Roads & Maritime Services

Great Western Highway (Forty Bends Upgrade)

Purple Copper Butterfly Management Plan

November 2013

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Appendix A – Purple Copper Butterfly Survey Form

1. Introduction

1.1 Introduction

This Purple Copper Butterfly Management Plan has been prepared to ensure that appropriate environmental protection and impact minimisation techniques are implemented during and following construction for the safety upgrade of the Great Western Highway at Forty Bends. Roads and Maritime Services (Roads and Maritime) is the proponent and determining authority for the proposed development. The upgrade of the Great Western Highway at Forty Bends was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC, now the Department of the Environment - DotE) and was determined to be a controlled action on 21 May 2013 (EPBC Ref: 2013/6804) and the project would be assessed by preliminary documentation. In particular, DotE requested more detail on avoidance and mitigation measures for the Purple Copper Butterfly. This management plan has been prepared to address this request.

1.2 Project background

The Great Western Highway is the principal road transport link connecting the central west region of NSW, the Blue Mountains and Sydney. The highway is an important freight transport corridor and is also used by thousands of road users per day travelling between Sydney and the towns and villages along its length. The highway provides a vital connection to many popular tourist destinations within the region and the Central West, including towns such as Oberon, Mudgee, Orange and Bathurst (SKM & PB 2012).

Roads and Maritime proposes to upgrade the Great Western Highway at Forty Bends between stn 30.74 and stn 33.12 west of Katoomba (the proposal). The proposal forms part of a series of ongoing upgrades of the Great Western Highway. This proposal is part of a commitment by the NSW and Australian Government to improve road safety and accessibility to communities in the Blue Mountains and the central west region of NSW (SKM & PB 2012).

One of the main safety issues associated with this section of the Great Western Highway is the number of motor vehicle accidents. Black ice formation has also been identified as a hazard and linked with vehicle accidents, along the highway at Forty Bends. The proposal would improve safety and travel efficiency within the Forty Bends area by providing an improved alignment and grade in addition to providing measures that would assist with preventing the formation of black ice, such as locating the upgrade along the south of the existing boundary, away from Hassans Walls. This is consistent with the NSW and Australian Governments' strategic priorities of improving the Great Western Highway's safety performance and efficiency, and would help meet ongoing and future road network needs. The existing alignment also has a limited number of opportunities for passing which would be improved by the proposed action (SKM & PB 2012).

1.3 The proposal

Roads and Maritime proposes to upgrade and widen about 2.4 kilometres of the Great Western Highway at Forty Bends to three lanes with a central median along the majority of its length. The proposed action extends from a point about 470 metres east of the eastern end of Forty Bends Road to a point about 20 metres east of McKanes Falls Road (the proposed action). An overview of the proposed action is shown in Figure 1.

The proposed action would relocate the road alignment to the south away from the Hassans Walls escarpment to reduce the formation of black ice, and consist of generally three lanes with eastbound and westbound carriageways separated by a combination of grassed and paved

medians with wire rope barriers. The proposed action would also include a five span bridge about 150 metres in length crossing Whites Creek. Other key features are upgrades to local roads and intersections and existing accesses to properties, construction of two u-turn facilities, three new retaining walls and temporary and permanent construction basins (SKM & PB 2012).

1.4 Previous studies

A number of previous studies have been conducted for the project. These include:

- Biodiversity Technical Paper (SKM & PB 2012) that was prepared to accompany the review of environmental factors (REF) for the project.
- Survey report for the Purple Copper Butterfly (MESS 2012) that was prepared as part of the Biodiversity Technical Paper.
- Referral of the project (2013).

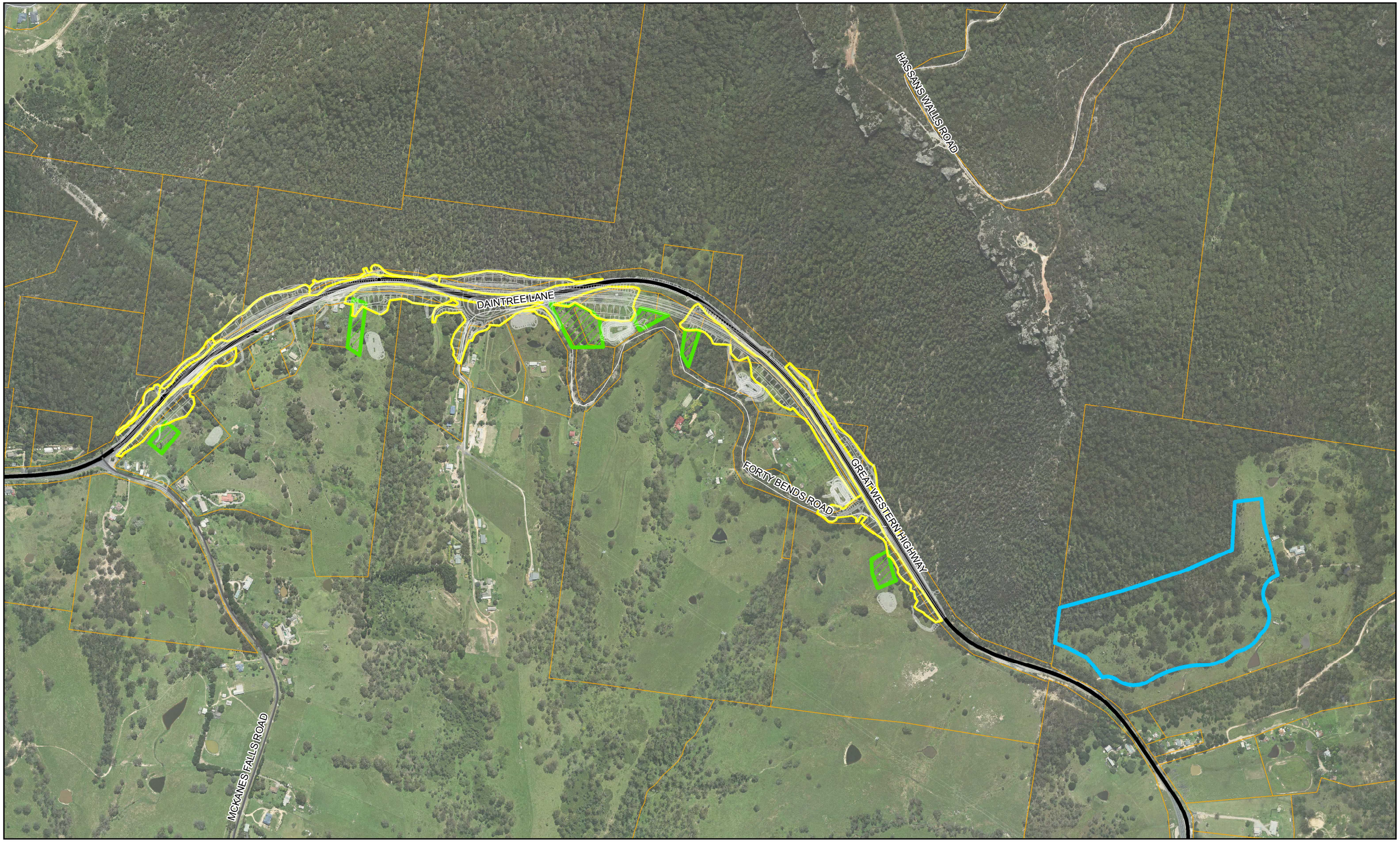
1.5 Purpose of this report

This Purple Copper Butterfly Management Plan has been prepared to provide a clear, concise and practical framework for the management of the species and its habitats near the proposal footprint, as well as for the pre-construction, construction and post-construction activities in the proposal footprint. It has been peer-reviewed by Ray Mjadwesch, a member of the Purple Copper Butterfly Recovery Team.

The objectives of the management plan are to provide procedures for:

- Managing and monitoring Purple Copper Butterfly populations near the proposal footprint during and post construction.
- Preventing unnecessary damage to habitat to be retained.
- Improving connectivity of habitat to be retained.

Throughout this report the following definitions are used: the ‘proposal footprint’ refers to the road infrastructure, including any drainage structures and ancillary sites and the ‘study area’ refers to the general location around the proposal footprint and includes any adjacent areas of land that may be potentially directly or indirectly impacted by the proposal construction and operation.



