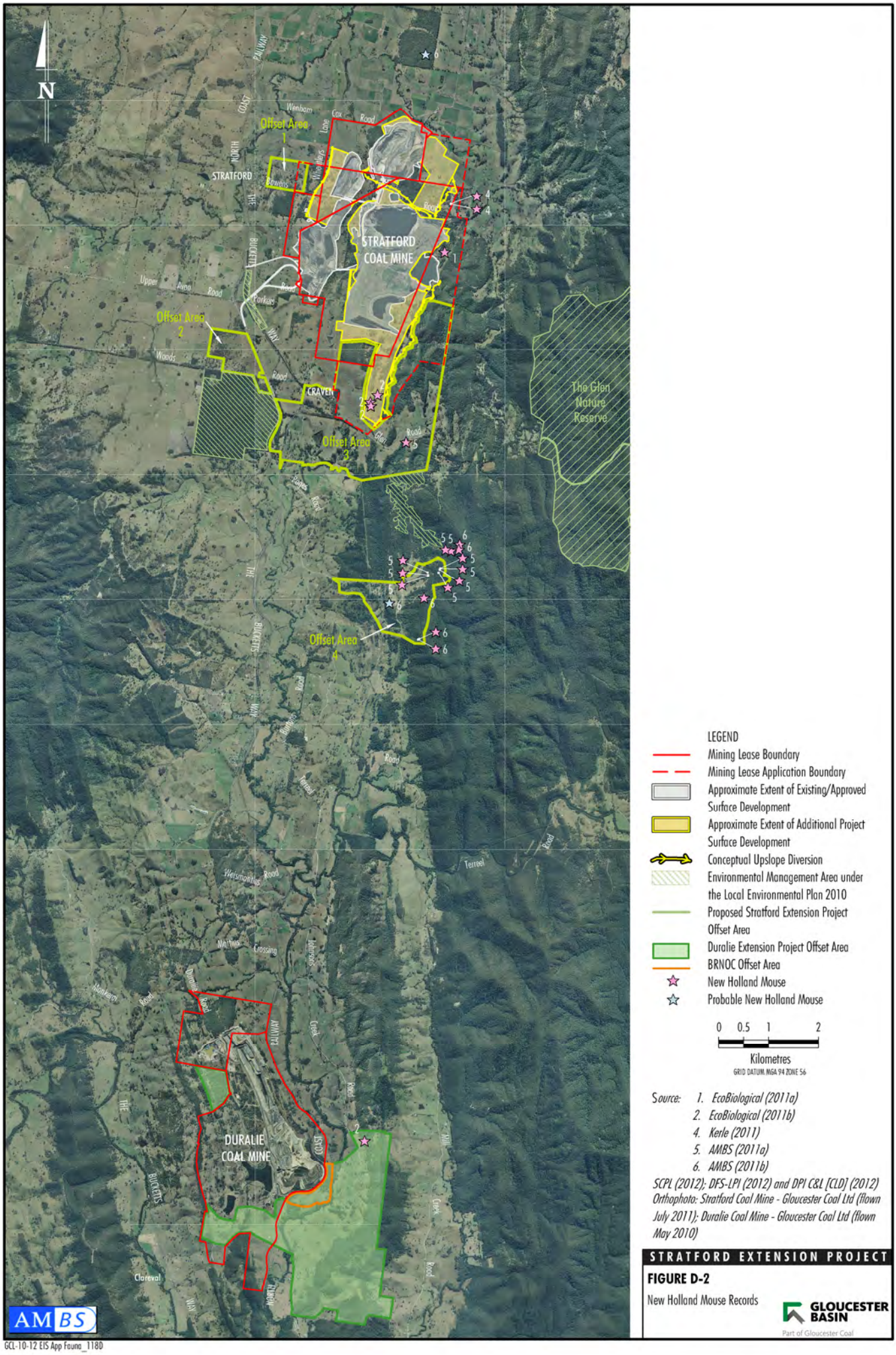
- Carai Plateau: six individuals were trapped by Sally Townley in September 1993, at an altitude of 900 m, with habitat consisting of *Eucalyptus laevopinea* open forest with an understorey dominated by *Lomandra* sp.;
- Chaelundi State Forest: Reed (1993) caught one individual in an area described as 'grass-covered alluvium with a *Eucalyptus tereticornis* overstorey';
- Chaelundi State Forest: Townley (1993) caught several individuals at an altitude of 840 m, in forest with a variety of Eucalyptus species, and an understorey of shrubs, grasses, and small herbs; and
- Oxley Wild Rivers National Park: Townley (date unknown) trapped over 20 individuals throughout a variety of different habitats between altitudes of 400 and 1,000 m. Habitats were open forest, dominated by a variety of different Eucalyptus species, with either grassy understoreys or dense heath layers.

