KUR-World

Flora and Fauna

Chapter 8.0

Environmental Impact Statement

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8.0 FLORA AND FAUNA

The purpose of this Chapter is to:

- Describe the existing regulatory frameworks regarding the assessment of the project on fauna and flora
- Provide the findings of the survey work undertaken on the site
- Identify the impacts of the project on fauna and flora
- Identify current regulatory management tools
- Provide mitigation and management measures to support those regulatory tools which will be applicable throughout the life of the project.

About 157.33ha[1] (~23.34%) out of a total of about 673.7ha[2] is proposed for potential development, noting that this excludes select retention of native vegetation within precincts beyond that identified for habitat retention or recommended additional habitat retention. Figure 8.1 identifies the project site and proposed development footprint[3]. The site is located near the Wet Tropics of Queensland World Heritage Area, the Great Barrier Reef World Heritage Area, the Wet Tropics of Queensland National Heritage Place and the Great Barrier Reef National Heritage Place. These environmental values are Matters of National Environmental Significance (MNES).

The northern portion of the project area has been used for cattle grazing since the early to mid-20th century and remains in use for this purpose. The majority of this northern portion was largely or partially cleared of woody vegetation on a number of occasions from the 1940s to the early 1990s. During the 1990s, regrowth vegetation began to re-establish. In 2014, approximately 46 ha of this regrowth vegetation was cleared to reinstate pasture. The southern portion of the project area is dominated by remnant vegetation. Historical aerial photographs indicate localised and episodic vegetation clearing events, though regrowth vegetation has since established over most of the previously cleared land. Four streams and their associated tributaries are present in the project area. The two largest streams are Owen Creek and Haren Creek. The project area contains parts of the headwaters for Warril and Cain Creeks. Owen Creek, Warril Creek and Cain Creek enter the Barron River approximately 1 km north of the project area. All creeks are situated within the Barron Water Plan Catchment Area and drain into the Barron River which passes through the Wet Tropics Queensland World Heritage Area, Wet Tropics Queensland National Heritage Place and feeds into the Great Barrier Reef World Heritage Area, Great Barrier Reef National Heritage Place and the Great Barrier Reef Marine Park.

[1] Includes: (a) the total area of all precincts (excluding Precinct P – Environmental Area); (b) the total area of the proposed internal road network (about 19.4ha); (c) 0.1 hectares for Zip Line tower establishment; (d) 0.1 hectares for helipad establishment; and (e) 2.1 hectares for the proposed new external access road. Excludes: (a) 2.7ha required within Precincts F, I, J and K for habitat retention; and 12.6ha required within Precinct F, I, J, K and O identified for recommended additional habitat retention.

[2] This total area includes the total area of all Precincts as defined in the KUR-World Concept Master Layout Revision H, in addition to (a) the proposed new access road; and (b) road reserve within and between lots comprising the site. Note that the identified developable area and/or the identified developable area percentage are not relative to the site area of 648.3ha (which is a lesser area as it does not constitute areas of road reserve).

[3] Figure 8.1 does not identify habitat retention and recommended habitat retention areas; in this regard refer also to Figure 8.12.

8.1 Executive Summary

The KUR-World project area contains flora and fauna characteristics with important social, economic, cultural and environmental benefits. The project has been designed to predominantly occur in non-remnant vegetation. Key to impact avoidance, is the proposed retention of approximately 500 hectares of habitat (equates to approximately 74% of the project area). This habitat predominantly occurs in the western portion of the Kuranda-Myola-Kowrowa rainforest corridor, which is a potentially significant corridor for a variety of wildlife. The design intention was to reduce the potential project-related environmental impacts.

The flora and fauna communities of the project area were described through reviews of available information and field surveys. Important biodiversity and natural environmental values were identified, including conservation value vegetation types, Threatened and Near Threatened species, Migratory species, important habitat and habitat corridors. The impacts on biodiversity and natural environmental values were assessed, and recommendations to mitigate impacts were made. Included in the list of extensive recommendations, is a project design modification to reduce the extent of fauna habitat loss in the north-east of the project area through a combination of habitat retention and rehabilitation. The potential for significant residual impacts on environmental values was assessed, taking account of the mitigation measures, and a thorough account is presented. In conclusion the actions relevant to flora and fauna that may require regulatory authorisation are discussed.

8.2 Statutory framework

There is Commonwealth and State legislation regarding flora and fauna that is potentially relevant to the project. The relevant legislation is discussed in detail in the KUR-World Flora and Fauna Technical Report (NRA 2017c[4]: refer to Section 2.1). The legislation identified is presented below.

- Queensland *Nature Conservation Act 1992* (NC Act)
- Queensland *Vegetation Management Act 1999* (VM Act)
- Queensland *Planning Act 2016*
- Queensland *Planning Regulation 2017*
- Queensland Significant Residual Impact Guideline. For matters of state environmental significance and prescribed activities assessable under the Sustainable Planning Act 2009. Queensland Environmental Offsets Policy December 2014. December 2014
- Queensland *Environmental Offsets Act 2014* (EO Act)
- Queensland Environmental Offsets Policy July 2017
- Queensland Environmental Offsets Policy. Significant Residual Impact Guideline. Nature Conservation Act 1992, Environmental Protection Act 1994 and Marine Parks Act 2004. December 2014.
- Queensland *Biosecurity Act 2014* (Biosecurity Act)
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Commonwealth Matters of National Environmental Significance. Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999.
- EPBC Act Environmental Offsets Policy, October 2012
- EPBC Act Environmental Offsets Assessment Guide

[4] NRA (2017c) is included as Appendix 5

- The EPBC Act Decision 2016/7710 identified the following matters of national environmental significance (MNES) which require assessment:
- World Heritage properties (sections 12 & 15A)
- National Heritage places (sections 15B & 15C)
- Listed threatened species and communities (sections 18 & 18A)
- Great Barrier Reef Marine Park (sections 24B and 24C).

This chapter provides information to enable the assessment of the project in accordance with the requirements of the bilateral agreement and will fulfil the requirements of Schedule 1, SDPWO Act Regulation 2010 and Schedule 4, Regulation 5 EPBC Act 1999.

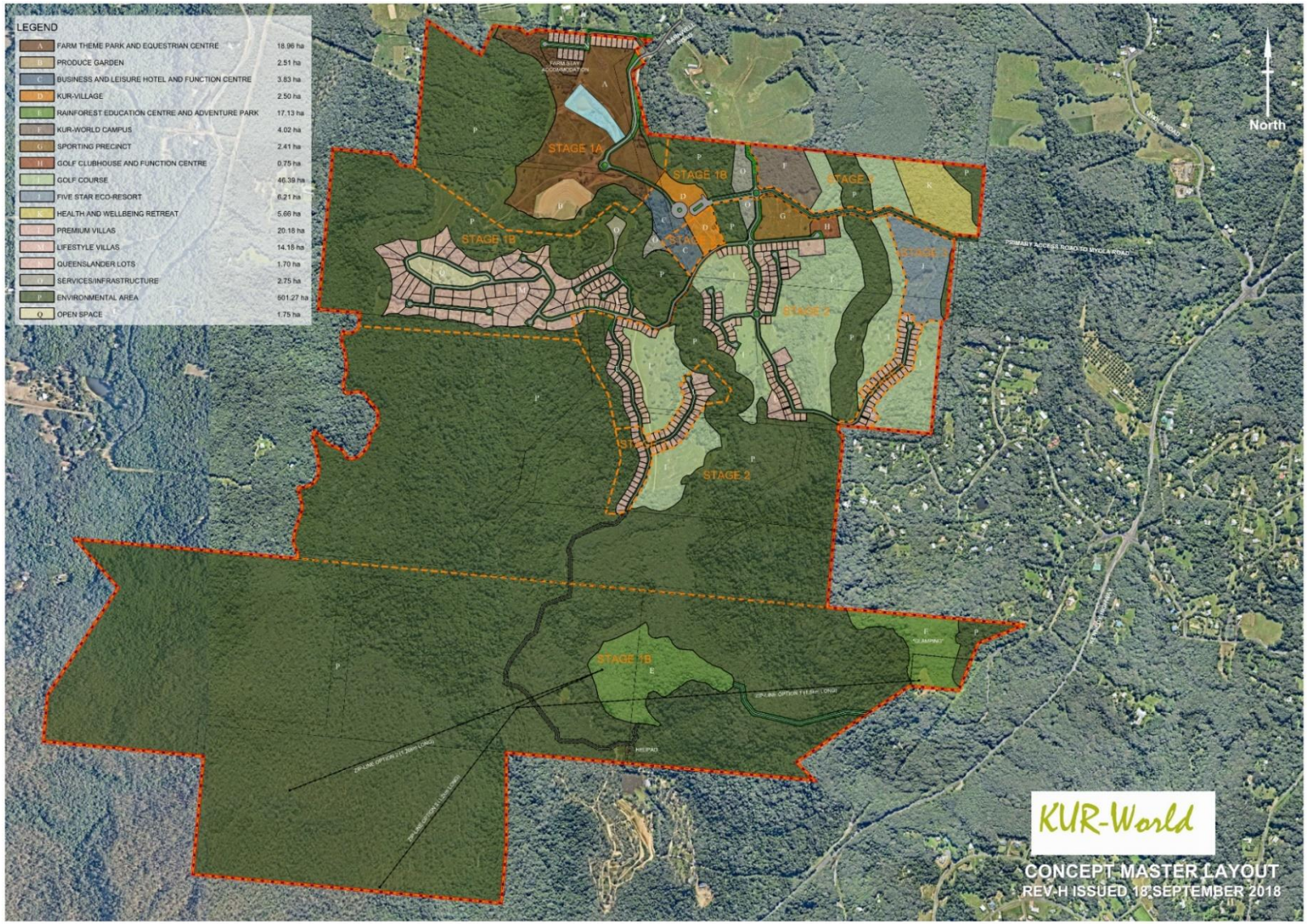

Figure 8-1 Project site and proposed development footprint.

8.3 Flora

8.3.1 Surveys

The results of the desk-based review informed the design of the field surveys and predictions regarding the presence or potential presence of flora values. The following are the primary information sources that were consulted.

- Results from searches of the following databases:
    - EPBC Act Protected Matters Search Tool (DoEE 2017a). An EPBC Act Protected Matters Report was generated for the area within a 10 km radius of point -16.8306, 145.6032.
    - EHP Wildlife Online database (EHP 2017a). Report was generated for the area within a 10 km radius of point -16.8306, 145.6032.
    - Atlas of Living Australia search (ALA 2017). Review of specific species records and a database search within a 5 km radius of point -16.8306, 145.6032.
- Regional Ecosystem (RE) mapping (Version 8.0) (DNRM 2017a; Figure 5) and VM Act Regulated Vegetation mapping (DNRM 2017b).
- NC Act Protected Plants Flora Survey Trigger Maps (EHP 2016b).
- Detailed surface geology - Queensland (DNRM 2011).
- Matters of State Environmental Significance Environmental Report (EHP 2017b) for a 2 km search area radius around point -16.8306, 145.6032.
- Reports relevant to flora values of the project area: Astrebla (2015a-b); Hoskin (2016, 2017).
- Aerial imagery available via Google Earth and Queensland Globe, and QImagery.

The desk-based review identified a variety of vegetation communities across the project area. RE mapping (DNRM 2017a, Version 8.0), in conjunction with aerial imagery, was used to plan the field surveys. The intention was to visit all identifiable vegetation types within the study area. The field survey was conducted over multiple mobilisations. The initial survey was conducted between 18 and 22 January 2017 (early wet season). Following the surveys, the preliminary results were reviewed to identify data deficiencies. Follow up surveys occurred between May and September 2017 (early dry season). Approximately 14 days were devoted to the field flora survey. Regional Ecosystem (RE) mapping for the project area was field verified using 19 secondary and 29 quaternary vegetation assessments following the method of Neldner *et al*. (2017a). Forested areas mapped by DNRM (2017a) as non-remnant vegetation were assessed. Potentially occurring Threatened and Near Threatened (T&NT) plants were identified by desk-based searches of appropriate databases and field surveys were designed to ensure effort was devoted to searching for (T&NT) plants. An inventory of plant species encountered during the course of field surveys was maintained. Full details of the field surveys and sources of reviewed data are provided in Appendix 5 (refer to Section 3.2).

8.3.2 Findings

8.3.2.1 Threatened ecological communities

The EPBC Protected Matters Report (refer to Appendix B in NRA 2017c) indicates the potential presence of the listed Threatened Ecological Community *Broad leaf tea-tree (Melaleuca viridiflora) woodlands in high rainfall coastal north Queensland*. This Threatened Ecological Community is not present within the project area.

8.3.2.2 Regional Ecosystem mapping

The REs mapped to occur within the project area by DNRM (2017) are presented in Figure 8-2. The REs status according to the EPBC Act, the VM Act and Biodiversity Status according to the Department of Environment and Heritage Protection (EHP) is presented in Table 8-1. According to DNRM (2017) RE mapping, REs with Of Concern status under the VM Act are present at the project site, namely REs 7.11.13, 7.11.33 and 7.11.44. Under EHP's Biodiversity Status, one endangered RE and some Of Concern REs are present at the project site. Field surveys identified differences between field verified REs and the DNRM (2017) mapped REs. Details of the differences and the extents of REs under DNRM (2017) mapping and field verified extents are presented in Table 8-1 and presented on Figure 8-3.