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0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Proposal
- Compound Site and Stockpile Locations
- Proposed Offset Site
- Property Boundaries
- Proposal Clearing
- Highways
- Major Roads
- Secondary Roads

Roads and Maritime Services
Mount Victoria to Lithgow:
Great Western Highway Forty Bends Road upgrade
Purple Copper Butterfly Assessment

Job Number	21-22704
Revision	A
Date	01 Nov 2013

Site Location and Layout

Figure 1

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Data Source: SKM and RMS All Boundaries, Proposal Site, Design July 2013; LPMA Roads March 2012 Created by: qjchung

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2. Purple Copper Butterfly

This chapter describes the biology and ecology of the Purple Copper Butterfly and its habitat and occurrence in the study area.

2.1 Biology and ecology

2.1.1 Conservation status

The Purple Copper Butterfly (*Paralucia spinifera*) is listed as a vulnerable species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is also listed as endangered under the NSW *Threatened Species Conservation Act 1995* (TSC Act). The Purple Copper Butterfly is shown in photographs 1 and 2 below.

Photograph 1 Purple Copper Butterfly (photograph courtesy of R. Mjadwesch)

Photograph 2: Purple Copper Butterfly (photograph courtesy of R. Mjadwesch)

2.1.2 Distribution

The Purple Copper Butterfly is found in an area of the Central Tablelands between Oberon, Hartley and Bathurst. It is restricted to sites above 900 metres above sea level (DSEWPAC 2013; NPWS 2001). Details of specific habitat requirements within this area are provided below.

2.1.3 Habitat requirements

The Purple Copper Butterfly is only known to occur in areas above 900 metres above sea level and where native *Bursaria spinosa* subsp. *lasiophylla* (Blackthorn) occurs. The vegetation structure at occupied sites is typically open woodland, with tall shrubs and tussock grasses. There is usually a ground cover of mixed low grasses and herbaceous species. The Purple Copper Butterfly has a mutualistic relationship with the ant, *Anonychomyrma itinerans*. *A. itinerans* has a wider distribution than the butterfly but is also only found above 900 metres above sea level. The Purple Copper Butterfly is usually found in discrete patches within larger areas of potential habitat (DSEWPAC 2013; NPWS 2001).

The relationships between the butterfly, ant and host plant are not completely understood, but it is thought to be highly significant. Even though it is sometimes difficult to detect, *A. itinerans* has been recorded at all of the Purple Copper Butterfly locations. Similarly, *Bursaria spinosa* subsp. *lasiophylla* is present at all known locations of the Purple Copper Butterfly (DSEWPAC 2013; NPWS 2001).

Most occupied sites are exposed to full sun for a large portion of the day. The majority of sites have a westerly to northerly aspect. Sites located on south-facing slopes are generally high

enough and flat enough to ensure that they also receive full sun. A common factor between many of sites is high levels of disturbance such as mining, roadways, electricity easements and frequent fire (DSEWPAC 2013; NPWS 2001). Examples of Bathurst Copper Butterfly habitat are provided in Photographs 3 and 4 below.

Photograph 3: Occupied habitat area east of the study area (photograph courtesy of R. Mjadwesch)

Photograph 4: Occupied habitat area at Bowenfels, north-west of the study area

2.1.4 Life cycle

After mating, females deposit between one to five eggs on leaves or debris towards the base of the host plant, *Bursaria spinosa* subsp. *lasiophylla* during spring. These take around 14–17 days to hatch. On hatching, larvae are attended by the ant species, *Anonychomyrma itinerans*. Larvae are active during the day until the fourth instar at which point both the larvae and the ant become nocturnal. The larvae graze on the host plant and since they will not traverse open ground, closely spaced plants with intertwining branches offer the best habitat for larvae (DSEWPAC 2013; NPWS 2001).

Pupation occurs from late December to late February and takes place in the ant's nest at the base of the host plant, where the pupae remain until the following spring (NPWS 2001).

The butterfly emerges from pupation from early August and is on the wing until at least early November. Although the timing of activity varies across the species range there appears to be a peak of activity for a couple of weeks in September for most sites (NPWS 2001).

Adult butterflies fly between August and November depending on the elevation and aspect of the site. The males fly rapidly at about 1 m from the ground and rest with wings parted in sites exposed to full sun. The females fly less rapidly and tend to remain nearer to the host plant. The Purple Copper Butterfly generally remains in the vicinity of the plant and are rarely observed more than 10 metres distant from the habitat (DSEWPAC 2013; NPWS 2001).

2.1.5 Population biology

The Purple Copper Butterfly occurs as a metapopulation in the Lithgow Valley area, that is, the species exists as a ‘population of populations’ where numerous small areas of habitat are occupied, and where a natural pattern of extinctions and colonisation of habitat occur (NPWS 2001). It is also likely, however, that continued fragmentation of habitat exacerbates declines in populations and resultant local extinctions. Recolonisation becomes increasingly difficult as areas of habitat become smaller and more disjunct. For many sites the fragmentation of habitat has occurred to such an extent that each sub-population may be considered closed (NPWS

2001). Genetic analysis found that populations are not genetically distinct, however, with high levels of heterozygosity within populations. This suggests populations sampled were recently 'connected', behaving as a single large, randomly mating population with significant gene flow among individual sites (Clarke and Grosse 2003).

2.2 The Purple Copper Butterfly in the study area

2.2.1 Field surveys

Various field surveys have been conducted for the project. These are summarised below.

Field surveys of the proposal corridor were conducted by SKM in April, May and August 2011. A preliminary survey of the preferred route corridor was conducted by SKM and Roads and Maritime over five days in October and November 2011. The aim of this survey was to identify target areas for survey, characterised by presence of the threatened butterfly's host plant *Bursaria spinosa lasiophylla* (SKM & PB 2012).

Targeted surveys for the Purple Copper Butterfly were then undertaken by Mjadwesch Environmental Service Support based on the habitat assessments undertaken by SKM (MESS 2012). The surveys were conducted during suitable weather conditions on the 21 September 2011 and 19 October 2011 by Ray Mjadwesch (Director, Mjadwesch Environmental Service Support), Andrew Carty (Senior Botanist, SKM) and Josie Stokes (Senior Biodiversity specialist, Roads and Maritime) (SKM & PB 2012). Surveys were undertaken under optimal "flying" conditions (sunny and warm, low wind, between 10:00am and 4:00pm) on these days. The following methods were employed for these surveys:

- Spot check at reference sites (Vickers Street &/or Bowenfels) to confirm that butterflies were active and flying on the day of the assessment
- Inspection of Blackthorn patches on foot. Many of the better (higher potential) habitat units were waypointed with a GPS (all waypoint units and map grids are Geodetic Datum of Australia) and photographed
- Walk through habitat to cause butterflies to take flight if present
- Periods of stationary / wide observation within each habitat unit
- Recording presence / absence and distribution of butterflies
- Searches for signs of caterpillars, including early instar and other grazing, and presence of the attendant ant *Anonychomyrma itinerans.*

A site visit was conducted in July 2013 for the preparation of this management plan by Ben Harrington (Senior Ecologist, GHD) and Ray Mjadwesch. Areas of known, high potential and potential habitat were inspected to gain an understanding of habitat categories.

Pre-clearing surveys were undertaken in areas of mapped potential habitat September 2013 (ie within the flying season of the butterfly) along the proposal footprint. These surveys were undertaken by Ray Mjadwesch and Josie Stokes in order to assess whether any butterflies were now occupying areas of potential habitat that was identified in the biodiversity technical paper.

2.2.2 Habitat within the study area

The Purple Copper Butterfly was recorded at three sites within the study area during the 2011 surveys (MESS 2012; SKM & PB 2012), none of which occurred within the proposal footprint. These occur near chainages 31000 and 32350 (see Figure 2).