Van Dyck and Lawrie (1997) concluded that the records confirmed the regular occurrence of the species at high altitudes and within tall open-forests, some of which have grassy understoreys rather than heath. However, they cautioned the proximity of the grassy understorey to heath (or other forms of dense understorey) should be examined before attributing grass as preferred habitat for the species.

In the Gloucester Valley, EcoBiological (2011) recorded the New Holland Mouse in areas dominated by Blady Grass (*Imperata cylindrica*), Bracken Fern (*Pteridium sp.*) and native grasses. The areas were subject to low grazing pressure, contained high plant species diversity and a lack of exotic plant cover. In contrast, Kerle (2011) has a low trapping success rate in areas containing Blady Grass and Bracken, instead recorded the New Holland Mouse at the edge of eucalypt woodland dominated by White Stringybark (*Eucalyptus globoidea*) and Grey Ironbark (*E. siderophloia*). The areas where the species was captured were subject to low grazing pressure, contained a dense groundcover and a very low proportion of exotic plants. Locations of where this species has been recorded within and surrounding the Stratford Mining Complex are shown on Figures D-1 to D-4.

Habitat in the Study Area

The results of a study carried out by the Australian Museum Business Services (AMBS) (2011) suggests habitat for the New Holland Mouse in the study area consists of areas with a high proportion of native plants, low weed density, groundcover density between 50-60% and greater grass cover. Sites where the species was recorded were subject to nil or only slight grazing pressure, had a high percentage cover of *Imperata cylindrica var. major* (Blady Grass) and a northerly or westerly aspect.



Source: 1. *EcoBiological (2011a)*
2. *EcoBiological (2011b)*
4. *Kerle (2011)*
5. *AMBS (2011a)*
6. *AMBS (2011b)*

SCPL (2012); DFS-LPI (2012) and DPI C&L [CLD] (2012) Orthophoto: Stratford Coal Mine - Gloucester Coal Ltd (flown July 2011); Duralie Coal Mine - Gloucester Coal Ltd (flown May 2010)