8.3.2.3 Flora species

The field surveys identified 395 plant species. Conditions were generally favourable during the field surveys for surveying and identifying plants. The list of plant species is provided in Appendix 5 (refer to Appendix J). Vegetation communities on the project area generally have moderate to high levels of habitat integrity. Threatening processes include weed ingress, livestock grazing, and cyclone damage related (refer to NRA 2017c Section 5.2.2 for further details).

8.3.2.4 Threatened and Near Threatened flora species

Three T&NT species were identified within the project area. The location of the identified T&NT species and the location of Regulated Vegetation (VM Act) are presented on Figure 8-4. Details of the threatened species identified within the project area are provided below.

- Daintree Gardenia (*Randia audasii*) (NC Act Near Threatened). A single mature plant was recorded in RE 7.11.7a. A targeted search was conducted in the vicinity but no more specimens of this taxon were located. *Randia* and the closely related genus *Gardenia* normally occur as scattered individuals, thus a wider search may locate more individual specimens of *R. audasii*.
- Slender Ginger (*Alpinia hylandii*) (NC Act Near Threatened). Three small patches of this plant were found in the northern portion of the project area.
- Myola Palm (*Archontophoenix myolensis*) (NC Act and EPBC Act Endangered). All of the *Archontophoenix* plants found in the project area were either young plants or plants not in flower. This circumstance precludes definitive identification to species level. However, for the purposes of this report all potential specimens are being treated as Myola Palm. Palms tentatively identified as Myola Palms are shown on Figure 8-4. All were recorded along drainage lines, the species' preferred habitat.

Database searches identified the potential presence of other T&NT plant species within the project area. The likely presence of these species on the project site was assessed using information obtained during the desk-based review and field survey. The results of this assessment are provided in Appendix 5 (refer to Section 4.2.4) and summarised below.

- Probable occurrence (potentially suitable habitat present though species not recorded despite targeted searches):
  - *Crepidomanes majoriae* (NC Act Vulnerable)
  - *Diplazium cordifolium* (NC Act Vulnerable)
  - Endlicher's Filmy Fern (*Polyphlebium endlicherianum*) (NC Act Vulnerable; EPBC Act Endangered)
  - Smooth-bark Rose Apple (*Syzygium hodgkinsoniae*) (NC Act and EPBC Act Vulnerable)
  - Velvet Jewel Orchid (*Zeuxine polygonoides Syn, Rhomboda polygonoides*) (NC Act and EPBC Act Vulnerable).
- Possible (possibly suitable habitat present though species not recorded):

- Rat's Tail Tassel-fern (*Phlegmariurus filiformis*) (NC Act and EPBC Act Endangered)
- *Cajanus mareebensis* (NC Act and EPBC Act Endangered).

Table 8-1 Regional Ecosystems (Version 8.0) mapped by DNRM (2017a) over the project area, their status and spatial extents.

Regional Ecosystem	Short Description	Status[A]			Area (ha)[B]	
		EPBC Act	VM Act	EHP Biodiversity	DNRM 2017a	NRA Revised
7.11.1	7.11.1: Simple-complex mesophyll to notophyll vine forest on moderately to poorly drained metamorphics (excluding amphibolites) of moderate fertility of the moist and wet lowlands, foothills and uplands. 7.11.1a: Mesophyll vine forest. Lowlands and foothills on metamorphics. Very wet and wet rainfall zones. 7.11.1b: Mesophyll vine forest recovering from disturbance, with *Acacia* spp. canopy or emergents. Lowlands and foothills on metamorphics, of the very wet and wet rainfall zones[C].	NL	LC	NC	12	49
7.11.7	7.11.7: Complex notophyll vine forest with Agathis robusta emergents on foothills and uplands on metamorphics 7.11.7a: Complex notophyll vine forests (with emergent *Agathis robusta*). Foothills and uplands of areas excluding the Seaview Range Subregion. Moist rainfall zone. 7.11.7b: Complex notophyll vine forests (with emergent *A. robusta*) recovering from disturbance, with Acacia spp. canopy or emergents. Foothills and uplands on metamorphics, of the moist rainfall zone[C].	NL	LC	NC	259	265
7.11.13	*Corymbia torelliana* open forest, usually with a vine forest element, on metamorphics	NL	OC	E	19	19
7.11.33	7.11.33: *Eucalyptus reducta* open forest to woodland on metamorphics. 7.11.33a: *Eucalyptus reducta* open forest to woodland on metamorphics.	NL	OC	OC	11	0
7.11.44	*Eucalyptus tereticornis* open forest to woodland on coastal metamorphic foothills.	NL	OC	OC	43	47
7.11.51	7.11.51: *Corymbia clarksoniana* and/or *Eucalyptus drepanophylla* open forest to woodland on metamorphics. 7.11.51a: *Corymbia clarksoniana*, *Eucalyptus tereticornis*, *E. drepanophylla* woodland, low woodland to open forest with *Allocasuarina torulosa*, *Allocasuarina littoralis*, *Lophostemon suaveolens*, *Acacia cincinnata*, *A. flavescens*, *Banksia aquilonia*, *Xanthorrhoea johnsonii*. Metamorphics.	NL	LC	OC	70	81
Non-remnant	Non-remnant	-	-	-	263	212

A: Status according to EHP's Biodiversity Status, VM Act and EPBC Act. Categories comprise: Endangered (E), Of Concern (OC), Least Concern (L), No Concern at Present (NC) and Not Listed (NL).

B: Area estimates are rounded to the nearest whole number. Values calculated based on DNRM (2017a) mapping (**Figure 8-2**) and revised mapping based on the results of the current study (**Figure 8-3**).

C: Identified in NRA revised mapping only.

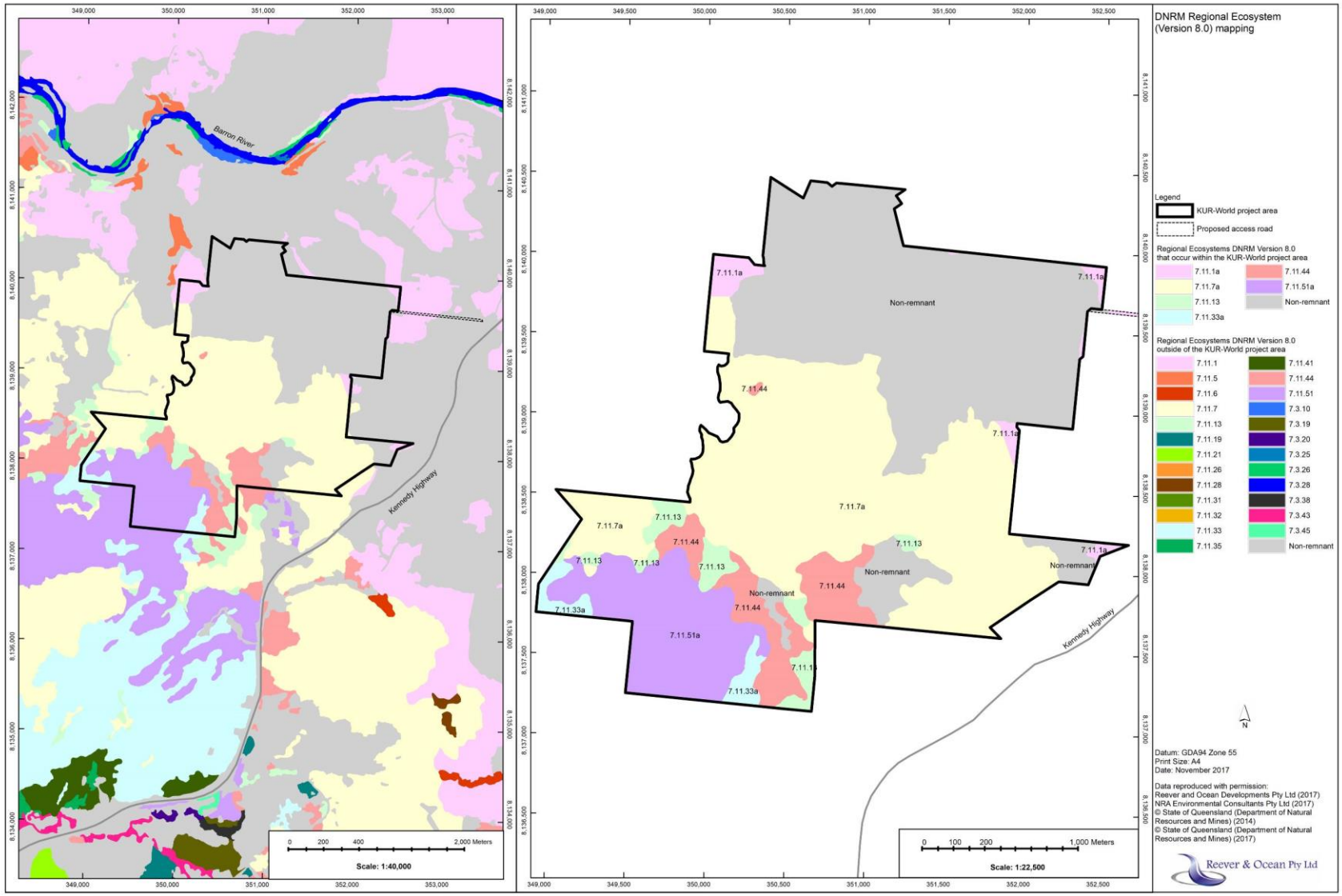

Figure 8-2 DNRM Regional Ecosystem (Version 8.0) mapping.

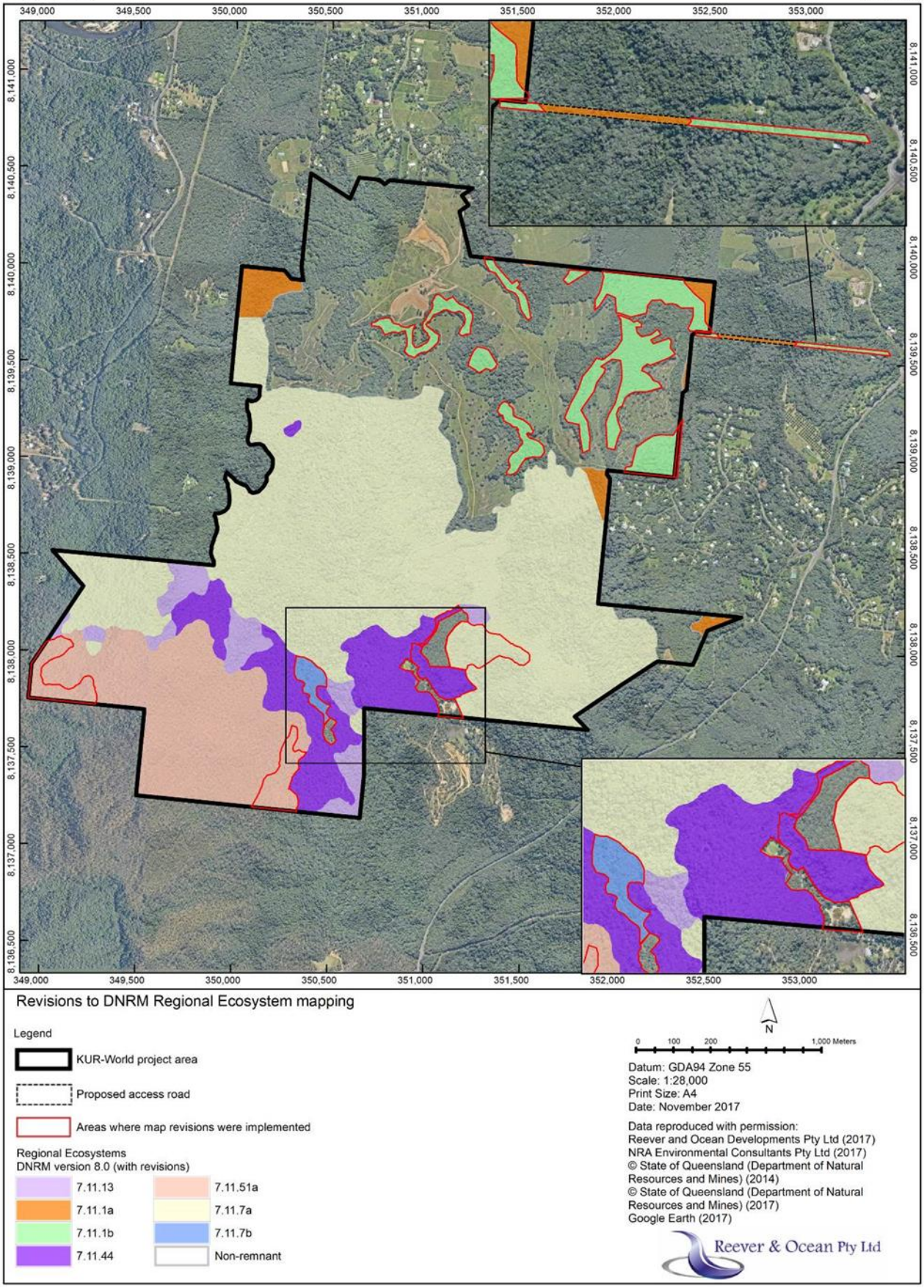

Figure 8-3 Revisions to DNRM Regional Ecosystem mapping.