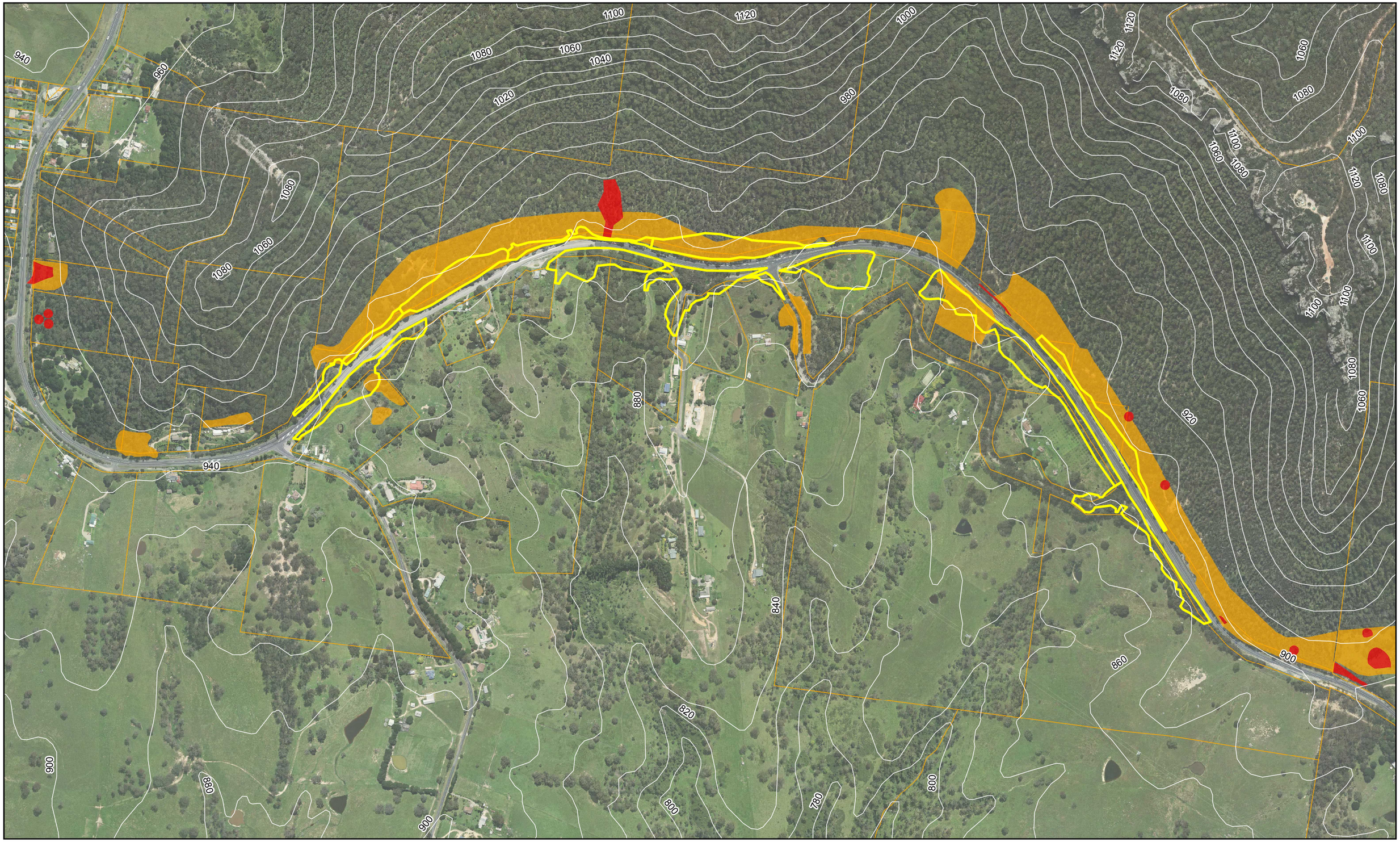
The location of Purple Copper Butterflies and potential habitat in the study area were identified in the biodiversity assessment and during recent surveys and the following categories have been defined (see Figure 2):

- Occupied Habitat: Areas of habitat where the Purple Copper Butterfly was confirmed to be present.
- Potential Habitat: Areas of habitat which support highly suitable habitat attributes for the Purple Copper Butterfly such as a sunny, warm aspect at altitudes above 900 metres where *Bursaria spinosa* subsp. *lasiophylla* is present and the attendant ant species was observed. This habitat type was mapped as 'High Potential Habitat' in the Biodiversity Technical Paper (SKM & PB 2012).

Areas of *Bursaria spinosa* subsp. *lasiophylla* below 900 metres is not included in mapping of potential habitat in this report. These areas were included as 'Potential Habitat' in the Biodiversity Technical Paper (SKM & PB 2012), along with some areas lacking *Bursaria spinosa* subsp. *lasiophylla*. As these are not potential habitat for the species, these areas are no longer being considered in this report.

An additional area of potential habitat was identified during the site visit in July 2013. This is located outside the proposal footprint on the northern side of the highway near Forty Bends Road. Butterflies were observed at this location during pre-clearing surveys undertaken in the flying season in September and October 2013,

No Purple Copper Butterflies were observed in any areas of potential habitat within the proposal footprint during pre-clearing surveys conducted in September 2013. The species was observed, however, at nearby reference sites and occupied habitat outside the proposal footprint, demonstrating that adults were flying during the time of the survey and would have been visible in the proposal footprint if present.



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0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

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LEGEND

- Contour (20m)
- Proposal Clearing
- Occupied Habitat
- Potential Habitat
- Property Boundaries

Roads and Maritime Services
Mount Victoria to Lithgow:
Great Western Highway Forty Bends Road upgrade
Purple Copper Butterfly Assessment

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Revision	A
Date	01 Nov 2013

Purple Copper Butterfly Habitat

Figure 2

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Data Source: SKM and RMS All Boundaries, Proposal Site, Design July 2013; LPMA Roads March 2012 Created by: qjchung

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3. Potential Impacts

This chapter provides a discussion of the key threats to the Purple Copper Butterfly and the potential for direct and indirect impacts of the proposal on the Purple Copper Butterfly and its habitat.

3.1 Habitat loss

Over the last one hundred and fifty years the native vegetation of the Central Tablelands has been extensively cleared for sheep and cattle grazing and more recently for the cultivation of Radiata Pine (*Pinus radiata*). Remnant native vegetation is generally restricted to road verges, Crown lands, and small areas under private ownership. The remnant habitat available to the Purple Copper Butterfly exists as a series of disjunct and often quite small sites (<0.5ha). The continued clearing and disturbance of remnant vegetation are the most serious threats to the Purple Copper Butterfly (NPWS 2001).

3.1.1 Impact of the proposed upgrade

The impact of this habitat loss was assessed within the biodiversity technical paper (SKM & PB 2012). The upgrade was designed to avoid occupied areas and minimise disturbance of potential habitat. Based on the concept design, potential impacts to habitat comprised of:

- 0 hectares of Occupied Habitat
- 2.01 hectares of High Potential Habitat
- 4.62 hectares of Potential Habitat.

The proposal has been designed to avoid areas of occupied habitat and minimise impacts to areas of potential habitat. Retaining these areas of potential habitat where possible will reduce the capacity for lost habitat to limit the species potential to disperse or colonise un-utilised habitats. The footprint of the proposed works has therefore been minimised wherever possible in the final design (SKM & PB 2012). Following further changes to the proposal footprint in detail design, the impact has been reduced to 3.83 hectares of potential habitat as determined in the recent targeted surveys and habitat assessment (see below).

Supplementary Purple Copper Butterfly surveys and habitat assessments have been undertaken during the species' flying period in September and October 2013. This has informed more accurate mapping of habitat in the Purple Copper Butterfly Proposal study area. Purple Copper Butterfly habitat is now mapped and assessed in terms of 'occupied' and 'potential' habitat (MESS, 2013) and the majority of the low potential habitat included in the impact calculations presented in SKM & PB (2012) is no longer considered habitat for the species based on marginal elevation, infrequent or senescent Native Blackthorn and/or unfavourable, shady aspect (Mjadwesch, R., MESS, pers. comm.). These areas are unlikely to be occupied in the future because the overriding aspect and elevation constraints would mean that any changes to vegetation structure (eg. as a result of fire) would not improve the exposure to sun (Mjadwesch, R., MESS, pers. comm.). The land slopes upwards from the south, with higher elevations and favourable conditions for the Purple Copper Butterfly on the north side of the highway and lower elevations that are less likely to be suitable habitat on the south side. The areas that were discounted are on the southern side of the Great Western Highway or adjoin disturbed cleared land and would have little value linking areas of occupied habitat.

Blackthorn plants which will be removed by the proposal are considered to be of moderate importance locally, and could potentially support populations under changed or more optimal habitat conditions (for example after a fire) (SKM & PB 2012). Fire has been found to increase

the quality of existing *Bursaria spinosa* habitat and the overall population of a related species in Eltham, Victoria (New et al 2000). In addition, planting of Bursaria adjacent to a site impacted by road works at Lidsdale allowed for successful translocation of Bathurst Copper Butterflies (Mjadwesch and Nally 2008).

An offset strategy has been prepared to address unavoidable residual impacts on potential habitat in the proposal footprint. This has been prepared in accordance with the EPBC Act Offsets Policy and calculator (DSEWPAC 2012) and will conserve areas of occupied and potential habitat in the vicinity of the proposal in perpetuity. Potential offset sites are being investigated immediately adjacent to the proposal, as well as elsewhere in the locality.