STRATFORD EXTENSION PROJECT

FIGURE D-2

New Holland Mouse Records

GLOUCESTER BASIN
Part of Gloucester Coal

AMBS

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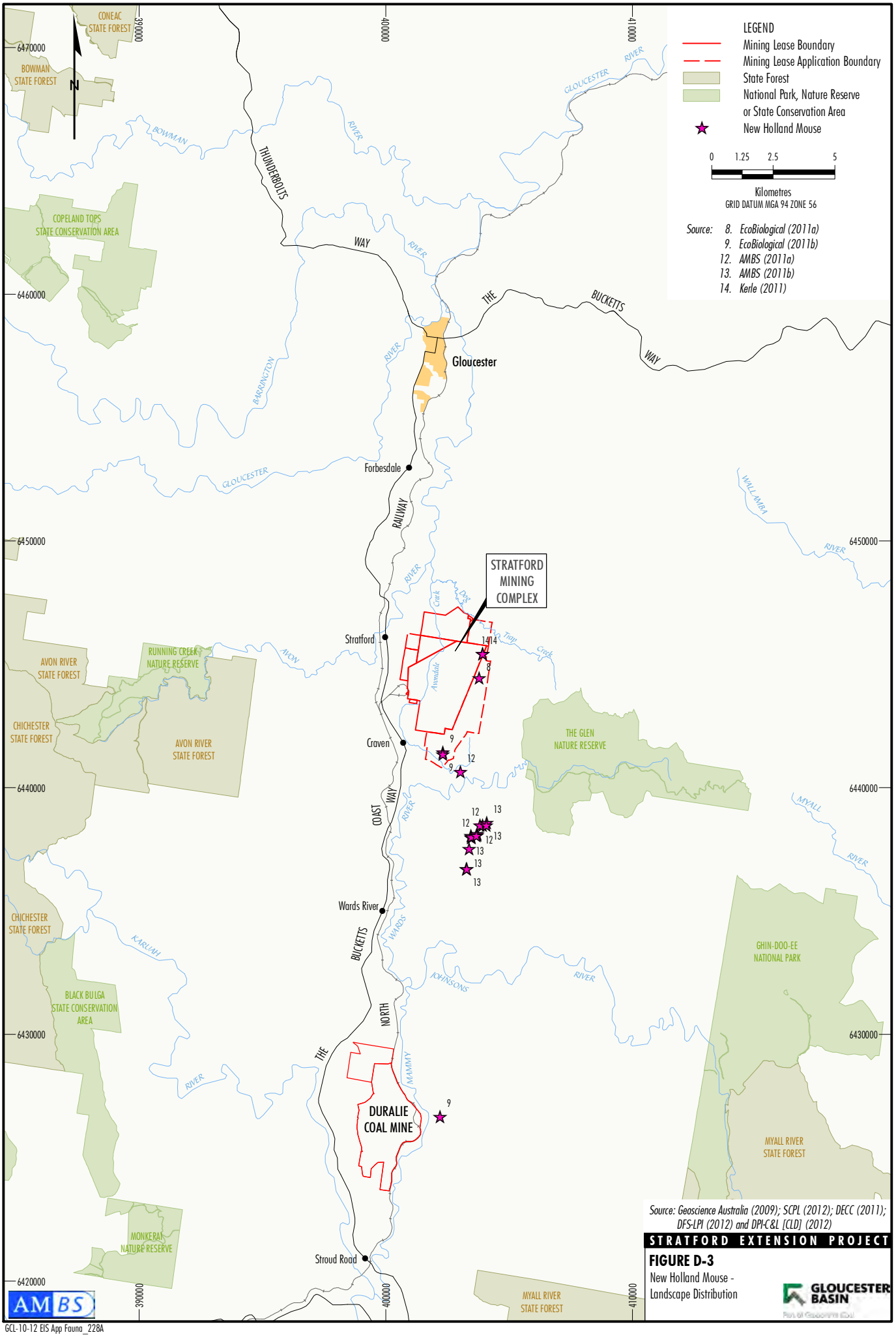

Source: Geoscience Australia (2009); SCPL (2012); DECC (2011); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE D-3