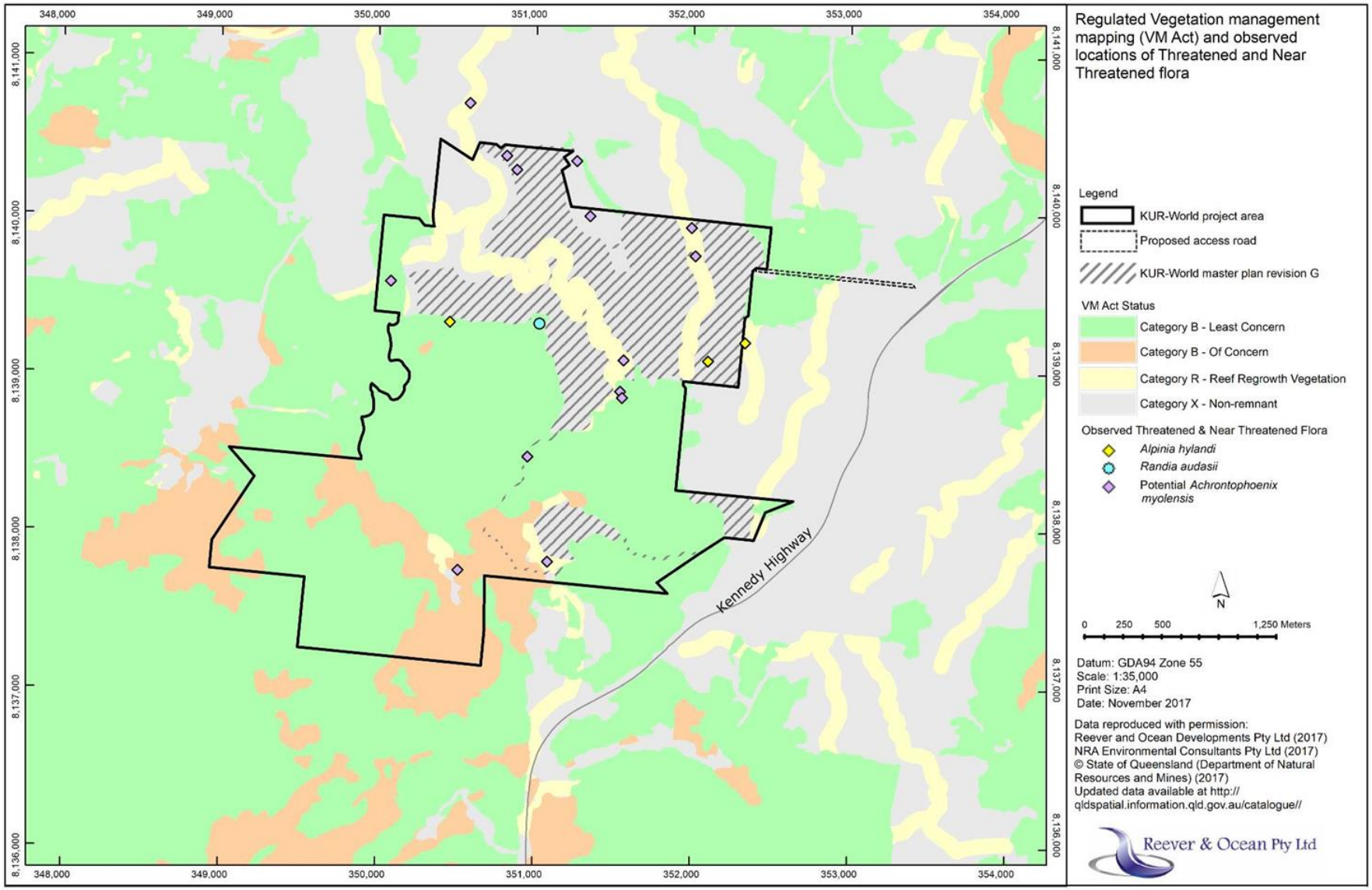

Figure 8-4 Regulated Vegetation management mapping (VM Act) and observed locations of Threatened and Near Threatened flora.

8.4 Fauna

8.4.1 Surveys

The results of the desk-based review informed the design of the field surveys and predictions regarding the presence or potential presence of fauna values. The following are the primary information sources that were consulted.

- Results from searches of the following databases.
    - EPBC Act Protected Matters Search Tool (DoEE 2017a). An EPBC Act Protected Matters Report was generated for the area within a 10 km radius of point -16.8306, 145.6032.
    - EHP Wildlife Online database (EHP 2017a). Report was generated for the area within a 10 km radius of point -16.8306, 145.6032.
    - Atlas of Living Australia search (ALA 2017). Review of specific species records and a database search within a 5 km radius of point -16.8306, 145.6032.
- Regional Ecosystem (RE) mapping (Version 8.0) (DNRM 2017a) and Broad Vegetation Groups (BVG) mapping (Version 3) (DSITI 2016).
- Hoskin's (2016, 2017) reports on the presence of threatened frogs in the study area.
- Aerial imagery available via Google Earth and Queensland Globe, and QImagery.

Cognisant of the existing information reviewed, baseline fauna surveys were conducted in the early wet season and early dry season. The field fauna survey program involved two independent studies, as follows.

1. A baseline terrestrial vertebrate fauna survey (hereafter, 'baseline fauna survey') conducted in general accordance with the approach described in Eyre *et al.* (2014). The survey included targeted sampling for T/NT&M fauna species, with the exception of threatened frogs.
2. A specialised survey for threatened stream-dwelling frogs.

The baseline fauna survey involved systematic sampling at formal survey sites, targeted sampling (using a subset of techniques) for specific species and/or at specific areas of interest, and continuous observation. As per advice contained in Eyre *et al*. (2014), surveys were timed to occur in the early wet and early dry seasons. The survey schedule is summarised below.

- Early wet season (EWS). The EWS survey occurred over five days in January 2017. A three-person team of ecologists was devoted to the task.
- Early dry season (EDS). The majority of the EDS survey work occurred over six days in May 2017. The survey team comprised four ecologists during the first and final day of the survey, and two ecologists for the remainder of the time. Additional acoustic bat detection/recording occurred in June 2017.

Surveys for threatened frogs occurred over eight days in January 2016 (reported in Hoskin 2016) and over nine days between February and March 2017 (reported in Hoskin 2017).

Full details of the field surveys for terrestrial fauna and sources of reviewed information are provided in Appendix 5 (refer to Section 3.3). Surveys for aquatic species were made (NRA 2017a) and the potential for groundwater dependent ecosystems was assessed within a specialised groundwater report (RLA 2017).

8.4.2 Findings

8.4.2.1 Fauna habitat

Four general habitat types were identified within the project area. These habitat types are listed below with reference to the corresponding BVGs (1:2M) (Figure 8-5).

- **Open Pasture** – Corresponds with the non-forested areas of non-remnant vegetation.
- **Mesophyll to Notophyll Vine Forest (MNVF) –** Corresponds with BVG 2 (Complex to simple, semi-deciduous mesophyll to notophyll vine forest, sometimes with *Araucaria cunninghamii* (Hoop Pine) and forested sections of non-remnant vegetation (DNRM 2017) in the northern portion of the project area (shown as BVG 2 on pre-clearing BVG mapping).
- **Notophyll to Microphyll Vine Forest (NMVF) –** Corresponds with BVG 5 (Notophyll to microphyll vine forests, frequently with *Araucaria* spp. or *Agathis* spp. (Kauri Pines)).
- **Eucalypt Open Forest to Woodland (EOFW) –** Corresponds with BVG 9 (Moist to dry eucalypt open forests to woodlands usually on coastal lowlands and ranges).

Detailed descriptions of the habitat types and their location within the project area are provided in Appendix 5 (refer to Section 4.3.1).

8.4.2.2 Habitat condition

The habitat integrity across the project area was generally moderate to high across forested areas. There are some existing threatening processes affecting the habitat including high edge to area ratio, livestock impacts, weeds, cyclone damage and the presence of access tracks. Further discussion of habitat conditions is presented in Appendix 5 (refer to Section 4.3.1).

8.4.2.3 Landscape context and connectivity

The project area is located on the western fringe of the Kuranda township with areas of large residential blocks to the east, north and west. Many of the surrounding areas were historically cleared for farming, particularly to the north and east, though are now occupied by residential areas or forested regrowth. The conservation value of forested regrowth is high in some instances.

The project area occurs in a broad section of landscape where north-south connectivity for certain rainforest fauna is relatively limited. The location of habitat corridors surrounding the project area are presented in Figure 8-6. Rainforest corridors occur in the vicinity of Barron River Falls and the general Kuranda-Myola-Kowrowa areas. The project area contributes to the Kuranda-Myola-Kowrowa corridor most substantially in the western portion of the corridor. Additionally, the area of Eucalypt woodland-open forest west of the project area may also be an important north-south corridor for a variety of wildlife, especially for species that prefer sclerophyll habitats.

The corridors described above, and to which the project area contributes, are potentially important to a multitude of wildlife, including high profile threatened species. For example, the rainforest corridors and ecotone areas may be important for the Southern Cassowary and the sclerophyll corridor and ecotone areas may be important for Northern Quoll (*Dasyurus hallucatus*), and at least historically for Northern Bettong (*Bettongia tropica*). The potential importance of these corridors to wildlife is recognised in various forums including the *Mareeba Shire Council Planning Scheme* (MSC 2017), which maps an 'ecological corridor' and 'habitat linkage' through the project area and surrounding land, and the *Wet Tropics Conservation Strategy 2004* (WTMA 2004) which describes 'Kuranda Envirolink' as a priority 1 corridor linking Rainy Mountain (north of Barron River) to Barron Gorge National Park (occurs north and south of the Barron River). WTMA (2004) describes 'Kuranda Envirolink' as a 'vital cassowary habitat and wildlife corridor [that] includes both remnant rainforest and sclerophyll communities'.

8.4.2.4 Fauna species

One hundred and seventy-three (173) vertebrate fauna species, representing 76 families, were recorded within the project area across all fauna studies (Appendix 5: refer to Table 9 and Appendix K). The suite of species recorded is a sub-set of the complete species assemblage that is likely to occur in the project area and is representative of the survey effort and conditions prior to and during the surveys. Of the forested habitats, species richness was highest in the EOFW. Species richness recorded in each forested habitat type during the baseline fauna survey programme is provided in Appendix 5 (refer to Table 10).

Of the vertebrate fauna species, 10 were fish species recorded in the creeks in the project area (Appendix 5 refer to Section 4.8). No EPBC Act or State conservation listed fish species were recorded in the project area. Aquatic fauna, both aquatic macroinvertebrates and fish, was indicative of good ecosystem health. No groundwater dependent ecosystems were recorded in the project area. A narrow terrestrial groundwater dependent ecosystem adjacent to Haren Creek is shown on published GDE mapping (RLA 2017: refer to Section 7.5). This ecosystem is designated as having low potential for groundwater interaction. The depth to the groundwater table at a site near to the potential groundwater dependent ecosystem was found to be 17 metres and it is considered unlikely that the vegetation along Haren Creek has root depths to enable access to the water table (RLA 2017).

There are existing threatening processes for the fauna within the project area. These include the disturbance resulting from existing land use, invasive species, activities in catchments upstream of the project area, the existing water quality, the current fire regime in the south-west of the project area and all threatening processes relevant to flora communities. These existing threats are discussed in greater detail in Appendix 5 (refer to section 5.3.2).