3.2 Habitat fragmentation

The widespread clearing of native vegetation has not only reduced the amount of *Bursaria spinosa* subsp. *lasiophylla* available for the butterfly, but also fragmented the habitat into isolated remnants. The isolation of the remaining sites is a significant threat to the Purple Copper Butterfly. The smaller a population, the more vulnerable it is to the various threats that operate against it. The dispersal ability of the Purple Copper Butterfly is limited by its small size, its flight behaviour and the proximity of potential habitat. For the majority of known habitat, movement between sites or colonisation of potential habitat by natural dispersal is limited by the large distances involved. Several sites are located close enough for inter-site movement to be feasible. This movement is likely to be assisted by the creation of habitat corridors that link sites (NPWS 2001).

3.2.1 Impact of the proposed upgrade

Purple Copper Butterfly habitats in the locality would be further fragmented by the proposed upgrade, because it would create a wider barrier between areas of potential habitat on either side of the Great Western Highway (SKM & PB 2012), although the species has only been recorded along the northern side of the highway to date. In addition, the upgrade would increase fragmentation between areas of potential habitat along the northern side of the highway by removing potential habitat. Management actions are proposed in section 5 to minimise the impact of this fragmentation.

3.3 Weeds

Weed invasion has been identified as a threat to the Purple Copper Butterfly at ten of the twenty-nine known occupied sites. Weeds, including Broome (*Cytisus scoparius*) and Blackberry (*Rubus fruticosus*), compete with the host Blackthorn and at some sites threaten to exclude the butterfly. Radiata Pine (*Pinus radiata*) wildings are also a problem at some sites where they threaten to shade out the habitat. Other lesser weeds include Hawthorn (*Crataegus* spp), Sweet Briar (*Rosa rubiginosa*) and Cotoneaster (*Cotoneaster* spp). These weed species not only compete with the host Blackthorn but also the range of shrubs that the butterfly utilises while on the wing (NPWS 2001). Conversely, some weeds may be beneficial, providing a source of nectar. The Purple Copper Butterfly has been observed flying approximately thirty metres across a sealed roadway to utilise flowers of white clover (*Trifolium repens*), and feeding on Broome flowers (NPWS 2001).

Of the 161 flora species identified in the study area during field surveys for the biodiversity technical paper, 28 were exotic species. Of the weeds recorded, those of particular relevance included Blackberry, Cotoneaster, and Bramble (*Rubus parviflorus*) (SKM & PB 2012). There is an existing edge effect evident along the northern edge of the highway in this section of Forty Bends associated with increased weed abundance (particularly *Vinca major*) and areas of soil disturbance and erosion. The proposed upgrade at Forty Bends would involve widening the road along the proposal length and potentially increasing the extent of the edge effected area

on the northern side (where the majority of the Purple Copper Butterfly habitat is located) (SKM & PB 2012).

3.3.1 Impact of the proposed upgrade

Construction and operation of the road could increase the incidence of weeds in the area. Management actions are described in section 5 to minimise the introduction or spread of weeds in areas of butterfly habitat, and to control existing weeds.

3.4 Loss of the attendant ant

The relationship between the Purple Copper Butterfly and its attendant ant (*Anonychomyrma itinerans*) is little known or understood. Healthy numbers of adult butterflies are generally associated with healthy numbers of this ant, and butterflies will rarely utilise *Bursaria spinosa* subsp. *lasiophylla* where the ant is not present. Changes to soil characteristics such as compaction, erosion or nutrient status can exclude the ant (Dexter & Kitching 1991a, Dexter & Kitching 1991b). The decline of butterfly numbers has also been correlated to disappearance of the attendant ant. It is not known how to create or maintain an environment suitable for the ant so that potential habitat adjacent to known sites becomes utilised. The effects of weed spraying, fire and grazing, on the attendant ant also need to be understood (NPWS 2001).

3.4.1 Impact of the proposed upgrade

Construction and operation of the road could increase the use of weed spray in the area. Management actions are described in section 5 to limit the use of weed spray in areas of butterfly habitat.

3.5 Vehicular access

Recreational use by trail bikes, mountain bikes and four wheel drives is adversely impacting a number of known Purple Copper Butterfly sites. Significant erosion of unformed trails within butterfly habitat is causing damage to host plants as well as associated ant colonies (NPWS 2001). Similarly, unmanaged vehicle access alongside the construction site could cause substantial damage to *Bursaria spinosa* subsp. *lasiophylla* plants and thus Purple Copper Butterfly habitat. Wind from passing vehicles along the highway also has the potential to result in accidental mortality of Purple Copper Butterflies.

3.5.1 Impact of the proposed upgrade

There is the potential for damage to butterfly habitat adjoining the proposal footprint during construction if vehicular access is not controlled. Vehicular access to butterfly habitat during operation of the upgraded highway is likely to be minimal. Management actions are proposed in section 5 to minimise the impact of vehicular access during construction and operation.

Purple Copper Butterflies have been observed being swirled out into the highway by passing trucks at Bowenfels where habitat is located immediately adjacent to the highway. Affected butterflies would be those active at the very edge of habitat areas adjoining the road and would be only a small proportion of the population (R. Mjadwesch, pers. comm. 2013). Given the upgrade of the highway will be located to the south of the existing centreline, away from occupied habitat areas, the proposed action is not likely to increase the incidence of accidental mortality from vehicle-generated wind. No additional mitigation measures are proposed for this potential impact.

3.6 Dust

At two known butterfly sites, dust from road traffic is believed to be affecting the butterfly (NPWS 2001). At these locations, host plants adjacent to the roadway are coated with a thick film coating of dust during the drier spring and summer months when the larvae are active. Despite butterflies being observed on the road verge *Bursaria spinosa* subsp. *lasiophylla*, no grazing is evident, and it is believed that the plants are not being used by the butterfly larvae. The dust film is likely to affect the edibility or at least palatability of the Blackthorn. The distribution of the sites along the road verge and the amount of *Bursaria spinosa* subsp. *lasiophylla* involved make the dust factor at these particular sites a significant management issue (NPWS 2001). This impact persists at one of these sites, however road closure at the other has fixed the issue (R. Mjadwesch, pers. comm. 2013).

3.6.1 Impact of the proposed upgrade

Potential habitat for the butterfly is located along much of the highway, and dust generation during construction is likely to impact this habitat. Dust is also likely to continue to be generated during operation of the highway. Management actions in section 5 are proposed to minimise the generation of dust during construction.

3.7 Fire

There is evidence to suggest that Purple Copper Butterfly habitat is adapted to the occurrence of fire events, and that it may play an important role in habitat maintenance (NPWS 2001). Despite being a spindly shrub, *Bursaria spinosa* subsp. *lasiophylla* foliage is quite flammable and readily ignited and burnt in even a low intensity fire event. While fire will kill the above ground component, the shrub readily resprouts from the base. Not only does fire support the spread of the host *Bursaria spinosa* subsp. *lasiophylla* the fresh growth following a fire event is favoured by the butterfly larvae (NPWS 2001).

The exclusion of fire from Purple Copper Butterfly habitat is considered a threat to the species in the absence of other disturbance regimes that encourage the regeneration of *Bursaria spinosa* subsp. *lasiophylla*. Although the use of fire as a management tool may assist in the management of Purple Copper Butterfly habitat, the timing of the activity is critical to managing rather than damaging habitat (NPWS 2001).

3.7.1 Impact of the proposed upgrade

Construction activities could increase the risk of bushfire in the study area. During construction potential ignition sources may include accidental ignitions (such as cigarettes or campfires, or from discarded glass bottles), hot works such as welding or angle grinders on days of elevated fire danger, sparks generated from plant/ vehicle contact with rock or metal, ignition from the use of explosives, sparks generated from plant/ vehicle contact with rock or metal with grass and fine fuels within the road reserve, and ignition of woodchip heaps. It is possible that the presence of the highway increases incidence of fire due to ignition of vegetation from discarded glass bottles and cigarette butts, and possibly also vehicle accidents and spillage of fuel.

Management actions are proposed in section 5 to prevent accidental ignition of fires in butterfly habitat along the highway as a result of construction activities.

3.8 Firewood collection

The habitat requirements of the Purple Copper Butterfly attendant ant, *Anonychomyrma itinerans*, are not well understood. It may be that dead and fallen timber are an important habitat component for the ant (NPWS 2001).

3.8.1 Impact of the proposed upgrade

The construction and operation of the road is not likely to reduce or increase incidence of fire wood collection in butterfly habitat in the area. Management actions are provided in section 5 to limit disturbance to dead and fallen timber during construction.