New Holland Mouse - Landscape Distribution

AMBS

GLOUCESTER BASIN

GCL-10-12 EIS App Fauna_228A

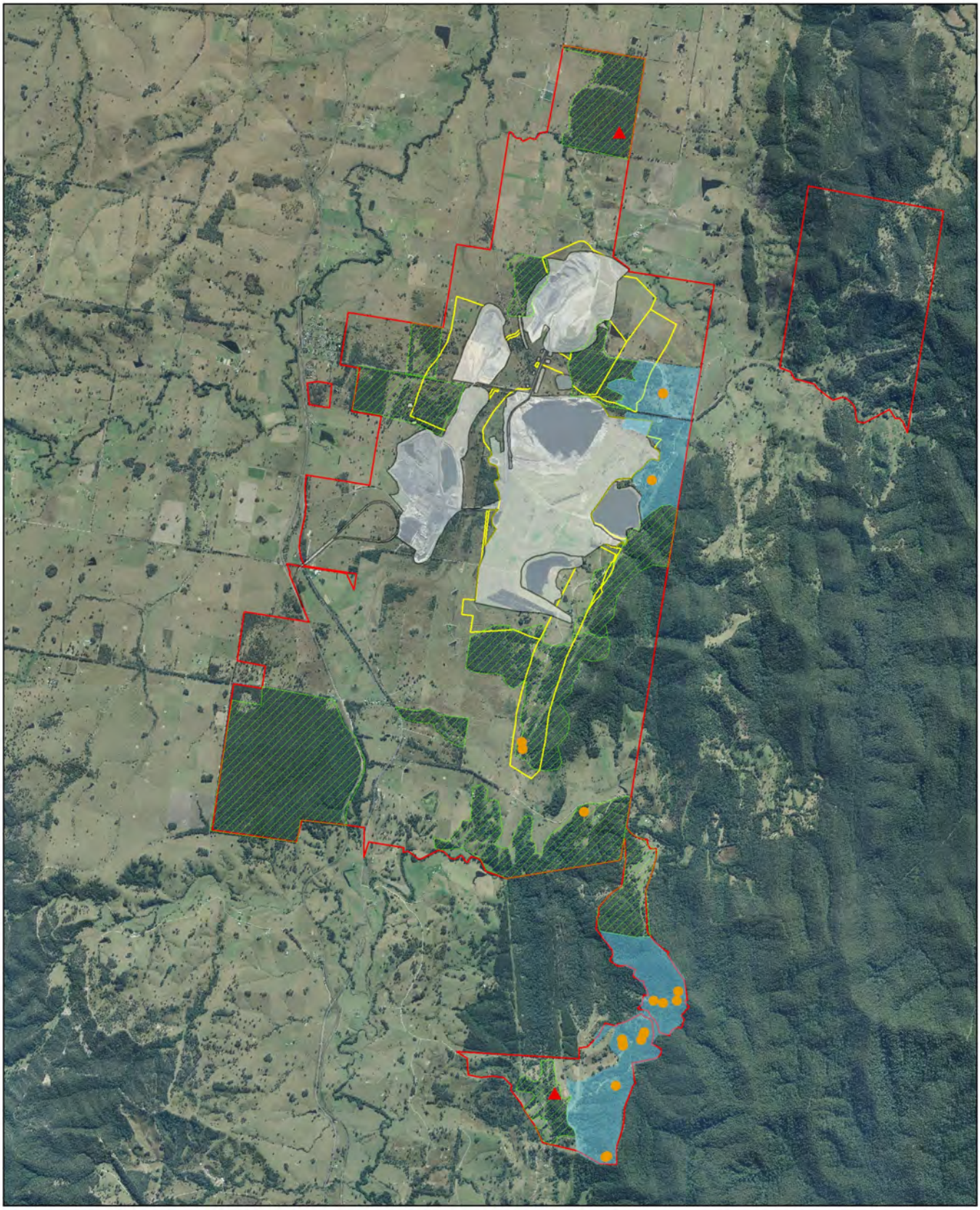

Figure D-4: New Holland Mouse - Potential Habitat

Notes: areas unmapped inside the study area are considered unlikely habitat where there is a low probability that the species would ccur.