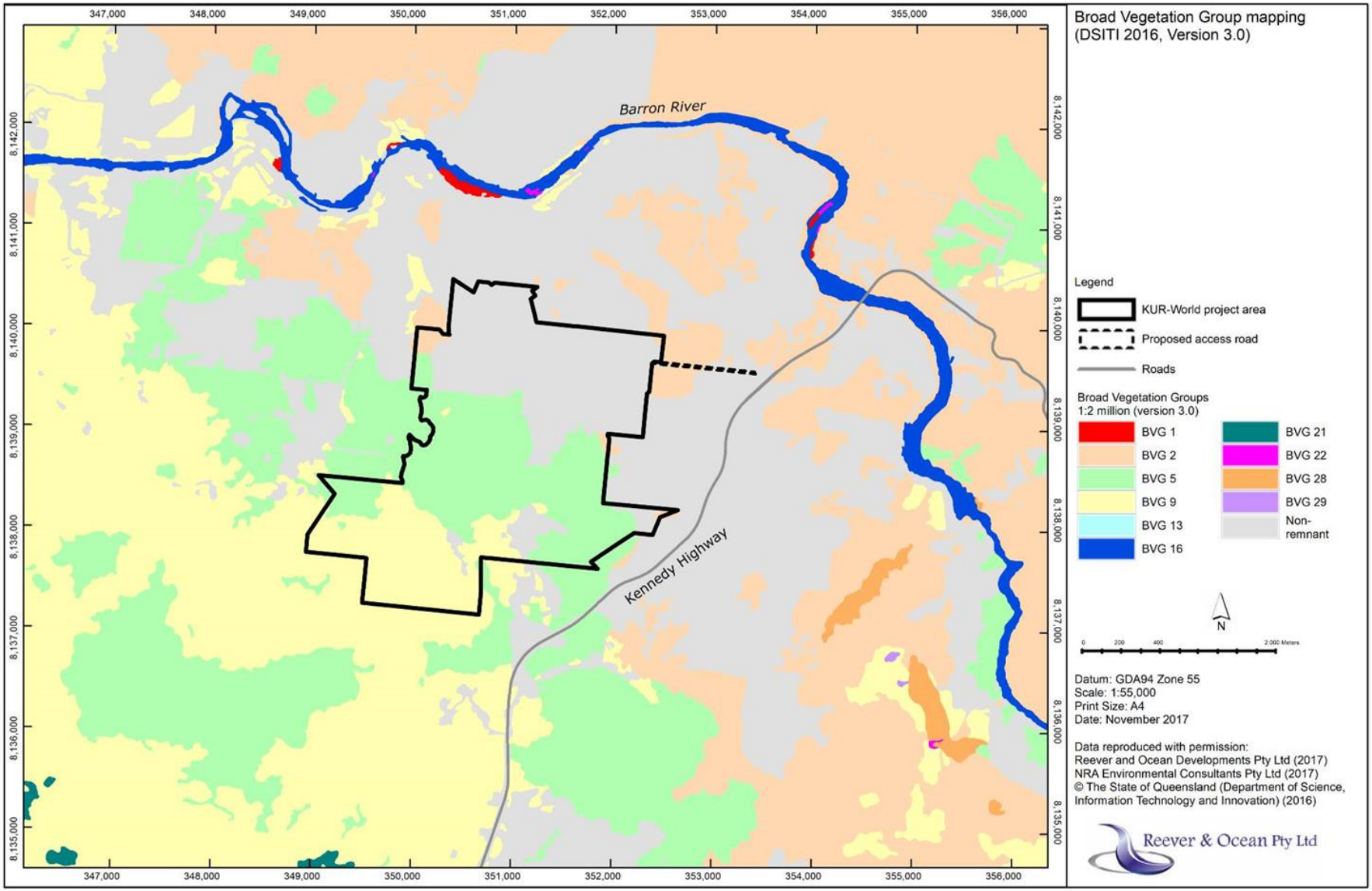

Figure 8-5 Broad Vegetation Group mapping (DSITI 2016, Version 3.0).

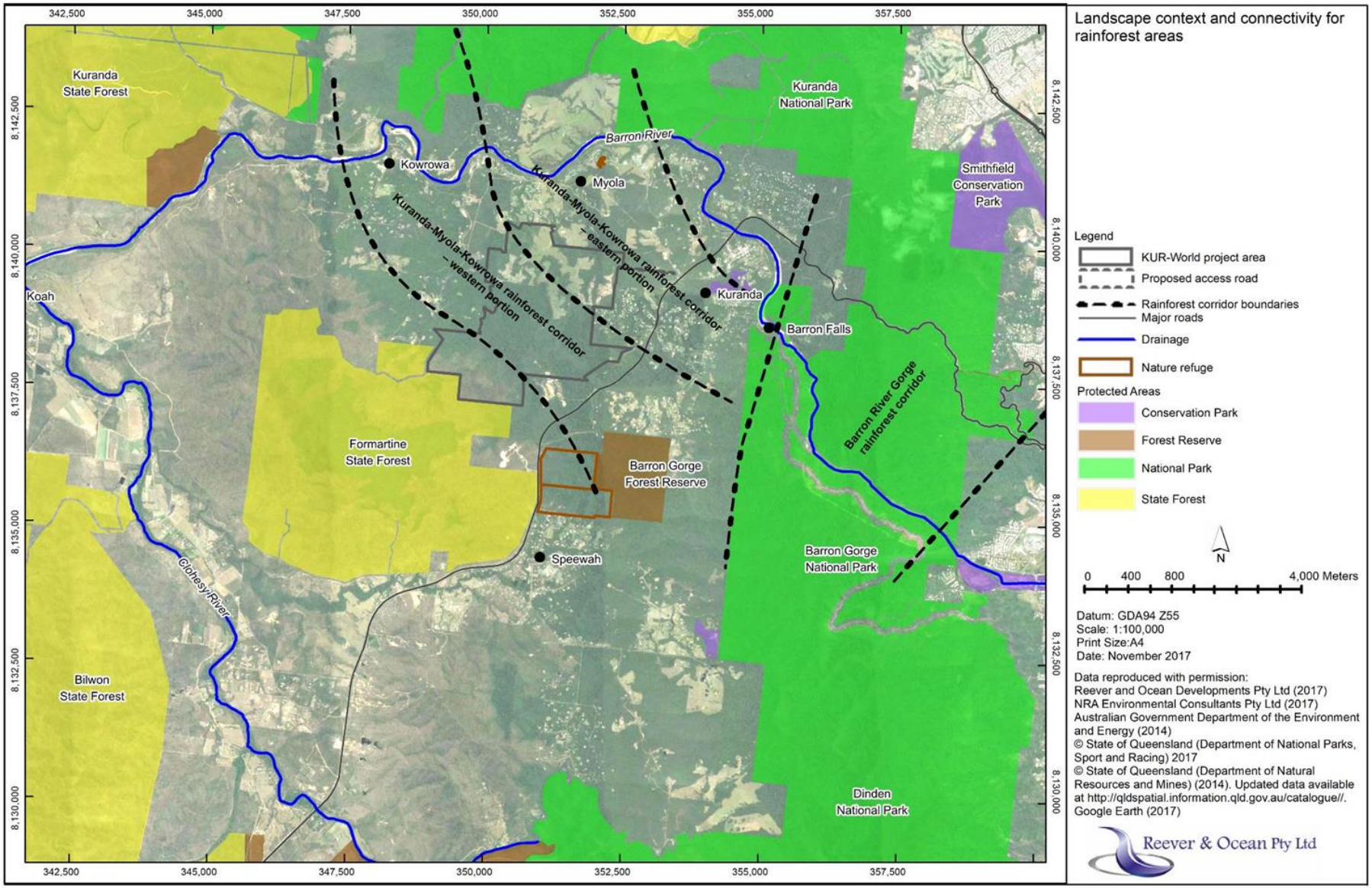

Figure 8-6 Landscape context and connectivity for rainforest areas.

8.4.2.5 Threatened and Near Threatened fauna species

Eight T&NT fauna species were recorded during the field surveys. The observed location of these species and the VM Act areas of essential habitat within the project area are presented in Figure 8-7. A list of the recorded T&NT fauna species and their legislative status is listed below.

- Kuranda Tree Frog (*Litoria myola*). Endangered NC Act and EPBC Act.
- Gouldian Finch (*Erythrura gouldiae*). Endangered NC Act and EPBC Act.
- Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus*). Endangered NC Act, Vulnerable EPBC Act.
- Greater Large-eared Horseshoe Bat (*Rhinolophus philippinensis*). Endangered NC Act, Vulnerable EPBC Act.
- Spectacled Flying-fox (*Pteropus conspicillatus*). Vulnerable NC Act and EPBC Act.
- Tapping Green-eyed Frog (*Litoria serrata*). Vulnerable NC Act.
- Macleay's Fig-parrot (*Cyclopsitta diophthalma macleayana*). Vulnerable NC Act.
- Tube-nosed Insectivorous Bat (*Murina florium*). Vulnerable NC Act.

Further information relating to these species, the Southern Cassowary (*Casuarius casuarius johnsonii*), and the Red Goshawk (*Erythrotriorchis radiatus*) is provided in Chapter 19 (Matters of National Environmental Significance, refer to section 19.8.2) and in Appendix 5 (refer to Section 4.3.2). Non-definitive evidence of Southern Cassowary and Red Goshawk presence was recorded on the project area and discussion is warranted given the potential interest associated with these species.

A list of the T&NT fauna species not recorded during field surveys though identified in the database search areas is provided in Appendix 5 (refer to Table 11). The likelihood of these species occurring within the project area was assessed with reference published information about the ecology and distribution of each species, and the habitat types and conditions observed on-site. Based on this assessment, 12 species may occur within the project area and one species is likely to occur on the project area; these species and their legislative status are listed below.

- Likely to occur.
  - Southern Cassowary (southern population) (*Casuarius johnsonii*). Endangered NC Act and EPBC Act.
- May occur.
  - Australian Lacelid (*Litoria dayi*). Endangered NC Act and EPBC Act.
  - Northern Bettong (*Bettongia tropica*). Endangered NC Act and EPBC Act.
  - Northern Quoll (*Dasyurus hallucatus*). Endangered EPBC Act.
  - Red Goshawk (*Erythrotriorchis radiatus*). Endangered NC Act, Vulnerable EPBC Act.
  - Semon's Leaf-nosed Bat (*Hipposideros semoni*). Endangered NC Act, Vulnerable EPBC Act.
  - Masked Owl (northern) (*Tyto novaehollandiae Kimberli*). Vulnerable NC Act and EPBC Act.
  - Greater Glider (*Petauroides Volans*). Vulnerable NC Act and EPBC Act.
  - Ghost Bat (*Macroderma gigas*). Endangered NC Act, Vulnerable EPBC Act.
  - Grey Falcon (*Falco hypoleucos*). Vulnerable NC Act.
  - Blue-faced Parrot-finch (*Erythrura trichroa*). Near Threatened NC Act.
  - Diadem Leaf-nosed Bat (*Hipposideros diadema reginae*). Near Threatened NC Act.
  - Lumholtz's Tree-kangaroo (*Dendrolagus lumholtzi*). Near Threatened NC Act.

The Australian Lacelid, Red Goshawk, Northern Quoll, Ghost Bat, Grey Falcon and Lumholtz's Tree-kangaroo are likely to be non-resident on the project area – their presence is more likely to be intermittent. The presence of Southern Cassowary is also likely to be intermittent. The pattern of occurrence of the remaining species is difficult to predict due to limited information on species distribution and/or ecology – their occurrence may range from frequent to intermittent (Appendix 5 refer to Table 11).

8.4.2.6 Special Least Concern fauna

The following Special Least Concern (NC Act) fauna were recorded within the project area.

- Short-beaked Echidna (*Tachyglossus aculeatus*).
- Spectacled Monarch (*Symposiachrus trivirgatus*).
- Rufous Fantail (*Rhipidura rufifrons*).

The above bird species are listed as Special Least Concern because they are Migratory-listed fauna under the EPBC Act. They are discussed in the following section.

The Short-beaked Echidna was recorded during fauna surveys on surveillance cameras in NMVF and EOFW. The species may occur in any of the forested areas on the project area and no specific areas of importance for the species are identifiable. It is likely to be common locally and regionally.

8.4.2.7 Migratory fauna

The Spectacled Monarch and the Rufous Fantail were recorded within the project area during the baseline surveys. Both species are relatively common locally and regionally. The Spectacled Monarch is likely to maintain a permanent or frequent presence on the project area, whereas the Rufous Fantail is a passage migrant and more likely to occur in the cooler months.

Database searches returned a further 35 Migratory-listed fauna. The majority of these are coastal or wetland species that are unlikely to occur on the project area due to the absence of suitable habitat.

Migratory species that may, or are likely to, occur are described below, and further discussion is presented in Appendix 5 (refer to Section 4.3.2).

- Likely to occur.
  - White-throated Needletail (*Hirundapus caudacutus*).
  - Fork-tailed Swift (*Apus pacificus*).
  - Black-faced Monarch (*Monarcha melanopsis*).
- May occur.
  - Oriental Cuckoo (*Cuculus optatus*).
  - Barn Swallow (*Hirundo rustica*).
  - Eastern Osprey (*Pandion cristatus*).
  - Glossy Ibis (*Plegadis falcinellus*).

The project area may occasionally, and temporarily, support ecologically significant proportions of White-throated Needletail and Fork-tailed Swift populations based on national threshold values described in DoE (2015). There are insufficient data to assess the likelihood of the project area supporting ecologically significant proportions of the other Migratory species listed above. Based on the 2017 survey results, and the observed conditions on-site, the project area is probably unlikely to support ecologically significant proportions of other Migratory species. The possible exception is the Spectacled Monarch which may at times come close to the national threshold values described in DoE (2015).