3.9 Collection

From its initial description as a new species, Edwards and Common (1978) raised concerns that over-collection of the Purple Copper Butterfly at its type locality may place the species in jeopardy (NPWS 2001).

3.9.1 Impact of the proposed upgrade

The construction and operation of the road could increase incidence of collection of the Purple Copper Butterfly in the area due to maps showing occupied habitat being published following impact assessments. No management actions are proposed for this threatening process.

3.10 Grazing

Grazing, like fire, can operate both as an important tool for reducing the effect of threats at a site or as a significant direct threat to the maintenance of Purple Copper Butterfly habitat (NPWS 2001). Low level grazing can maintain an open sunny site by removing shrubs and reducing regeneration of canopy species. Conversely, grazing at high stocking rates can damage butterfly habitat by removing Blackthorn, and excluding grazing may be harmful to Purple Copper Butterfly habitat particularly in the absence of other mechanisms to control weeds and vegetation that are reducing the availability of habitat (NPWS 2001).

3.10.1 Impact of the proposed upgrade

The construction and operation of the road is not likely to reduce or increase grazing levels in butterfly habitat in the area. No mitigation measures are proposed for this threatening process.

3.11 Feral animals

Feral pigs have been identified as a significant threat to one of only two butterfly sites located within a conservation reserve. Feral goats have also been identified as threats to habitat by grazing the host plant (NPWS 2001).

3.11.1 Impact of the proposed upgrade

The construction and operation of the road is not likely to reduce or increase incidence of feral animals in butterfly habitat in the area. No management actions are proposed for this threatening process.

4. Identification of Mitigation Measures

This chapter details mitigation measures identified in the biodiversity technical paper (SKM & PB 2012), as well as additional measures to avoid direct and indirect impacts.

4.1 Avoidance of habitat

The ability of the proposal to avoid Purple Copper Butterfly habitat is limited by the nature of the proposal (ie, the proposal being a highway upgrade). As noted earlier, the proposal has been designed to avoid areas of occupied habitat and minimise impacts to areas of potential habitat. Retaining these areas of potential habitat where possible will reduce the capacity for lost habitat to limit the species potential to disperse or colonise un-utilised habitats. The footprint of the proposed works has therefore been minimised wherever possible in the final design (SKM & PB 2012).

The site constraints that limited the opportunity to avoid completely or minimise the impact further include:

- The existing dwellings within the project limits.
- The heritage items identified within the study area.
- Maintenance of safe access to the existing properties.
- Presence of Ribbon Gum grassy woodland (an endangered ecological community).

Since exhibition of the REF, the proposed design has undergone a series of refinements in the development of the detail design based on ongoing design and community feedback. These refinements include a reduction in the length of the proposed action from 2.8 kilometres to 2.4 kilometres, a reduction in the overall number of water quality basins and amendments to retaining walls to better suit the geotechnical conditions of the area. The area of native vegetation impacted as a result of the proposal has been reduced from 22.66 hectares to 20.81 hectares, however the impact on moderate to high condition remnant forest vegetation increased from 7.49 hectares to 8.26 hectares. The refinement of the proposal would not impact any additional areas of occupied or potential Purple Copper Butterfly habitat (SKM and PB 2013). Impacts on potential Purple Copper Butterfly habitat were calculated to be 2.01 hectares of high potential impact and 4.62 hectares of potential habitat, with no occupied habitat to be impacted (SKM and PB 2012). The 4.62 hectares of potential habitat included low potential habitat, which has been discounted in recent surveys based on marginal elevation, infrequent or senescent Native Blackthorn and/or unfavourable, shady aspect (Mjadwesch, R., MESS, pers. comm.) (see section 3.1.1 for more detail).

The changes to the concept design have allowed for avoidance of areas of potential Purple Copper Butterfly habitat. Based on these changes and re-examination of potential habitat during recent surveys, the impact area has been reduced to approximately 3.83 hectares in total. The following changes have been made to enable this reduction in impact area:

- Additional clearing of native vegetation was required on the northern side of the highway to minimise the black ice formation. However, the option was not progressed due to the amount of clearing requried. Instead, the design incorporates the realignment of bridge, concrete pavement, a heating system for the bridge deck for limiting the black ice formation.
- The design requires excavation on the northern side at three locations where the majority of the potential Purple Copper Butterfly habitat exists. In order to minimise the

impact from this operation, slope treatment with shotcrete and soil nails was included in the final design. This will substantially reduce the impact on potential habitat.

- The locations of the proposed stockpile and compound sites were reviewed and adjustments made to avoid the impact on potential habitat.

4.2 Mitigation measures identified in the REF

A range of mitigation measures to minimise impacts on the Purple Copper Butterfly were identified in the biodiversity technical paper (SKM & PB 2012). These are summarised below:

- Vegetation clearing and habitat reduction
  - Avoidance of known areas of habitat currently occupied by the Purple Copper Butterfly
  - Designing the road alignment and siting ancillary areas (such as stockpiles and sediment basins) to avoid impacting areas of high quality habitat for the Purple Copper Butterfly
  - Management of weeds including location of weed infested areas, measures to prevent the spread of weeds, and mechanical weed control.
- Pre-clearing surveys
  - Surveys would be conducted for Purple Copper Butterfly by a suitably qualified expert during adult flying and juvenile larval seasons (September and October-November respectively). Pre-clearing surveys have been conducted by R. Mjadwesch in 2013 during the flying season. No areas of occupied habitat have been recorded within the proposal footprint.
  - Protection/management measures would be implemented (such as fencing of identified areas as exclusion zones during construction) should the species be present in or adjacent to the proposed construction site.
- Exclusion fencing
  - Provide input into the location and extent of exclusion zones
  - Ensure that the location of Purple Copper Butterfly habitat is mapped and identified in the CEMP
  - The location and type of exclusion fencing to be installed would be identified on plans in the CEMP and the function and importance of the exclusion zones communicated to construction personnel
  - Basic temporary fencing would be installed to indicate the limits of clearing.
- Wildlife connectivity and habitat restoration
  - Opportunities sought to include vegetation sympathetic to the habitat requirements of the Purple Copper Butterfly by incorporating the larvae-feed species Blackthorn (*Bursaria spinosa* subsp. *lasiophylla*) and creating and maintaining sunny habitats.
  - This section of the Great Western Highway has been identified as being a high risk area for the formation of black ice on the road surface, creating dangerous driving conditions. No trees would be included in the landscaping on the northern side of the proposal to minimise shading which would potentially have a positive impact on the quality of habitat created for Purple Copper Butterfly, as this species prefers an unshaded, sunny aspect.
  - Allocate sufficient time for the collection of local seed and propagation of tube stock to be used in revegetation, in particular local provenance seed of the high-altitude subspecies of Blackthorn (*Bursaria spinosa* subsp. *lasiophylla*) to function as habitat for the Purple Copper Butterfly.

– Inspection, monitoring and maintenance of revegetated areas should be conducted biannually for a minimum of two years following the completion of construction in accordance with the landscape management plan.

These mitigation measures are incorporated into the management actions detailed in section 5.

4.3 Additional mitigation measures

The recovery plan for the Purple Copper Butterfly was reviewed in order to identify additional mitigation measures. Recovery actions (NPWS 2001) are listed in Table 1, along with their relevance to this management plan. These additional mitigation measures are incorporated into the management actions detailed in section 5.

Table 1 Recovery actions and relevance to this management plan

Recovery action	Details	Relevance to this management plan	Previously identified or new action?
10.3.1	Complete assessment of threats operating on freehold land	Not relevant	N/A
10.3.2	Clearing prevention and impact assessment	Undertaken as part of the EIS. Management actions detailed in section 5.2 of this management plan. Residual impacts will be offset.	Previously identified, however more specific detail included.
10.3.3	Manage weeds to prevent impacts on habitat	Management actions detailed in section 5.4 of this management plan.	Previously identified, however more specific detail included.
10.3.4	Create habitat corridors to reduce isolation of sites	Management actions detailed in section 5.3 of this management plan.	Previously identified, however more specific detail included.
10.3.5	Monitor the illegal collection of Purple Copper Butterfly	Not relevant	N/A
10.3.6	Manage vehicular access and recreational vehicle use to prevent impacts on habitat	Management actions detailed in section 5.4.4 of this management plan.	New action.
10.3.7	Management of road surfaces and maintenance activities to prevent impacts on habitat	Management actions detailed in section 5.6 of this management plan.	New action.
10.3.8	Management of fire prevention activities and planning to prevent impacts on habitat	Management actions detailed in section 5 of this management plan.	New action.
10.3.9	Management of grazing activities to prevent impacts on habitat	Not relevant	N/A
10.3.10	Management of impacts associated with feral animals	Not relevant	N/A
10.3.11	Management of dead timber removal / firewood collection to prevent impacts on habitat	Management actions detailed in section 5.7 of this management plan.	New action.