0 0.5 1 2 Kilometres

N

Legend

- New Holland Mouse
- New Holland Mouse (probable)
- Potential Habitat
- Potential Habitat (patchy/marginal)
- Approximate Extent of Existing/Approved Surface Development
- Approximate Extent of Additional Project Surface Development
- Study Area

AMBS

These results are similar to the habitat types described by EcoBiological (2011) and Kerle (2011) in the study area. Their results suggested the species prefers areas with low grazing pressure, few exotic species and dense groundcover. However, Kerle (2011) reported a very low trapping rate in areas containing Blady Grass, whereas AMBS (2011) results suggest Blady Grass is an important habitat feature for the New Holland Mouse. EcoBiological (2011) reported high plant diversity at sites containing the species; however, AMBS (2011) results did not find any difference between present and absent sites with regard to native plant diversity.

Based on the previous surveys, known habitat for the species exists in areas south of Glen Road (Figure D-2). Potential habitat for this species within and surrounding the Stratford Mining Complex is shown on Figure D-4. Based on the results from Kerle (2011) and EcoBiological (2011), habitat for the species is also likely to exist in areas to the north-east and south-east of the Stratford Coal Mine, and to the south-east of the DCM. However, there were also many locations throughout the Gloucester Valley where targeted trapping was undertaken but the New Holland Mouse was not recorded. Kerle (2011) recorded the species at one out of five sites, EcoBiological (2011) recorded the species at two out of six sites, and AMBS (2011) recorded the species at four out of 18 sites. It is likely the New Holland Mouse has a patchy distribution throughout the Gloucester Valley.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Criterion 1: lead to a long-term decrease in the size of an important population
The Project is likely to result in the loss of individuals currently occupying known habitat at the southern end of the Project area. However, the species has been recorded in a number of locations outside of the Project area that will not be affected by the Project. There are a number of records of the species to the south-east of the Project area, including some in Offset area 4. In the long-term, the Project will include the conservation of current known habitat for this species in the Offset areas in perpetuity, the revegetation of cleared lands within other parts of the Offset areas, the progressive rehabilitation of post-mine landforms, the development of a Biodiversity Management Plan and impact mitigation and management measures targeted specifically at the conservation of this species.

On the basis of the above it is concluded that the Project is likely to result in the short-term loss of some of the individuals within the study area, but is not likely to result in a long-term decrease in the overall size of an important population.

Criterion 2: reduce the area of occupancy of an important population
The Project would result in the removal of a small area (17 ha) of core habitat and another 102 ha of patchy/marginal habitat. The area of occupancy for this species would therefore be affected to some degree, at least in the short-term. However, larger areas of suitable habitat occur outside of the Project area, including within the proposed Offset areas (85 ha of core habitat and 227 ha of patchy habitat). In the long-term, the Project will include the conservation of current known habitat for this species in the Offset areas in perpetuity, the revegetation of cleared lands within other parts of the Offset areas, the progressive rehabilitation of post-mine landforms, the development of a Biodiversity Management Plan and impact mitigation and management measures targeted specifically at the conservation of this species.

Criterion 3: fragment an existing important population into two or more populations;
The Project is unlikely to create any additional barriers to migration for any local populations, as it removes habitat at the edge of an existing area of suitable habitat. The New Holland Mouse seems to occur patchily and may consist of many small populations throughout the Gloucester Valley. The Project is unlikely to fragment any populations into two or more populations.

Criterion 4: adversely affect habitat critical to the survival of a species
No critical habitat has been identified for this species. The small area of potential habitat that would be cleared as part of the Project is unlikely to be critical to the survival of the species given the areas where most individuals were recorded will remain largely unaffected by the Project (i.e. east of the Avon North Open Cut and within Offset area 4). The Offset areas are likely to conserve habitat for the species.

Criterion 5: disrupt the breeding cycle of a population;
The removal of a relatively small area of potential habitat from the edge of known habitat is unlikely to disrupt the breeding cycle of the population, given that the species occurs in a number of locations outside of the Project area that will not be affected by the Project.

Criterion 6: modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
The removal of a relatively small area of potential habitat is unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, especially considering the areas of known and potential habitat which exist in the proposed Offset areas. The species has been known to utilise areas of regeneration and it is possible that the revegetation programmes may be of benefit to this species in the future (up to 435 ha of cleared land would be revegetated).