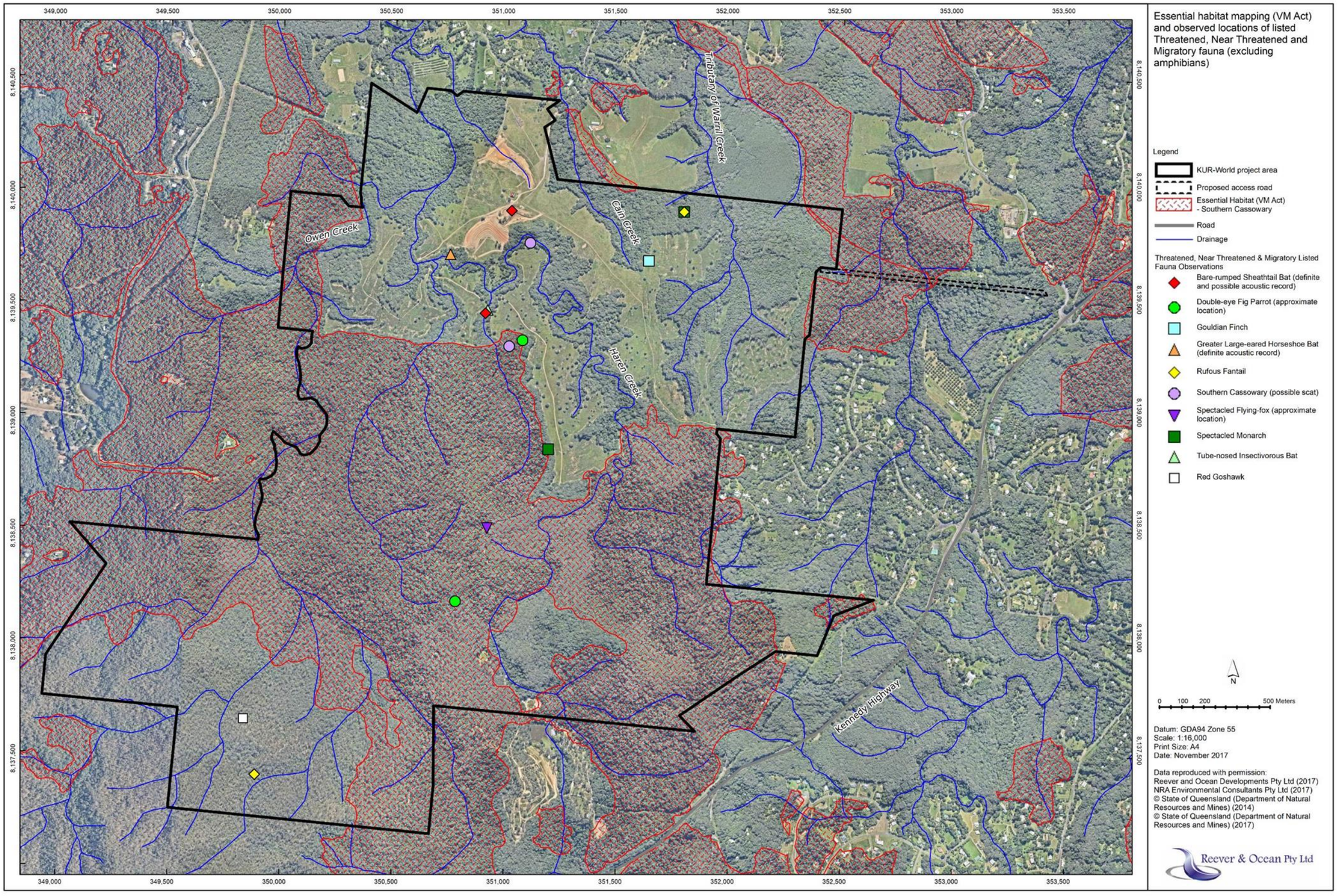

Figure 8-7 Essential habitat mapping (VM Act) and observed locations of listed Threatened, Near Threatened and Migratory fauna (excluding amphibians)

8.5 Matters of State Environmental Significance

Matters of State Environmental Significance (MSES) mapping (EHP 2017) is shown on Figure 8-8 and shows the following MSES present within the project area.

- **Regulated Vegetation**. Comprising Great Barrier Reef Regrowth Watercourse (Category R) vegetation and REs listed as Of Concern (Category B) under the VM Act.
  - Category R vegetation occurs along forested streams that are shown on DNRM (2017) RE mapping as non-remnant vegetation. As described in Appendix 5 (refer to Section 4.2.2), some of these areas meet the criteria for remnant vegetation. The revised RE types on these sections of remnant vegetation comprise RE 7.11.1b in the northern portion of the project area, and RE 7.11.7b and RE 7.11.44 in the south of the project area (Figure 8.3.4.2). RE 7.11.1b and RE 7.11.7b have a Least Concern VM Act status, while RE 7.11.44 is Of Concern.
  - DNRM (2017) mapping shows the following VM Act Of Concern REs on the project area: RE 7.11.13, RE 7.11.33 and RE 7.11.44. RE 7.11.33 was not found on the project area during field surveys and in the revisions in Appendix 5 (refer to Section 4.2.2) these areas are mapped as the VM Act Least Concern 7.11.51 (RE 7.11.51 is not MSES). Revised mapping (Figure 8-3) increased the extent of RE 7.11.44.
- **Wildlife habitat**. Essential Habitat for the Endangered (NC Act) Southern Cassowary is mapped over most DNRM (2017) remnant vegetation areas of the project area (Figure 8-7). The revisions shown on Figure 8-3 increase the extent of Essential Habitat for Southern Cassowary, and by default MSES for wildlife habitat.

8.6 Matters of National Environmental Significance

The following Matters of National Environmental Significance (MNES), as they relate to terrestrial flora and fauna, were identified as present within the project area.

- **EPBC Act Endangered species**. A breeding population of Kuranda Tree Frog occurs along certain streams in the north of the project area (Figure 8-9). The Bare-rumped Sheathtail Bat was recorded within the project area and may forage above all habitats on the project area (including Open Pasture) and EOFW may contain roosting habitat.
- **EPBC Act Vulnerable species**. The Greater Large-eared Horseshoe Bat may occur in most habitats within the project area (except Open Pasture away from forest edges), with core habitat potentially occurring along forest edges, streams and near breaks in vegetation cover such as tree falls. EOFW may contain roosting habitat for the species. The Spectacled Flying-fox may forage in all habitats on the project area (except Open Pasture), and the areas of EOFW may contain optimal foraging resources. No flying-fox camps occur on the project area.
- **EPBC Act Migratory species**. Spectacled Monarch and Rufous Fantail may occur in most habitats on the project area (except Open Pasture).

Non-definitive records of the following MNES were also recorded within the project area.

- Non-definitive evidence of the EPBC Act Endangered Southern Cassowary was recorded on the project area. There is historical evidence of the species on the project area and the area contains potential habitat. Existing threatening processes are possibly inhibiting the establishment of a permanent and appreciable population on and directly adjacent to the project area.
- The EPBC Act Endangered Red Goshawk (a juvenile bird) was possibly sighted in EOFW habitat in the south-west of the project area. The uncertainty is due to the brevity of the sighting. The species may

forage over all forested habitat types of the project area, though EOFW is likely to be preferred, and its presence is likely to be temporary and irregular.

- The EPBC Act Endangered Myola Palm may occur along forested streams within the project area. Mature and fruiting plants are required to confirm the identification of these individuals. Its presence has been confirmed in the downstream (off-site) receiving environment (Warril Creek).

The following MNES were not recorded on the project area though are predicted to occur.

- Threatened fauna species:
  - that may occur, or are likely to occur, on a temporary and/or intermittent basis (Australian Lacelid, Ghost Bat and Northern Quoll); and
  - whose pattern of occurrence is difficult to predict due to limited information on species distribution and/or ecology – their occurrence may range from frequent to intermittent (Semon's Leaf-nosed Bat, Masked Owl, Northern Bettong and Greater Glider).
- Migratory fauna species that:
  - are likely to occur regularly (Black-faced Monarch); or
  - may occur, or are likely to occur, occasionally (White-throated Needletail, Fork-tailed Swift and Barn Swallow); or
  - may occur intermittently (Oriental Cuckoo, Eastern Osprey and Glossy Ibis).
- Threatened flora species considered to have a 'probable' likelihood of occurrence (Endlicher's Filmy Fern, Smooth-bark Rose Apple and Velvet Jewel Orchid) and 'possible' likelihood of occurrence (Rat's Tail Tassel-fern and *Cajanus mareebensis*).

Potential habitat for the above MNES collectively covers all forested sections of the project area, including forested areas mapped (DNRM 2017) as non-remnant vegetation[5]. The possible exceptions to this are the Glossy Ibis that may on rare occasion, and temporarily, forage in Open Pasture, and the Masked Owl that may occasionally forage along forest edges. Forested streams are of highest conservation value as these areas are known to support breeding populations of EPBC Act Threatened frogs and are potentially core habitat for EPBC Act Threatened Myola Palm and micro-bats. EOFW in the southern portion of the project area is potentially important as it may contain foraging and roosting habitat for a variety of Threatened fauna.

[5] Core habitat for each species is described in Table 8-3 (Threatened plants), Table 8-4 (Threatened and Migratory fauna).

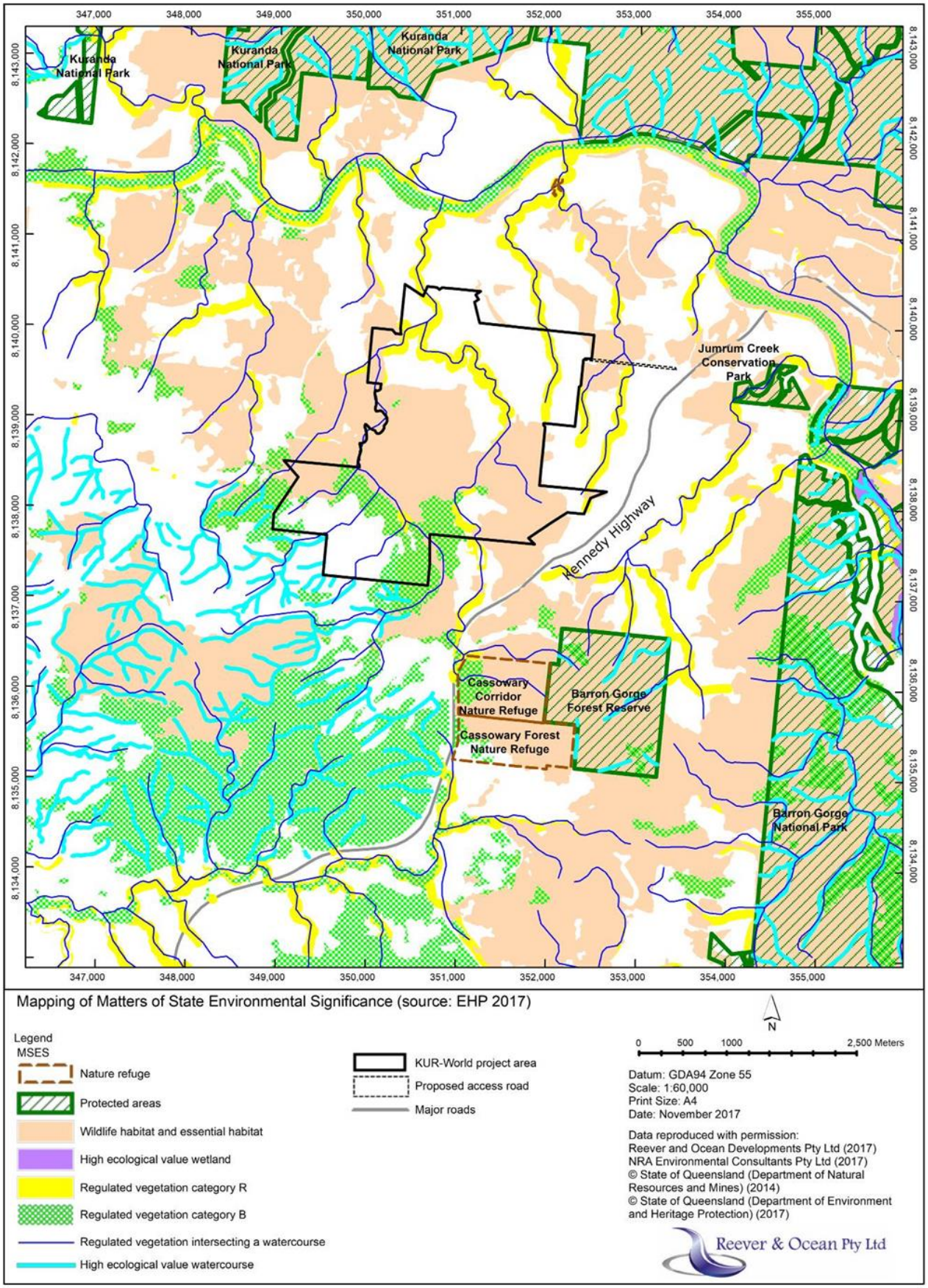

Figure 8-8 Mapping of Matters of State Environmental Significance (source: EHP 2017).