5. Management Actions

This chapter provides detailed information on proposed management actions, including description and objectives, assessment of expected or predicted effectiveness, justification of location and design, thresholds for corrective action and a monitoring program, corrective actions should thresholds be exceeded, and parties responsible for implementation.

All management actions detailed below will be incorporated into the Construction Environmental Management Plan (CEMP) and relevant subplans (e.g. weeds, sediment control, landscaping) for the project.

5.1 Worker induction

5.1.1 Summary

All workers are to be informed of Purple Copper Butterfly habitat requirements and protection arrangements prior to work on site as part of their site induction.

5.1.2 Objective

To ensure all workers are aware of the Purple Copper Butterfly, its habitat, and requirements for protection.

5.1.3 Management actions

Table 2 Management actions for worker inductions

Management action	Timing	Responsibility	Monitoring	Performance Indicators/Thresholds	Corrective Actions	Reporting
Ensure all workers are provided with an environmental induction prior to starting work on site. This would include information on the ecological values of the subject site and study area and protection measures to be implemented to protect Purple Copper Butterfly habitat.	Prior to commencement of work on site	Environment Manager Construction Manager Site Environmental Officers	Monthly checks of records database for compliance in undertaking inductions.	All workers to sign induction form to confirm understanding of Purple Copper Butterfly management actions.	Re-education of contractors following any breaches/damage to habitat	As per CEMP requirements for inductions.
Provide photographs of the Purple Copper Butterfly and caterpillar, attendant ant and Bursaria plants on the environmental noticeboard at the site office and direct staff to familiarise themselves with these prior to commencing work.	Prior to commencement of work on site	Environment Manager Construction Manager Site Environmental Officers	N/A	N/A	N/A	N/A

5.1.4 Effectiveness

Site inductions are used on all Roads and Maritime construction sites to provide staff with information on relevant hazards and environmental no-go areas if relevant. Construction sites often have environmental noticeboards where information on issues of concern can be placed. Where threatened species are an issue, photographs of these are included on the noticeboard to enable staff to familiarise themselves with the species of concern. These measures are effective in making staff aware of biodiversity issues at construction sites.

5.2 Protection from habitat loss

5.2.1 Summary

The continued clearing and disturbance of remnant vegetation are the most serious threats to the Purple Copper Butterfly (NPWS 2001). Loss of habitat has been calculated as part of the EIS. There should be no further loss of habitat as a result of construction activities.

5.2.2 Objective

Prevent any additional clearing of Purple Copper Butterfly habitat beyond that calculated in the EIS, as per Recovery Plan action 10.3.2.

5.2.3 Management actions

Table 3 Management actions to minimise habitat loss

Management action	Timing	Responsibility	Monitoring	Performance Indicators/Thresholds	Corrective Actions	Reporting
Undertake pre-construction surveys to identify any high potential habitat that may have become occupied	Spring 2013/2014	Ecologist	Annual monitoring of Purple Copper Butterflies pre, during and post construction	Continued presence of Purple Copper Butterflies in occupied habitat areas.	Habitat maintenance/ improvement	Annual report following field surveys (to Roads and Maritime, OEH and DotE)
• Purple Copper Butterfly habitat to be cleared is to be accurately mapped by a surveyor and identified in the CEMP • Purple Copper Butterfly habitat to be retained is to be included in sensitive area maps for the project. • Areas of native vegetation to be cleared would be clearly identified with parawebbing or flagging tape to ensure that clearing does not occur beyond the area necessary for the proposal. • The location of exclusion fencing would be identified on plans in the CEMP and the function and importance of the exclusion zones communicated to construction personnel.	Pre-construction	Ecologist Construction Manager	Weekly environmental inspection to incorporate checks of fencing	No increase in area of Purple Copper Butterfly habitat that would be removed	Any additional clearing areas would need to be incorporated into the calculations for the offset strategy	Construction weekly environmental inspection checklist
When felling trees during vegetation clearing, ensure that the potential Purple Copper Butterfly habitat outside the construction foot print is protected and not affected by the fallen trees. Trees should be felled away from	Construction	Ecologist Construction Manager	Ongoing during construction	No increase in area of Purple Copper Butterfly habitat that would be removed	Any additional clearing areas would need to be incorporated into the calculations for the offset strategy	Construction weekly environmental inspection checklist

Management action	Timing	Responsibility	Monitoring	Performance Indicators/Thresholds	Corrective Actions	Reporting
exclusion zones and into the construction footprint.						
Recalculation of areas of Purple Copper Butterfly habitat to be removed to ensure the offset strategy accounts for all cleared habitat.	During- and post-construction	Ecologist	N/A	No increase in area of Purple Copper Butterfly habitat that would be removed	Any additional clearing areas would need to be incorporated into the calculations for the offset strategy	Post-clearing report to go to Roads and Maritime, OEH and DotE
Locating stockpiles of materials or fill in areas that are currently cleared or disturbed. This would reduce the need to clear additional areas of Purple Copper Butterfly habitat.	During construction	Construction Manager	Ongoing during construction	No stockpiles in areas of Purple Copper Butterfly habitat.	Any additional clearing/disturbance areas would need to be incorporated into the calculations for the offset strategy	Construction weekly environmental inspection checklist Roads and Maritime EMS incident report form (if damage occurs)
No slashing of Purple Copper Butterfly habitat along road verges	Post-construction	RMS maintenance manager	Annual monitoring of Purple Copper Butterflies pre-, during and 2 years post-construction, in conjunction with monitoring of revegetated areas	No slashing of Purple Copper Butterfly habitat along road verges	Reconfirm conservation significance and management actions with RMS maintenance manager following any accidental slashing.	Annual report following monitoring surveys (to Roads and Maritime)

5.2.4 Effectiveness

Pre-construction surveys of the study area have been undertaken in the 2013 flying season to ensure no additional areas of occupied Purple Copper Butterfly habitat would be impacted. These have been effective in reassessing occupied and potential habitat for the species, and reducing the area of impact of the proposal.

Mapping of sensitive areas and use of exclusion fencing are standard mitigation measures used for Roads and Maritime road upgrade project CEMPs where biodiversity values would be impacted. Stockpile sites are generally located by Roads and Maritime in areas that are already disturbed, in order to minimise further impacts on biodiversity. These measures would be effective in preventing further impacts on the Purple Copper Butterfly.

Recalculation of impact areas following clearing is often undertaken for large projects where offsets are required. This allows for precise calculations of the exact footprint of the clearing, and thus precise calculations of offset requirements.

Slashing may damage Bursaria plants. Protection of butterfly habitat is a priority recovery action. Effectiveness of this measure would be determined during the annual monitoring of the Purple Copper Butterfly habitat adjacent to the proposal.

5.3 Habitat restoration

5.3.1 Summary

Habitat restoration will be undertaken following construction to establish Blackthorn (*Bursaria spinosa* subsp. *lasiophylla*) in a manner that maximises habitat links between areas of known and potential Purple Copper Butterfly habitat. The timing of seed collection, areas to be planted as linkages, and numbers of tubestock needed to create linkages would be determined in the landscape plan for the project.

5.3.2 Objectives

Improve links between areas of Purple Copper Butterfly habitat along the highway as per Recovery Plan action 10.3.4.