Criterion 7: result in invasive species that that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
Predation by introduced predators, including the Red Fox (*Vulpes vulpes*), Cat (*Felis catus*) and Dog (*Canis familiaris*) is a threat to the New Holland Mouse (Smith and Quin, 1996) and competition from introduced rodents, such as the house mouse is a potential threat (Fox and Gullick, 1989). It is unlikely that there would be an increase in cats, foxes or house mice as a result of the Project. Nonetheless, a feral animal control programme would be implemented as part of the Project.

The occurrence of the New Holland Mouse appears to be related to a high proportion of native plants and low weed density. A weed management strategy would be included as part of the proposed management of the Offset areas.

Criterion 8: introduce disease that may cause species to decline; or
A disease affecting the mice themselves is not listed as a threat to this species. However, the indirect effect of dieback caused by *Phytophtora cinnamomi* is listed as a threat. The Project is not a new development and hence the introduction of the disease to the area is unlikely. Revegetation works and management would include the implementation of guidelines for *Phytophtora cinnamomi*.

The Project is therefore considered unlikely to introduce a disease that may cause this species to decline.

Criterion 9: interfere substantially with the recovery of the species
No recovery plan has been prepared for the New Holland Mouse. It is unlikely that the removal of the small area of potential habitat and loss of individuals would substantially interfere with the recovery of this species given the availability of known and potential suitable habitat outside the Project area and the establishment of Offset areas which are likely to benefit the conservation and recovery of the species. Further, revegetation of cleared land within the Offset areas (up to 435 ha) may benefit the species, given that the species is known to utilise regenerating habitats. Mitigation would be implemented including pre-clearance trapping surveys.

Conclusions

On the basis of the above, it is considered unlikely that the Project would significantly impact upon the New Holland Mouse given that:

- the Project would remove only a small area of potential habitat (17 ha of core habitat and 102 ha of patchy/marginal habitat), relative to the availability of known or potential suitable habitat in the Offset areas (85 ha of core habitat and 227 ha of patchy/marginal habitat);
- the locations in which most records for the species were obtained are outside the Project area, including several within the Offset area;
- the Project will include the conservation of current known habitat for this species in the Offset areas in perpetuity, the revegetation of cleared lands within other parts of the Offset areas, the progressive rehabilitation of post-mine landforms, the development of a Biodiversity Management Plan and impact mitigation and management measures targeted specifically at the conservation of this species.

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Appendix E: Listed migratory species

Species listed as Migratory under the EPBC Act predicted to have potential to occur within the locality.

Common Name	Scientific Name	Status within Stratford Mining Complex	Distribution and Breeding Biology	Significant Impact Criteria			
				Substantially modify, destroy or isolate an area of important habitat?	Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat?	Seriously disrupt the lifecycle of an ecologically significant proportion of the population?	Conclusion
Fork-tailed Swift	*Apus pacificus*	Recorded	Widespread migrant to Australia (Oct–Mar). Breeds in Asia. Aerial species, travelling large distances and not reliant on specific terrestrial habitats.	a) Only small, widely dispersed numbers potentially in the locality, so not a significant proportion of the national population. b) No breeding occurs in the study area, so habitat not important for a significant proportion of the national population. c) Widely distributed species, not at the limits of their ranges. d) Species are not listed as threatened and therefore are not considered to be in decline.	The Project would not result in any invasive species becoming established in the area. No 'important habitat' for the listed migratory species under consideration exists in the locality.	The study area does not support important breeding or feeding habitat, and will not disrupt the migration or resting behaviour of any migratory species. Therefore, the Project will not disrupt the lifecycle of an ecologically significant proportion of a population of any migratory species under consideration.	No significant impact is expected from the Project
Rainbow Bee-eater	*Merops ornatus*	Recorded	Widespread over most of Australia. Breeds in excavated burrows in sandy banks.				
White-throated Needletail	*Hirundapus caudacutus*	Predicted	Widespread migrant to eastern and northern Australia (Oct–Mar). Breeds in Asia. Aerial species, travelling large distances and not reliant on specific terrestrial habitats.				
Great Egret	*Ardea alba*	Recorded	Widespread throughout Australia. Breeding occurs in colonies.	a) Only small, widely dispersed numbers potentially in the locality, not a significant proportion of the population. b) No colonial breeding sites in the locality suitable for these species, so habitat not important for a significant proportion of the national population. c) Widely distributed species, not at the limit of their ranges.	The Project would not result in an invasive species becoming established in the area. No 'important habitat' for the listed migratory species under consideration exists in the locality.	The study area does not support important breeding or feeding habitat, and will not disrupt the migration or resting behaviour of any migratory species. Therefore, the proposal will not disrupt the lifecycle of an ecologically significant proportion of a population of any migratory species under consideration.	No significant impact is expected from the Project
Cattle Egret	*Ardea ibis*	Recorded	Widespread throughout Australia. Breeding occurs in colonies.				