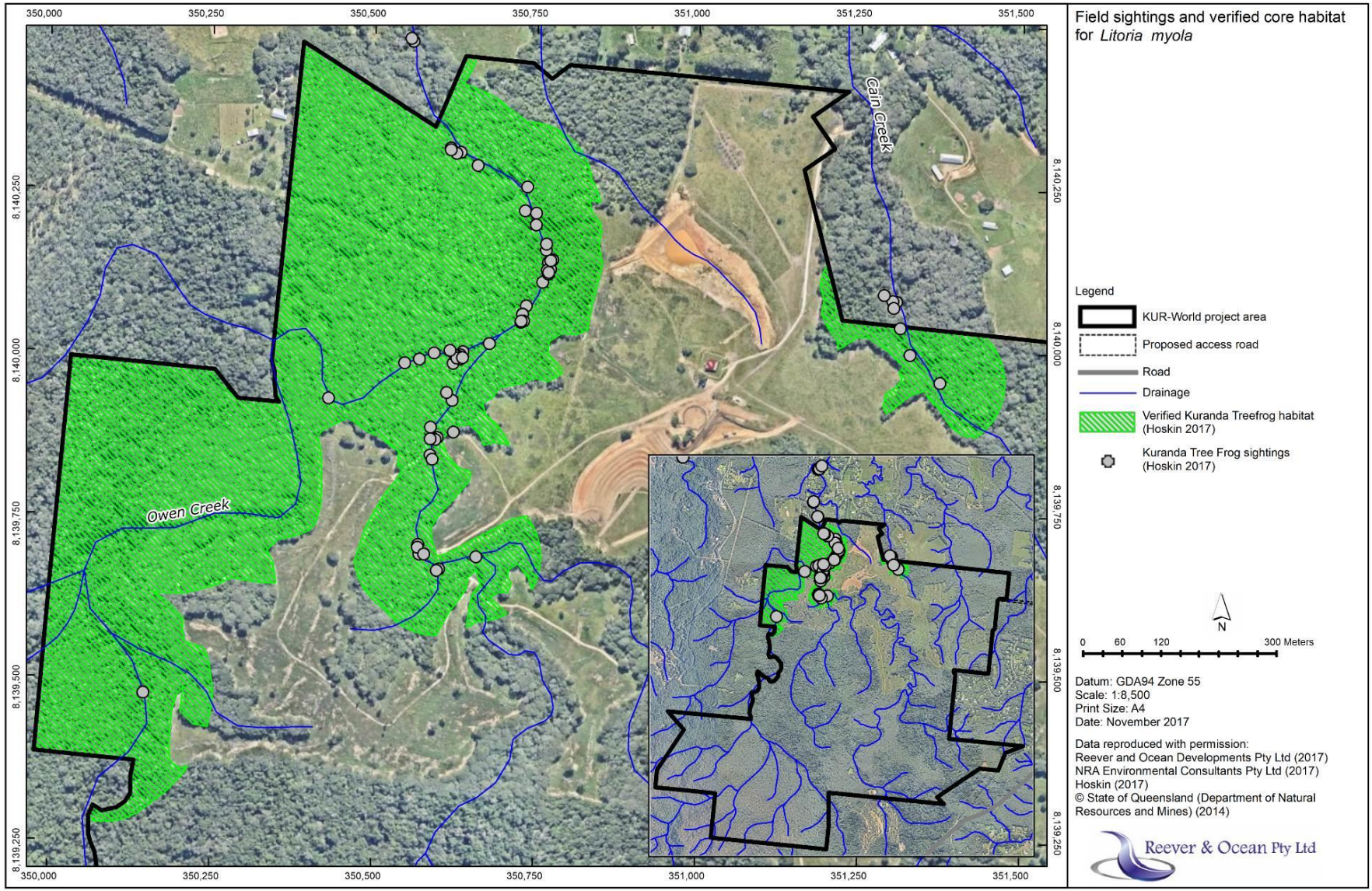

Figure 8-9 Field sightings and verified core habitat for *Litoria myola*.

8.7 Potential impacts and mitigation measures

The project has the potential to result in a range of direct and indirect threats to the flora and fauna values. Direct threats, in the form of authorised vegetation clearing, will be most pronounced during the construction phase. Indirect threats refer to those secondary threats that may occur as a result of the development. Their impacts may extend beyond the development footprint and throughout the operational life of the project. The fauna species (and populations) that are potentially most vulnerable to the direct and indirect threats (and resulting impacts) are those that:

- are permanent, frequent or regular inhabitants of the site
- are sensitive to the threats posed by the action[6]
- have core, limiting or critical habitat within the receiving environment of impact.

The potential project related impacts on flora and fauna values are described and quantified in following sections.

8.7.1 Potential impacts to flora

The project has the potential to generate a range of direct and indirect threats with the potential to impact on flora values.

8.7.1.1 Direct threats

8.7.1.1.1 *Regional ecosystems and ecological communities*

The project has been designed to predominantly occur in non-remnant vegetation as shown on DNRM (2017) mapping (Figure 8-2). Clearing extents associated with the proposed development, using DNRM (2017) and NRA revised mapping (Figure 8-3), are shown in Table 8-2. The assumptions used for calculation of clearing extents are presented in Appendix 5 (refer to section 5.2.3).

Table 8-2 Clearing extents associated with the proposed KUR-World development plan.

Regional Ecosystem Code	Status[A]			Potential Impact Area (ha) & Proportion (%)[B]	
	EPBC Act	VM Act	EHP Biodiversity	DNRM (2017)	NRA (this study)
7.11.1a-b	NL	LC	NC	1 (7%)	21 (43%)
7.11.7a-b	NL	LC	NC	2 (1%)	9 (3%)
7.11.13	NL	OC	E	0	<1 (<1%)
7.11.33	NL	OC	OC	0	0
7.11.44	NL	OC	OC	1 (2%)	3 (6%)
7.11.51a	NL	LC	OC	0	0
Total Remnant Vegetation				4 (1%)	33 (7%)
Total Non-remnant Vegetation				167 (63%)	138 (65%)

A: Status according to EHP's Biodiversity Status, VM Act and EPBC Act. Categories comprise: Endangered (E), Of Concern (OC), Least Concern (L), No Concern at Present (NC) and Not Listed (NL).

B: Area estimates are rounded to the nearest whole number. They are estimates because area determinations are based on work that involves the interpretation of aerial photographs that are rectified for use, the delineation of boundaries between vegetation communities may not be precise, and that delineation is defined by a line on a map, the width of which also constitutes a source of imprecision. Values calculated based on DNRM (2017) mapping (Figure 8-2) and revised mapping derived from NRA (Appendix) (Figure 8-3). Proportions shown in parenthesis are the area of RE lost relative to what currently exists on the project area.

[6] Due to biology (including life history), behaviour and/or population size.

The proposed clearing will result in the direct loss of the following values (rounded to nearest whole number).

- **EPBC Act**. Nil loss of Threatened Ecological Communities.
- **VM Act**.
  - According to DNRM (2017) mapping, development is proposed over REs of the following status: 3 hectares Least Concern and 1 hectare Of Concern.
  - According to NRA revised mapping, development is proposed over REs of the following status: 30 hectares Least Concern and 3 hectares Of Concern.
- EHP Biodiversity Status.
  - According to DNRM (2017) mapping, development is proposed over REs of the following status: 3 hectares No Concern at Present and 1 hectare Of Concern.
  - According to NRA revised mapping, development is proposed over REs of the following status: 30 hectares Least Concern, 3 hectares Of Concern and <1 hectare Endangered.

8.7.1.1.2 *Threatened and Near Threatened flora*

The proposed development has the potential to result in the direct loss of T&NT plants and their habitat. One T&NT species, the Near Threatened (NC Act) Slender Ginger, was found within the proposed development area (in the north east of project area; Figure 8-4). Myola Palm also occurs within the proposed project area, though this species occurs along streams and is unlikely to be directly affected by clearing. The potential loss of core habitat for T&NT species known or predicted to occur on the project area is shown in Table 8-3.

Table 8-3 Threatened and Near Threatened flora known or predicted to occur on the project area, their status, potential habitat and potential impact area.

Species	Presence[A]	Status[B]		Potential Core Habitat (Regional Ecosystem)[C]	Potential Impact Area (ha) & Proportion (%)[D]	
		NC Act	EPBC Act		DNRM (2017)	NRA Revised
Daintree Gardenia (*Randia audasii*)	Verified	NT	-	RE 7.11.1.	1 (7%)	21 (43%)
Slender Ginger (*Alpinia hylandii*)	Verified	NT	-	RE 7.11.1.	1 (7%)	21 (43%)
Crepidomanes majoriae	Probable	V	-	RE 7.11.1.	1 (7%)	21 (43%)
Endlicher's Filmy Fern (*Polyphlebium endlicherianum*)	Probable	V	E	RE 7.11.1.	1 (7%)	21 (43%)
Rat's Tail Tassel-fern (*Phlegmariurus filiformis*)	Possible	E	E	RE 7.11.1.	1 (7%)	21 (43%)
Diplazium cordifolium	Probable	V	-	RE 7.11.1 (streams)	1 (7%)	21 (43%)
Myola Palm (*Archontophoenix myolensis*)	Verified[E]	E	E	RE 7.11.1, RE 7.11.7 (streams).	3 (1%)	30 (10%)
Smooth-bark Rose Apple (*Syzygium hodgkinsoniae*)	Probable	V	V	RE 7.11.1, RE 7.11.7 (streams).	3 (1%)	30 (10%)

Species	Presence[A]	Status[B]		Potential Core Habitat (Regional Ecosystem)[C]	Potential Impact Area (ha) & Proportion (%)[D]	
		NC Act	EPBC Act		DNRM (2017)	NRA Revised
Velvet Jewel Orchid (*Zeuxine polygonoides* Syn, *Rhomboda polygonoides*)	Probable	V	V	RE 7.11.1, RE 7.11.7 (streams).	3 (1%)	30 (10%)
Cajanus mareebensis	Possible	E	E	RE 7.11.44.	1 (2%)	3 (6%)

A: Either 'Verified' as present during the NRA study (Appendix 5), or, predicted to have a 'Probable' or 'Possible' presence on project area.

B: Status of Threatened and Near Threatened species as listed under the NC Act and EPBC Act. Categories comprise: Near Threatened (NT), Vulnerable (V) and Endangered (E).

C: Habitats, as represented by REs, the species is most likely to occur in. Based on the parent RE (vegetation community variations not stated). Species typically associated with streams are indicated.

D: Area estimates are rounded to the nearest whole number. They are estimates because area determinations are based on work that involves the interpretation of aerial photographs that are rectified for use, the delineation of boundaries between vegetation communities may not be precise, and that delineation is defined by a line on a map, the width of which also constitutes a source of imprecision. Values calculated based on DNRM (2017) mapping (Figure 8-2) and revised mapping based on the results of NRA (Appendix 5) (Figure 8-3). Proportions shown in parenthesis are the area of RE lost relative to what currently exists on project area.

E: Assumed present. Taxonomy of plants on project area is unresolved.

8.7.1.2 Indirect threats

Potential indirect threats to flora values associated with urban developments are listed below.

- Edge effects. Clearing and subsequent development could result in changes to wildlife communities and environments along, and extending out from, the edge of disturbance. Clearing in linear patterns, such as along road easements may act to funnel winds along disturbance edges and the edge of cleared areas can favour non-native and disturbance adapted species. The threat of increasing edge effects is discussed in further detail in Appendix 5 (refer to Section 5.2.3).
- Inappropriate excavation or earthworks practices, during construction and/or operation, resulting in erosion and vegetation loss.
- Inappropriate vegetation clearing practices, during construction and/or operation, resulting in the inadvertent loss of vegetation (directly or indirectly due to erosion).
- Fugitive dust smothering vegetation, reducing plant health in the immediate receiving environment. This impact is most likely during the construction phase.
- Release of contaminated waters, excessive nutrients or hazardous substances to the natural environment resulting in reduced plant health, habitat degradation, habitat modification and/or loss of vegetation.
- Urban developments, during construction and operation, have the potential to result in new biosecurity incursions and/or contribute to the spread of existing infestations. Reduced habitat quality is a potential consequence of both scenarios.

It is not possible to quantify the potential magnitude of impacts that may result from the above indirect threats. Some indirect threats are likely to be short-term and very localised in spatial extent (for example fugitive dust) whereas others, if not properly managed, may cause severe and/or irreversible impacts at the site, local and regional scales (for example biosecurity incursions).

8.7.2 Management measures for flora impacts

The below list presents the mitigation measures specific to flora, though many are applicable to other terrestrial ecological values.