5.3.3 Management actions

Table 4 Management actions for habitat restoration

Management action	Timing	Responsibility	Monitoring	Performance Indicators/Thresholds	Corrective Actions	Reporting
Identify areas for planting linkages, numbers of tubestock required, and planting schedule	Prior to construction	Bush regenerator Bathurst Copper Butterfly specialist	N/A	N/A	N/A	As per landscaping plan
Collection of local Bursaria seed and propagation of tube stock to be used in revegetation.	Prior to and/or during early stages of construction	Bush regenerator Bathurst Copper Butterfly specialist	N/A	Growth of suitable numbers of tubestock (to be determined in landscape plan)	Collection of additional seed and further propagation	Monthly updates to Roads and Maritime on numbers of tubestock being propagated and advice on whether these would be sufficient for planting
Planting of *Bursaria spinosa* subsp. *lasiophylla* along batters and other temporarily disturbed areas.	Post-construction	Bush regenerator Ecologist Bathurst Copper Butterfly specialist	Monthly for the first six months following planting, then quarterly for two years.	Growth of sufficient plants (as determined in landscape plan) to form a corridor between habitat areas Limited mortality of plants (as determined in landscape plan)	Further planting if corridor density not sufficient	Post-planting reports to Roads and Maritime
No planting of trees on the northern side of the highway.	Post-construction	Bush regenerator	N/A	No growth of trees	Removal of tree seedlings	Post-planting report to Roads and Maritime

5.3.4 Effectiveness

Planting of new habitat areas using tubestock Blackthorn (*Bursaria spinosa* subsp. *lasiophylla*) was successfully undertaken at Lidsdale where the road upgrade impacted occupied Purple Copper Butterfly habitat. This included the use of propagated plants from a local nursery within the construction site. Activity of the attendant ant encouraged using a honey and water solution. Plants were left on site until butterflies had laid eggs and larvae had hatched. Once the final footprint of the amended design was determined, the caterpillars and ants were relocated out of the footprint into adjacent habitat areas. A total of 1260 caterpillars were relocated during this process. Blackthorn (*Bursaria spinosa* subsp. *lasiophylla*) plants were then moved from the construction footprint into adjacent areas, and supplementary Bursaria planting undertaken. Movement of plants in pots from the construction site to adjacent areas ensured attendant ants in the soil were also relocated (MESS 2005; Mjadwesch and Nally 2008). Recent surveys at the Lidsdale site have shown that the Purple Copper Butterfly population is still present in the revegetated area, although some follow-up weeding is required (Ray Mjadwesch, pers. comm. 2013). This study shows the effectiveness of creating new habitat areas for the Purple Copper Butterfly.

Shading reduces habitat quality for this species, as the Purple Copper Butterfly prefers sites with an open, sunny aspect (NPWS 2001). Preventing planting of large trees would be effective in preventing shading of areas of occupied or potential habitat for the species.

5.4 Weed management

5.4.1 Summary

Undertake weed control and prevent introduction of weeds into areas of Purple Copper Butterfly habitat. Management actions below are to be incorporated into the weed management sub-plan of the CEMP.

5.4.2 Objectives

Reduce the incidence of weeds and prevent the introduction and spread of weeds in Purple Copper Butterfly habitat areas within the proposal study area, in accordance with Recovery Plan action 10.3.3.

5.4.3 Management actions

Table 5 Management actions for weed management

Management action	Timing	Responsibility	Monitoring	Performance Indicators/Thresholds	Corrective Actions	Reporting
• A site assessment undertaken by an ecologist or person trained in weed identification and management to assess the extent and severity of weed species in the construction footprint. • Mapping of weed infestations within Purple Copper Butterfly habitat areas.	Pre-construction	Bush regenerator	N/A	Identification of weed infestations within Purple Copper Butterfly habitat areas	N/A	Mapping to be included in the CEMP
• Weed control within habitat areas to be removed undertaken by a person trained in weed identification and management.	Pre-construction	Bush regenerator	6-monthly inspections in areas to be retained (see below).	No introduction of weeds into habitat to be retained.	Conduct follow up treatment in areas to be retained where necessary for any new weed or if any major infestations occur on site	Construction weekly environmental inspection checklist
• Weed control within habitat areas to be retained undertaken by a person trained in weed identification and management. • The control programs will use bush regeneration techniques such as cut and paint method where the shrub is cut off close	During construction	Bush regenerator	6 monthly inspections during and for 2 years post-construction	Reduction in weed levels within retained habitat in the study area No new areas of weeds	Conduct follow up treatment where necessary for any new weed or if any major infestations occur on site	Post-weeding reports Roads and Maritime EMS incident report form (if necessary)

Management action	Timing	Responsibility	Monitoring	Performance Indicators/Thresholds	Corrective Actions	Reporting
to the ground and herbicide, generally Roundup, applied to the cut stem. • Hand removal of weeds where it would not cause too much disturbance to adjacent Blackthorn plants or ant colonies. • No use of weed spray in areas of potential butterfly habitat.						
• Removal of weeds off site to an appropriate facility	During construction	Construction Manager	N/A	No weeds dumped in stockpile areas	Weeds to be removed in an appropriate manner off site	Construction weekly environmental inspection checklist
• All vehicles and plant should be washed prior to work on site to prevent the introduction of weeds.	During construction	Construction Manager	As necessary, and during weekly environmental inspection	Clean vehicles and plant only to be used on site	Vehicles or plant to go to the nearest washdown station for cleaning	Construction weekly environmental inspection checklist
• Avoid stockpiling of materials or fill adjacent to native vegetation wherever possible. • Avoid disposal of waste and / or contaminated construction materials (e.g. spoil material) in areas adjacent to native vegetation.	During construction	Construction Manager	Weekly environmental inspection	No entry of fill or waste into adjacent vegetation	Move stockpiles to appropriate areas.	Construction weekly environmental inspection checklist Roads and Maritime EMS incident report form (if necessary)
• Implement soil erosion and sediment control measures. • Undertake maintenance of silt fences and other mitigation measures to isolate runoff and limit the potential for colonisation by weeds.	During construction	Construction Manager	Weekly environmental inspection	No sediment runoff in areas of butterfly habitat	Fix any breaches in sediment fencing immediately. Careful removal of sediment runoff if necessary.	Construction weekly environmental inspection checklist Roads and Maritime EMS incident report form (if necessary)
• Disturbed areas (including decommissioning of access tracks – see below) are to be progressively stabilised to prevent erosion and weed establishment.	During and post-construction	Construction Manager Bush regenerator	Weekly environmental inspection during stabilisation. Quarterly inspections during and for 2 years post-construction	Disturbed areas planted with appropriate groundcovers and *Bursaria* (see section 5.3) No new areas of weeds.	Plant *Bursaria* seedlings. Conduct follow up weed treatment where necessary for any new weed or if any major infestations occur on site	Construction weekly environmental inspection checklist Quarterly reports following post-construction inspections

5.4.4 Effectiveness

Weed management is a standard mitigation measure for Roads and Maritime project CEMPs. Guidance on weed management is provided in Guide 6 within the Roads and Maritime Biodiversity Guidelines for protecting and managing biodiversity on Roads and Maritime projects (RTA 2011). This includes control of weeds already present, as well prevention of spread of weeds and weed propagules through cleaning of vehicles prior to work at a site and installation of erosion and sediment control fences. These measures are effective at reducing impacts from weeds when properly implemented. Management of weeds has successfully increased habitat condition at the Lidsdale site (MESS 2005). Weed control has also been undertaken successfully at various other sites as part of the recovery plan (NPWS 2001).

5.5 Vehicular access

5.5.1 Summary

Unmanaged vehicle access alongside the construction site could cause substantial damage to Bursaria plants and thus Purple Copper Butterfly habitat.

5.5.2 Objectives

Prevent damage to Purple Copper Butterfly habitat to be retained as a result of vehicle movements, in accordance with Recovery Plan action 10.3.6.

5.5.3 Management actions

Table 6 Management actions to prevent damage of habitat by vehicles and access roads

Management action	Timing	Responsibility	Monitoring	Performance Indicators/Thresholds	Corrective Actions	Reporting
• Inform contractors of the sensitivity of Purple Copper Butterfly habitat and the need for its protection.	Pre-construction	Construction Manager Site Environmental Officers	Monthly inspections during construction (in conjunction with inspections of sediment fencing).	No damage to Bursaria plants from vehicles	Re-education of contractors following any breaches/damage to habitat	CEMP reporting requirements for worker inductions
• Prevent unauthorised vehicle access through the installation of gates/barriers and fencing. • Install sensitive environment signs on fencing. • Appropriate drainage of temporary access roads and use of sediment fencing to ensure that runoff does not impact on Purple Copper Butterfly habitat. • Use of exclusion fencing alongside Purple Copper Butterfly habitat.	Pre-construction	Construction Manager Site Environmental Officers	Monthly inspections during construction (in conjunction with inspections of sediment fencing).	No damage to Bursaria plants from vehicles No runoff from access tracks into Purple Copper Butterfly habitat	Placement of additional sensitive area signs Repair of fences Repair of drains Repair of sediment fencing	Construction weekly environmental inspection checklist Roads and Maritime EMS incident report form (if necessary)
Decommissioning of access roads to be undertaken such that there is no damage to Purple Copper Butterfly habitat.	Post-construction	Construction Manager Ecologist	Post-completion inspection	No damage to butterfly habitat	Planting of Bursaria plants in disturbed areas	Final CEMP report

5.5.4 Effectiveness

Site inductions are used on all Roads and Maritime construction sites to provide staff with information on relevant hazards and environmental no-go areas if relevant. Construction sites often have environmental noticeboards where information on issues of concern can be placed. Where threatened species are an issue, photographs of these are included on the noticeboard to enable staff to familiarise themselves with the species of concern. These measures are effective in making staff aware of biodiversity issues at construction sites.