Common Name	Scientific Name	Status within Stratford Mining Complex	Distribution and Breeding Biology	Significant Impact Criteria			
				Substantially modify, destroy or isolate an area of important habitat?	Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat?	Seriously disrupt the lifecycle of an ecologically significant proportion of the population?	Conclusion
				d) Species are not listed as threatened, therefore are not considered to be in decline.			
Satin Flycatcher	*Myiagra cyanoleuca*	Recorded	Widespread in eastern Australia. Breeding occurs throughout eastern Australia (Sep–Mar) followed by northward migration.	a) Only small, widely dispersed numbers potentially in the area, not a significant proportion of the population. b) Breeding may occur in the study area but very rarely, so habitat not important for a significant proportion of the national population. c) Widely distributed species, not at the limits of their ranges. d) Species are not listed as threatened, therefore not considered to be in decline.	The proposal will not result in an invasive species becoming established in the area. No 'important habitat' for the listed migratory species under consideration exists in the locality.	The study area does not support important breeding or feeding habitat, and will not disrupt the migration or resting behaviour of any migratory species. Therefore, the Project will not disrupt the lifecycle of an ecologically significant proportion of a population of any migratory species under consideration.	No significant impact expected from the Project.
Rufous Fantail	*Rhipidura rufifrons*	Recorded	Widespread in eastern and northern Australia. Breeding occurs in South (Oct–Feb) then migrates North.				
Black-faced Monarch	*Monarcha melanopsis*	Recorded	Widespread in eastern Australia. Breeding occurs throughout eastern Australia.				
Spectacled Monarch	*Monarcha trivirgatus*	Recorded	Widespread in eastern and northern Australia. Resident in Queensland, summer breeding migrant in the south.				
Double-banded Plover	*Charadrius bicinctus*	Recorded	Non-breeding winter migrant to south eastern Australia. Habitat includes beaches, mudflats, river banks, fields.	a) Only small, widely dispersed numbers potentially in the locality, so not a significant proportion of the national population. b) No breeding occurs in the study area, so habitat not important for a significant proportion of the national population. c) Widely distributed species, not at the limits of their ranges. d) The habitat to be removed is not the preferred breeding or feeding habitat and will	The Project would not result in any invasive species becoming established in the area. No 'important habitat' for the listed migratory species under consideration exists in the locality.	The study area does not support important breeding or feeding habitat, and will not disrupt the migration or resting behaviour of any migratory species. Therefore, the Project will not disrupt the lifecycle of an ecologically significant proportion of a population of any migratory species under consideration.	No significant impact is expected from the Project
Latham's Snipe	*Gallinago hardwickii*	Recorded	Non-breeding migrant to south eastern Australia. Habitat includes wetlands with dense ground cover.				
Swift Parrot	*Lathamus discolor*	Predicted	Non-breeding migrant to south-eastern Australia.				