- **Management Measure 1:** Destroy existing infestation of Cat's Claw Creeper (*Macfadyena unguis-cati*) and monitor the area for re-emergence or recovery of the species. Re-treat as required to achieve eradication.
- **Management Measure 2:** Prior to clearing woody vegetation (remnant or non-remnant) conduct surveys for T&NT plants in accordance with the Queensland Protected Plant Survey Guidelines [note: some of this work is complete; see Astrebla (2015)]. Subsequent management of any T&NT plants threatened by development should occur in accordance with relevant legislation.
- **Management Measure 3:** Minimise vegetation clearing extent via planning and implementation of systems/controls during construction (for example permit to clear system and clearly marking clearing extents prior to disturbance). This includes clearing for new roads and bridges.
- **Management Measure 4:** Implement systems to prevent unauthorised vegetation clearing throughout the operational life of the development.
- **Management Measure 5:** Develop and implement a rehabilitation plan. The plan should be prepared by suitably qualified persons and be appropriate for the setting (that is consider project and activity-related threats and all values of the receiving environment). All areas in the Environmental Area currently devoid of native vegetation should be rehabilitated to natural conditions. Areas disturbed during construction that are not needed for the operation phase should be rehabilitated as soon as they become available.
- **Management Measure 6:** Develop and implement a project-specific biosecurity management plan (construction and operation phases). The plan should include methods for prevention of introduction and/or spread of weeds, pests and pathogens, inspections/monitoring and control. The plan should be developed by a suitably qualified person and be appropriate for the setting (that is consider project-related threats, local/regional threats and all values of the receiving environment).
- **Management Measure 7:** Develop and implement an appropriate project-wide landscaping plan (construction and operation phases). The plan should provide guidance on plant species selection and describe limitations or precautions with regard to the receiving environment (example limitations or issues when landscaping in or near habitats for threatened stream-dwelling frogs). The plan should be developed by, or reviewed by, a suitably qualified person(s) to ensure it is appropriate for the setting (that is consider activity-related threats and all values of the receiving environment).
- **Management Measure 8:** Develop and implement a fire management plan (construction and operation). The plan should include methods for prevention of uncontrolled wildfire and emergency response.
- **Management Measure 9:** Develop and implement a stormwater management plan designed to achieve no adverse change in the environmental values of the aquatic receiving environment. The management plan should include a monitoring programme capable of detecting change in key indicators (that is indicators that are specific to potential project-related contamination sources and specific to known values of the receiving environment). The sampling regime should be sufficient to detect changes in key indicators and allow/provide for a timely management response.
- **Management Measure 10:** The wastewater treatment system, inclusive of effluent irrigation (if this occurs), should be designed and managed so as to achieve no adverse change in the environmental values of the aquatic receiving environment.
- **Management Measure 11:** Manage run-off or wash-down water from animal enclosures/stables to avoid contamination of the aquatic receiving environment.
- **Management Measure 12:** Irrigation practices should be managed to reduce the run-off of irrigated water or the infiltration of potentially contaminated water (for example nutrients, pesticides, herbicides) to groundwater.
- **Management Measure 13:** Develop and implement a dust management plan (construction).

- **Management Measure 14:** Develop and implement Erosion and Sedimentation Control Plans (ESCPs) for each area of construction and for the operational phase, inclusive of certification of the plans by a Certified Professional in Erosion and Sediment Control (CPESC) or equivalent. ESCPs should be designed with the objective of achieving no adverse impact on the aquatic receiving environment.
- **Management Measure 15:** Develop and implement a management plan for the storage and handling of chemicals and hazardous substances (construction). The management plan should consider storage of minimum necessary volumes, emergency response training, procedures and controls in the event of an inadvertent release of chemicals or hazardous substances.
- **Management Measure 16:** Design plans for communal buildings and infrastructure facilities should consider the potential need for storage and handling of chemicals and hazardous substances.
- **Management Measure 17:** Training and site inductions to increase environmental awareness, identification of project-related threats and management requirements/obligations (construction and operation).
- **Management Measure 18:** Feral pigs should be managed to reduce numbers and limit access to creeks across the project area.
- **Management Measure 19:** Prevent cattle access to creeks via fencing and the provision of off-creek watering points.
- **Management Measure 20:** Implement and appropriately resource (capital, labour, time, equipment) a management system to ensure that recommendations presented in this report, and any subsequent flora and fauna assessments, are implemented. The system should identify lines of responsibility/accountability and encompass the life of project (construction and operation).

8.7.3 Potential impacts to fauna

The project has the potential to generate a range of direct and indirect threats with the potential to impact on fauna values.

8.7.3.1 Direct threats

Direct threats comprise the loss of habitat (and subsequent displacement of wildlife), and direct mortality or harm during clearing and excavation works. With respect to habitat loss, it is the loss of core, limiting, or critical habitat that poses the greatest direct threat. Habitats in the local area are frequently exposed to catastrophic weather events (for example severe tropical cyclones) and therefore supporting or marginal habitats may also be important when core, limiting or critical habitats are unavailable.

The potential magnitude of direct harm to T/NT&M fauna, or fauna more generally, as a consequence of vegetation clearing and excavation cannot be quantified. The potential magnitude of harm is likely to be proportional to the scale of habitat loss. Controls should be implemented during construction works to reduce the potential for harm. The Tapping Green-eyed Frog is the most susceptible T/NT&M species to this threat because it has core habitat in proposed impact areas and it has limited ability to rapidly vacate impact areas.

The potential magnitude of core habitat loss for T/NT&M species as a consequence of the proposed development is shown in Table 8-4. The assumptions and data sources used for calculation of potential core habitat loss are provided in Appendix 5 (refer to Section 5.3.3).

Table 8-4 Threatened, Near Threatened and Migratory-listed species known or predicted to occur on the project area, their status, potential core habitat and potential impact area.

Species	Status[A]		Core Habitat[B]	Predicted Occurrence[C]	Potential Impact Area (ha) & Proportion (%)[D]	
	NC Act	EPBC Act			NRA Habitat Mapping[E]	DSITI (2016) Habitat Mapping
Kuranda Tree Frog	E	E	MNVF (streams for breeding) (Figure 8.6.2)	Regular / resident	0	N/A
Tapping Green-eyed Frog	V	-	MNVF and NMVF (streams for breeding) (Figure 8.7.3.2.1)	Regular / resident	59 (16%)	N/A
Bare-rumped Sheathtail Bat	E	V	EOFW	Regular / resident	6 (4%)	1 (1%)
Greater Large-eared Horseshoe Bat	E	V	MNVF, NMVF and EOFW	Regular / resident	87 (15%)	6 (1%)
Spectacled Flying-fox	V	V	MNVF, NMVF and EOFW	Regular / resident	87 (15%)	6 (1%)
Macleay's Fig-parrot	V	-	MNVF, NMVF and EOFW	Regular / resident	87 (15%)	6 (1%)
Spectacled Monarch	SL	M	MNVF, NMVF and EOFW	Regular / resident	87 (15%)	6 (1%)
Black-faced Monarch	SL	M	MNVF, NMVF and EOFW	Regular / resident	87 (15%)	6 (1%)
Rufous Fantail	SL	M	MNVF, NMVF and EOFW	Regular / resident	87 (15%)	6 (1%)
White-throated Needletail	SL	M	Above (airspace) all habitats	Regular / resident	Nil	Nil
Fork-tailed Swift	SL	M	Above (airspace) all habitats	Regular / resident	Nil	Nil
Greater Glider	V	V	EOFW	Uncertain	6 (4%)	1 (1%)
Blue-faced Parrot-finch	NT	-	EOFW	Uncertain	6 (4%)	1 (1%)
Northern Bettong	E	E	EOFW	Uncertain	6 (4%)	1 (1%)
Tube-nosed Insectivorous Bat	V	-	MNVF, NMVF and EOFW	Uncertain	87 (15%)	6 (1%)
Semon's Leaf-nosed Bat	E	V	MNVF, NMVF and EOFW	Uncertain	87 (15%)	6 (1%)
Masked Owl	V	V	MNVF, NMVF and EOFW	Uncertain	87 (15%)	6 (1%)
Diadem Leaf-nosed Bat	NT	-	MNVF, NMVF and EOFW	Uncertain	87 (15%)	6 (1%)

Species	Status[A]		Core Habitat[B]	Predicted Occurrence[C]	Potential Impact Area (ha) & Proportion (%)[D]	
	NC Act	EPBC Act			NRA Habitat Mapping[E]	DSITI (2016) Habitat Mapping
Southern Cassowary	E	E	MNVF and NMVF	Intermittent	80 (19%)	5 (2%)
Lumholtz's Tree-kangaroo	NT	-	MNVF and NMVF	Intermittent	80 (19%)	5 (2%)
Australian Lacelid	E	E	MNVF (streams for breeding)	Intermittent	0	N/A
Northern Quoll	LC	E	EOFW	Intermittent	6 (4%)	1 (1%)
Red Goshawk	E	V	EOFW	Intermittent	6 (4%)	1 (1%)
Grey Falcon	V	-	EOFW	Intermittent	6 (4%)	1 (1%)
Oriental Cuckoo	SL	M	EOFW	Intermittent	6 (4%)	1 (1%)
Glossy Ibis	SL	M	Open Pasture	Intermittent	84 (87%)	N/A
Ghost Bat	E	V	MNVF, NMVF and EOFW	Intermittent	87 (15%)	6 (1%)
Eastern Osprey	SL	M	MNVF, NMVF and EOFW	Intermittent	87 (15%)	6 (1%)
Barn Swallow	SL	M	Above (airspace) all habitats	Intermittent	Nil	Nil

A: Status of Threatened, Near Threatened and Migratory species as listed under the NC Act and EPBC Act. Categories comprise: Least Concern (LC), Special Least Concern (SL), Migratory (M), Near Threatened (NT), Vulnerable (V) and Endangered (E).

B: Predicted core habitat for each species on project area. Core habitat does not necessarily encompass the full range of habitats in which a species may occur; for most species on the project area, all forested habitat types will be of some potential value. See Appendix 5 (refer to Section 4.3.2) for further detail.

C: Predicted occurrence based on published information on species distribution and ecology and observed conditions on-site. Categories comprise: 'Regular / resident', 'Intermittent' and 'Uncertain'. See Appendix 5 (refer to Section 4.3.2) for further detail.

D: Based on direct loss of predicted core habitat. They are estimates because area determinations are based on work that involves the interpretation of aerial photographs that are rectified for use, the delineation of boundaries between vegetation communities may not be precise, and that delineation is defined by a line on a map, the width of which also constitutes a source of imprecision. Area estimates are rounded to the nearest whole number. Proportions shown in parenthesis are the area of habitat lost relative to what currently exists on the project area.

E: Revised habitat mapping is where all forested areas are treated as potential habitat. Pre-clearing BVG mapping was used to delineate distribution of BVG types. Specific mapping and decisions rules were used for Kuranda Tree Frog (Figure 8-9) and Tapping Green-eyed Frog (Figure 8-10).

8.7.3.2 Indirect threats

Indirect threats refer to those secondary threats that may occur as a result of the development. Their impacts may extend beyond the development footprint and some may persist throughout the operational life of the project. Potential indirect threats to fauna values associated with urban developments may include the following.

- All indirect threats described for flora (see Appendix 5, refer to Section 5.2.3) are applicable to fauna in that plant communities are a component of fauna habitat.
- Sedimentation and contamination of waterways resulting in reduced water quality and condition of in-stream habitats.

- Alteration of surface hydrology (that is changing drainage, the locations where surface water occurs and altered environmental flows).
- Direct and/or secondary poisoning of wildlife due to 'pest' control programmes (lethal or sub-lethal impacts).
- Altered fauna communities in response to artificial lighting and changes to the acoustic environment.
- Increased number of cats and dogs and subsequent incidence of attacks on native wildlife, and/or alteration of natural behaviours of native wildlife due to the presence of cats and dogs.
- Increased chance of wildlife colliding with vehicles.
- Increased number of human-wildlife interactions. These may have negative effects on some wildlife for example some wildlife are shy of humans and may vacate an area.
- Increased levels of habitat fragmentation that is changed fauna behaviours in response to human presence and/or physical habitat loss.

It is not possible to quantify the potential magnitude of impact that may result from the above indirect threats. Some indirect threats are likely to be short-term and very localised in spatial extent (for example fugitive dust) whereas others, if not properly managed, may cause severe and/or irreversible impacts at the site, local and regional scales (for example biosecurity incursions) (Table 8-5). The fauna species (and populations) that are potentially most vulnerable to the indirect threats (and resulting impacts) are those that:

- are permanent, frequent or regular inhabitants of the site (*see* Table 8-4).
- are sensitive to the threats posed by the action[7]
- have core, limiting or critical habitat within the receiving environment of impact.

The fauna species predicted to have an intermittent occurrence within the project area, and whose core habitats or areas of activity are likely to be remote to the main area of potential indirect threats, comprise: White-throated Needletail, Fork-tailed Swift, Greater Glider, Northern Bettong, Lumholtz's Tree-kangaroo, Northern Quoll, Red Goshawk, Grey Falcon, Ghost Bat, Oriental Cuckoo and Barn Swallow. These species are least vulnerable to the potential indirect threats of the project. The Kuranda Tree Frog and Tapping Green-eyed Frog are the most vulnerable in that they have critical habitat in the immediate receiving environment and are sensitive to most of the potential identified indirect threats.