Mapping of sensitive areas and use of exclusion fencing are standard mitigation measures used for Roads and Maritime road upgrade project CEMPs where biodiversity values would be impacted. Detailed mapped of the construction boundary at the Lidsdale site allowed for relocation of Purple Copper Butterfly caterpillars out of the construction site (MESS 2005). Use of exclusion fencing would be effective in preventing impacts on habitat areas to be retained.

Erosion and sedimentation management is a standard mitigation measure for Roads and Maritime project CEMPs. Installation of appropriate sediment control fences would be effective in preventing damage to habitat.

5.6 Dust generation

5.6.1 Summary

Generation of dust, and the resulting settling of dust on nearby *Bursaria* plants, could reduce the quality of available foraging habitat of the Purple Copper Butterfly.

5.6.2 Objectives

Prevent damage to Purple Copper Butterfly habitat from dust, in accordance with Recovery Plan action 10.3.7.

5.6.3 Management actions

Table 7 Management actions to minimise damage to habitat from the generation of dust

Management action	Timing	Responsibility	Monitoring	Performance Indicators	Corrective Actions	Reporting
• Setting maximum speed limits for construction and operational traffic within the proposal area to limit dust generation. • Use of a water tanker or similar to spray unpaved roads during construction where required. • Application of dust suppressants or covers on soil stockpiles. • Immediate removal off site of excavated fill materials not required for backfilling.	Pre-construction During construction	Construction Manager Site Environmental Officers	Weekly environmental inspection	No increase in dust levels in habitat areas to be retained	Use of water tanker to spray habitat areas if there is no rain forecast	Construction weekly environmental inspection checklist Roads and Maritime EMS incident report form (if necessary)

5.6.4 Effectiveness

Dust suppression is a standard mitigation measure for Roads and Maritime project CEMPs. Water tankers are effective at reducing dust levels in areas adjacent to construction sites.

5.7 Disturbance of dead and fallen timber

5.7.1 Summary

Dead and fallen timber may be important components of Purple Copper Butterfly habitat (NPWS 2001).

5.7.2 Objectives

Prevent removal of dead and fallen timber from within retained areas of habitat, in accordance with Recovery Plan action, in accordance with Recovery Plan action 10.3.11.

5.7.3 Management actions

Table 8 Management actions to minimise disturbance of dead and fallen timber

Management action	Timing	Responsibility	Monitoring	Performance Indicators/Thresholds	Corrective Actions	Reporting
• No disturbance of dead and fallen timber within Purple Copper Butterfly habitat • No firewood collection by construction staff • Information to be relayed to construction staff during site induction	During construction	Construction Manager	Weekly inspection	No removal of timber	Re-education of contractors following any breaches/damage to habitat	Roads and Maritime EMS incident report form

5.7.4 Effectiveness

Site inductions are used on all construction sites to provide staff with information on relevant hazards and environmental no-go areas if relevant. Construction sites often have environmental noticeboards where information on issues of concern can be placed. These would include information on Purple Copper Butterfly habitat and protection measures, including not disturbing fallen timber. These would be effective if properly implemented.

5.8 Accidental fire

5.8.1 Summary

Fire is a risk to Purple Copper Butterfly habitat during construction. Fire could be ignited from sources such a cigarettes or campfires, or from discarded glass bottles, hot works such as welding or angle grinders on days of elevated fire danger, sparks generated from plant/ vehicle contact with rock or metal, ignition from the use of explosives, sparks generated from plant/ vehicle contact with rock or metal with grass and fine fuels within the road reserve, and ignition of woodchip heaps.

5.8.2 Objectives

Prevent damage to Purple Copper Butterfly from accidental fire, in accordance with Recovery Plan action 10.3.8.

5.8.3 Management actions

Table 9 Management actions to minimise risk of accidental fire

Management action	Timing	Responsibility	Monitoring	Performance Indicators/Thresholds	Corrective Actions	Reporting
• Hot works permits will be obtained for all activities likely to generate sparks. Restrictions contained within these permits would be based on the forecast fire danger. • Pre-planned fire response action plans will be prepared in accordance with the nationally endorsed 'Prepare, Act, Survive' format. The action plans will be issued as part of the site induction for all site personnel. • Limitations on relevant construction procedures will be developed which would be applied during the fire season based on specific fire danger ratings. An example of such restrictions would include the halting of all construction works during extreme or catastrophic fire danger days.	During construction	Construction Manager	N/A	No damage to butterfly habitat from accidental fires	Additional planting of Bursaria plants (see section 5.3)	Roads and Maritime EMS incident report form

5.8.4 Effectiveness

Fire and emergency procedures are standard management measures are included in Roads and Maritime project CEMPs. These procedures would be effective at preventing accidental fire as a result of construction activities if appropriately implemented.

6. Reporting

This chapter provides a summary of the reporting requirements arising from the management actions detailed in this management plan. Details of these reports are provided in the relevant sections of section 5.

6.1 Pre-construction

The following reporting is required in the pre-construction phase:

- Landscaping plan, including habitat restoration for the Purple Copper Butterfly.
- Monthly updates to Roads and Maritime regarding plant propagation.
- Annual report following pre-clearing survey for Purple Copper Butterfly.

6.2 Construction

The following reporting is required in the construction phase:

- CEMP reporting requirements for worker inductions.
- Construction weekly environmental inspection checklist:
    - Environmental protection fencing inspections
    - stockpile inspections
    - sediment fence inspections
    - weed infestation areas
    - removal of weeds
    - use of water tanker
    - vehicle access
    - stabilisation of areas as necessary.
- Roads and Maritime EMS incident report form for any damage to habitat to be retained (if required).
- Post weed-control reports (six monthly for two years post construction).
- Post-clearing report that details final clearing areas to go to Roads and Maritime, OEH and DotE.
- Final CEMP report.

6.3 Post-construction

The following reporting is required in the post-construction phase:

- Post-clearing report to provide calculation of final clearing areas of potential Purple Copper Butterfly habitat that is removed, to feed into the final calculations for the offset strategy.
- Post-planting report for habitat restoration area (monthly for the first six months, then quarterly for two years).
- Quarterly reports on stabilisation of areas to Roads and Maritime during and for two years post construction.

- Annual butterfly monitoring reports for two years post construction. An example Purple Copper Butterfly survey form is provided in Appendix A.

7. References

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Appendices

Appendix A – Purple Copper Butterfly Survey Form

Observer(s) Name: **Contact:**

Chainage: **North ☐ South ☐**

Date:

Start time: **Finish time:**

GPS coordinates: Map Zone: **Map datum:**

Easting: **Northing:**

Weather conditions:

Cloud cover		Wind		Precipitation		Temperature	
	None		None		None		<0°C
	Up to 25%		Light breeze		Drizzle		0-10°C
	26-50%		Light wind		Light rain		11-20°C
	51-80%		Steady wind		Heavy rain		21-29°C
	Overcast		Strong wind		Downpour		30°C +

Site Conditions: Air temp.:……. Ground temp.:…… Relative humidity:……. (if thermometer held)

Dominant ground cover: Leaf litter ☐ Grasses & herbs ☐ Timber ☐ Stones & pebbles ☐
% BSL stems choked by weeds: up to 10%☐ 10-25% ☐ 25-50% ☐ 50-75%☐ >75%□☐

Attendant ant: Present ☐ Absent ☐

Survey method: Transect ☐ Area search ☐ Systematic scrutiny of all BSL on site ☐

Total number of caterpillars observed: None ☐ 1-5 ☐ 5-10 ☐ 10-30 ☐ 30-50 ☐ 50-100 ☐ >100 ☐
Exact number:

Total number of butterflies observed: None ☐ 1-5 ☐ 5-10 ☐ 10-30 ☐ 30-50 ☐ 50-100 ☐ >100 ☐
Exact number:

Other insects present on Bursaria:

Other observations at this site:

Follow up required? Yes □ No □ If yes, describe:…

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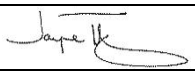
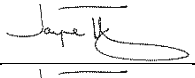
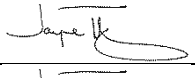
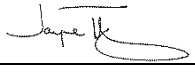
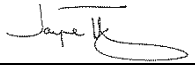
0	K Crosby	J. Tipping		J. Tipping		26/09/13
1	K Crosby	J. Tipping		J. Tipping		30/10/13
2	K Crosby	J. Tipping		J. Tipping		7/11/2013

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