Common Name	Scientific Name	Status within Stratford Mining Complex	Distribution and Breeding Biology	Significant Impact Criteria			
				Substantially modify, destroy or isolate an area of important habitat?	Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat?	Seriously disrupt the lifecycle of an ecologically significant proportion of the population?	Conclusion
				therefore not increase the decline of this species.			
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Recorded	Widespread throughout Australia, in close proximity to waterways.	a) Only small, widely dispersed numbers potentially in the locality, so not a significant proportion of the national population. b) Breeding could occur in the locality but the habitats to be disturbed are unlikely to be important for breeding purposes. c) Widely distributed species, not at the limits of its range. d) Habitat that would be removed is not in an area where the species is decline.	The Project would not result in any invasive species becoming established in the area. No 'important habitat' for the listed migratory species under consideration exists in the locality.	The study area does not support important breeding or feeding habitat, and will not disrupt the migration or resting behaviour of any migratory species. Therefore, the Project will not disrupt the lifecycle of an ecologically significant proportion of a population of any migratory species under consideration.	No significant impact is expected from the Project
Regent Honeyeater	*Anthochaera phrygia*	Predicted	Occurs throughout south-eastern Australia. Only two known key breeding areas in NSW, in the Capertee Valley and the Bundarra-Barraba region. These breeding areas are not near the study area. The species has not been recorded within the locality.	a) Only small, widely dispersed numbers potentially in the area, not a significant proportion of the national population. b) No breeding occurs in the study area, so habitat not important for significant proportion of population. c) Species occurs north and south of the study area, so not at the limit of its range. d) Has declined across most of NSW. The habitat to be removed is not the preferred breeding or feeding habitat and will therefore not increase the decline of this species.	The Project would not result in an invasive species becoming established in the locality. No 'important habitat' for the listed migratory species under consideration exists in the study area.	The study area does not support important breeding or feeding habitat, and will not disrupt the migration or resting behaviour of any migratory species. Therefore, the proposal will not disrupt the lifecycle of an ecologically significant proportion of a population of any migratory species under consideration.	No significant impact expected from the Project.

Common Name	Scientific Name	Status within Stratford Mining Complex	Distribution and Breeding Biology	Significant Impact Criteria			
				Substantially modify, destroy or isolate an area of important habitat?	Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat?	Seriously disrupt the lifecycle of an ecologically significant proportion of the population?	Conclusion
Painted Snipe	*Rostratula benghalensis s. lat.*	Predicted	Scattered distribution in Australia. Habitat includes freshwater wetlands. Movements poorly known, possibly in response to flooding events.	a) Only small, widely dispersed numbers potentially in the locality, so not a significant proportion of the national population. b) Breeding could occur in the locality but the habitats to be disturbed are unlikely to be important for breeding purposes. c) Widely distributed species, not at the limits of its range. d) The habitat to be removed is not the preferred breeding or feeding habitat and will therefore not increase the decline of this species.	The Project would not result in any invasive species becoming established in the area. No 'important habitat' for the listed migratory species under consideration exists in the locality.	The study area does not support important breeding or feeding habitat, and will not disrupt the migration or resting behaviour of any migratory species. Therefore, the Project will not disrupt the lifecycle of an ecologically significant proportion of a population of any migratory species under consideration.	No significant impact is expected from the Project
Clamorous Reed-Warbler	*Acrocephalus stentoreus*	Predicted	Widespread throughout northern, eastern and western Australia. Habitat includes freshwater wetlands or other vegetation near water. Spring/summer breeding migrant to the south,				

Note: This table summarises the impact assessment for migratory species listed under the EPBC Act that were recorded or predicted to potentially occur in the study area. The impact assessment follows the 'significant impact criteria' as outlined in the EPBC Act Policy Statement 1.1, *Significant Impact Guidelines* (DEH 2006).