Table 8-5 Potential indirect threats (in the absence of mitigation) to fauna.

Indirect Threat	Potential Spatial Scale of Impact [A]	Potential Temporal Scale of Impact [B]	Comments
Habitat loss due to uncontrolled clearing, excavation, or other physical disturbance.	Site-specific.	Medium (assuming some natural regeneration) to long-term.	Standard controls can reduce likelihood of impact. Some impacts reversible.
Habitat degradation: edge effects.	Site-specific.	Short to long-term.	Most pronounced along disturbance edges and likely to vary spatially and temporally.
Habitat degradation: biosecurity ingress and proliferation.	Mostly site-specific; however, potential for local or regional scale impacts.	Long-term.	Standard controls can reduce likelihood of impact, and in most cases,

[7] Due to biology (including life history), behaviour and/or population size.

Indirect Threat	Potential Spatial Scale of Impact [A]	Potential Temporal Scale of Impact [B]	Comments
			reduce spatial and temporal scale of impact.
Habitat degradation: fugitive dust.	Site-specific.	Short-term.	Standard controls can reduce risk.
Sedimentation and contamination.	Mostly site-specific; however, potential for local scale impacts.	Short to long-term depending on severity.	Standard controls can reduce likelihood of impact.
Alteration of surface hydrology.	Mostly site-specific; however, potential for local scale impacts	Short to long-term.	Standard controls can reduce risk.
'Pest' control programmes.	Mostly site-specific; however, potential for local or regional scale impacts.	Long-term.	Threats difficult to monitor and control during operational life of project.
Artificial lighting and anthropogenic noise.	Site-specific.	Long-term.	Standard controls can reduce likelihood of impact.
Domestic cats and dogs.	Site-specific.	Long-term.	Standard controls can reduce likelihood of impact. Some controls difficult to enforce.
Collision with vehicles.	Mostly site-specific; however, potential for local or regional scale impacts.	Long-term.	Standard controls can reduce likelihood of impact.
Human-wildlife interactions	Site-specific.	Long-term.	Standard controls can reduce likelihood of impact. Some controls difficult to enforce.
Habitat fragmentation.	Site-specific and local scale.	Long-term.	Sensitive planning can reduce impacts.

[A] Spatial scale categories comprise: site-specific (that is project area), local area (for example within 5 kilometres of project area) and regional (for example within 20 kilometres of project area).

[B] Temporal scale categories comprise: short-term (1 year to 5 years), medium-term (5 years to 30 years) and long-term (>30 years).

Detailed discussion of indirect threats with potential influence on T/NT&M is presented in Appendix 5 (refer to section 5.3.3).

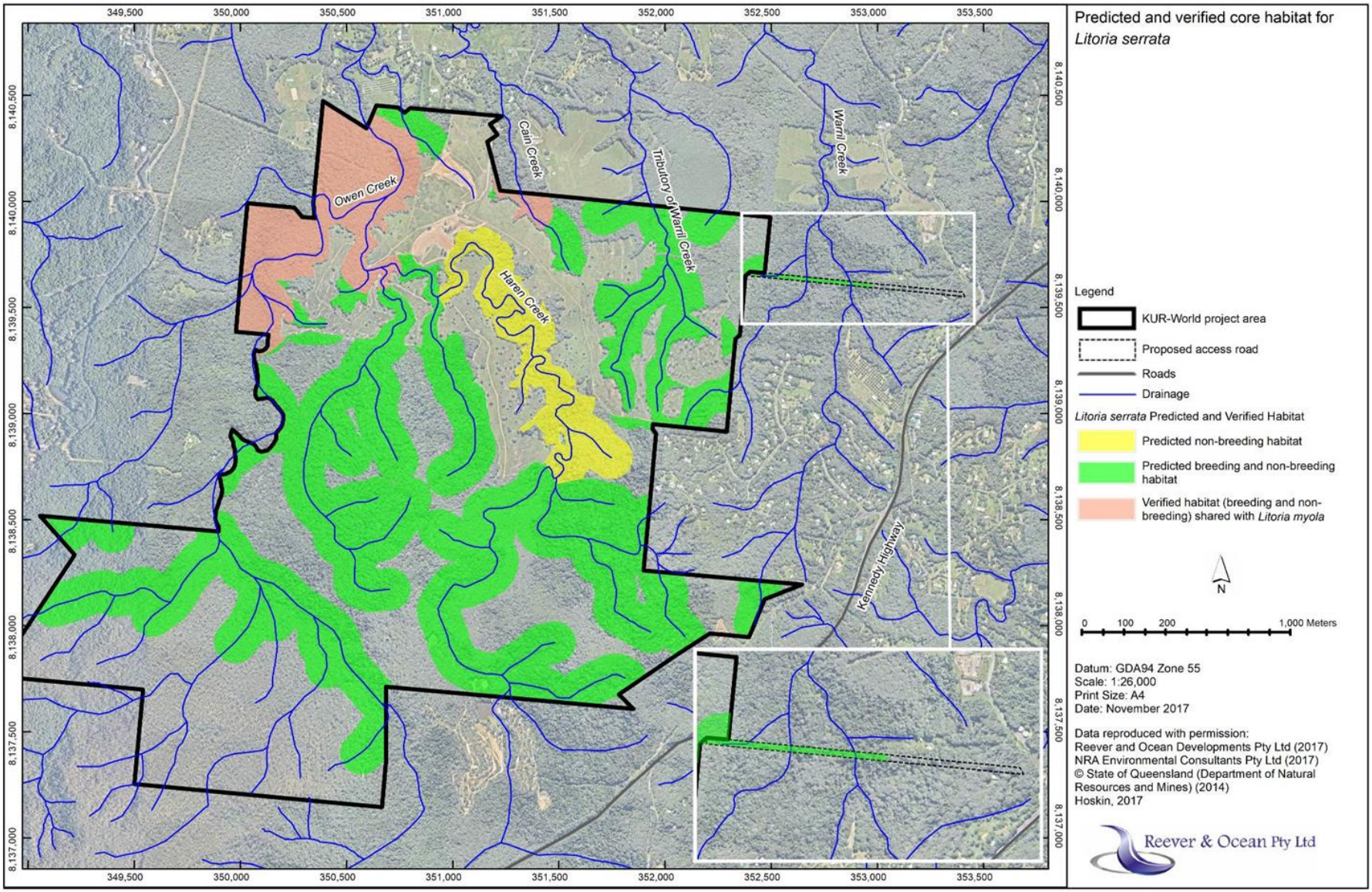

Figure 8-10 Predicted and verified core habitat for *Litoria serrata*.

8.7.3.3 Management measures for fauna impacts

The below list presents the mitigation measures specific to fauna, though many are applicable to other terrestrial ecological values. Most of the management measures relating to flora are applicable to fauna and are not repeated below.

- **Management Measure 21:** Reduce the extent of fauna habitat loss in the north-east of the project area. The primary objectives for habitat retention should be to: (a) reduce net Tapping Green-eyed Tree Frog habitat loss; (b) reduce net MNVF habitat loss; and (c) retain a forest corridor along the Warril Creek tributary. The recommended minimum areas for habitat retention are shown on Figure 8-11. Similar results can be achieved with different configurations. Any adjustment in the configuration of retained habitats should optimise protection of habitats where Tapping Green-eyed Frog occur at high densities, which in the north-east of the project area corresponds with the downstream reach of the Warril Creek tributary.
- **Management Measure 22:** Restore riparian vegetation along Haren Creek, Owen Creek, Cain Creek and the tributary of Warril Creek. The recommended areas for habitat restoration are shown on Figure 8-11 (approximately 12 hectares). Habitat restoration should aim to improve the condition of riparian habitats for fauna and be of a habitat type that reflects pre-clearing conditions.
- **Management Measure 23:** Where clearing within, or adjacent to, Tapping Green-eyed Frog and Kuranda Tree Frog habitat cannot be avoided, manage bank stability and stormwater discharge to ensure no adverse change in the environmental values of the aquatic receiving environment. The use of vegetative buffers and engineering solutions should be considered.
- **Management Measure 24:** Measures to protect water quality should be integrated into project Erosion and Sediment Control Plans (ESCPs), Storm Water Management Plans and Surface Water Monitoring Programmes (SWMPs).
- **Management Measure 25:** Inspect disturbance areas for roosting or nesting fauna prior to clearing. If nesting or roosting fauna are found, clearing at that location should cease until the appropriate management and approval requirements are ascertained and implemented. A fauna spotter/catcher is to be present during clearing activities.
- **Management Measure 26:** Woody vegetation clearing should occur progressively to give animals that survive the tree-felling activity a chance to move out of the area. This is especially important in areas of potential Tapping Green-eyed Frog habitat (Figure 8-10).
- **Management Measure 27:** During the construction phase, develop and implement controls relating to noise management (including: maintain vehicles and machinery according to manufacturer specifications; fit and maintain appropriate mufflers on machinery used on-site).
- **Management Measure 28:** Lighting in public spaces should be designed to minimise artificial light impacting natural habitats, in particular avoid artificial light impacts on riparian habitats. The use of lighting shields, directional lighting, timers and motion-sensors should be considered.
- **Management Measure 29:** Pathways through the development area should be designed to prevent pedestrian access to core Kuranda Tree Frog habitat (Figure 8-9), and areas immediately upstream of this habitat (nominally 1 kilometre from mapped habitat).
- **Management Measure 30:** Roads through forest areas, notably the proposed access roads, should be designed to minimise the barrier effects to fauna movements and to reduce the likelihood of fauna being hit by vehicles. A suitably qualified and experienced ecologist should be involved with the designs. All fauna groups should be considered, though specific attention should be given to threatened stream-dwelling frogs and Southern Cassowary. Clearing widths (construction and operation) should be kept as low as possible and strategies to reduce the impact of light and acoustic pollution, especially near streams, should be incorporated into designs. Bridges should be used over larger streams, and designed to permit fauna movements (including Southern Cassowary) and

minimise ground disturbance. A maximum 50km/hour speed limit should apply to the access roads, though the need for further speed reductions, and speed reduction furniture, should be considered during the design phase (for example lower speeds due to poor line of sight along roadways).

- **Management Measure 31:** The Rainforest Education Centre and Adventure Park (inclusive of the Zip Line) should be designed so as to result in minimal clearing of woody vegetation, especially remnant vegetation.
- **Management Measure 32:** The project biosecurity management plan (Management Measure 6) should include specific focus on protecting riparian habitats, in particular core habitat for Kuranda Tree Frog (Figure 8-9).
- **Management Measure 33:** The use of toxic baits to control feral vertebrate pests is discouraged. Toxic baits should only be considered if the potential for non-target impacts on native fauna has been properly assessed (for example by a suitably qualified person) and if strategies to negate non-target impacts are available and implemented. For example, toxic baiting of wild dogs may pose a threat to Northern Quoll, and the use of rodenticides can result in secondary poisoning (that is kill or harm) higher order predators (for example Masked Owl).
- **Management Measure 34:** All management and monitoring plans relating to the aquatic environment should consider the requirements of Kuranda Tree Frog and Tapping Green-eyed Frog. Populations of Kuranda Tree Frog in the entire receiving environment (that is on and off-site) should be considered.
- **Management Measure 35:** Prohibit cat ownership and limit dog ownership to small breeds, or certified assistance dogs. The rules regarding pet ownership should include proper containment within place of residence. All rules should be enforceable and monitored.
- **Management Measure 36:** The development should include a community/public education programme so that all residents and visitors are aware of the sensitivity of the receiving environment, and aware of any relevant rules or regulations.
- **Management Measure 37:** The Zip Line should be designed and constructed with the knowledge that the area could be fire affected.
- **Management Measure 38:** Barrier netting should not be used along the golf course unless it poses a negligible threat to volant fauna as determined by a suitably qualified ecologist.
- **Management Measure 39:** The use of surface or ground-stored water should not adversely change the environmental values of the aquatic receiving environment. The parameters around which water is used should be based on specific assessment by suitably qualified persons and consider the specific values of the receiving environment.
- **Management Measure 40:** An Environmental Management Plan (Operational Phase) should be developed for each development precinct or activity. The plan should identify and address potential threats to the environment associated with the activity/land use, measures to address threats, responsibilities and performance measures. This is particularly important for the golf course which may require the use of chemicals in areas near to Threatened frog habitat.
- **Management Measure 41:** The Environmental Area should be retained as a reserve for native wildlife with the primary function of nature conservation. The management plan should be developed by a suitably qualified and experienced ecologist. The management plan should aim to protect the value of the area as habitat for native flora and fauna, and protect its value as a wildlife corridor. The management plan should identify the values of the area, existing and emerging threats, and actions to address and monitor existing and emerging threats. The management plan should be appropriately resourced (capital, labour, time, equipment) and have clear lines of responsibility/accountability that encompass the life of project.
- **Management Measure 42:** Conduct targeted surveys for T&NT fauna in forests and woodlands immediately west of the project area. The results should be used to inform the fire management plan

for the south-western portion of the Environmental Area. The survey should include targeted searches for Northern Bettong and Northern Quoll.

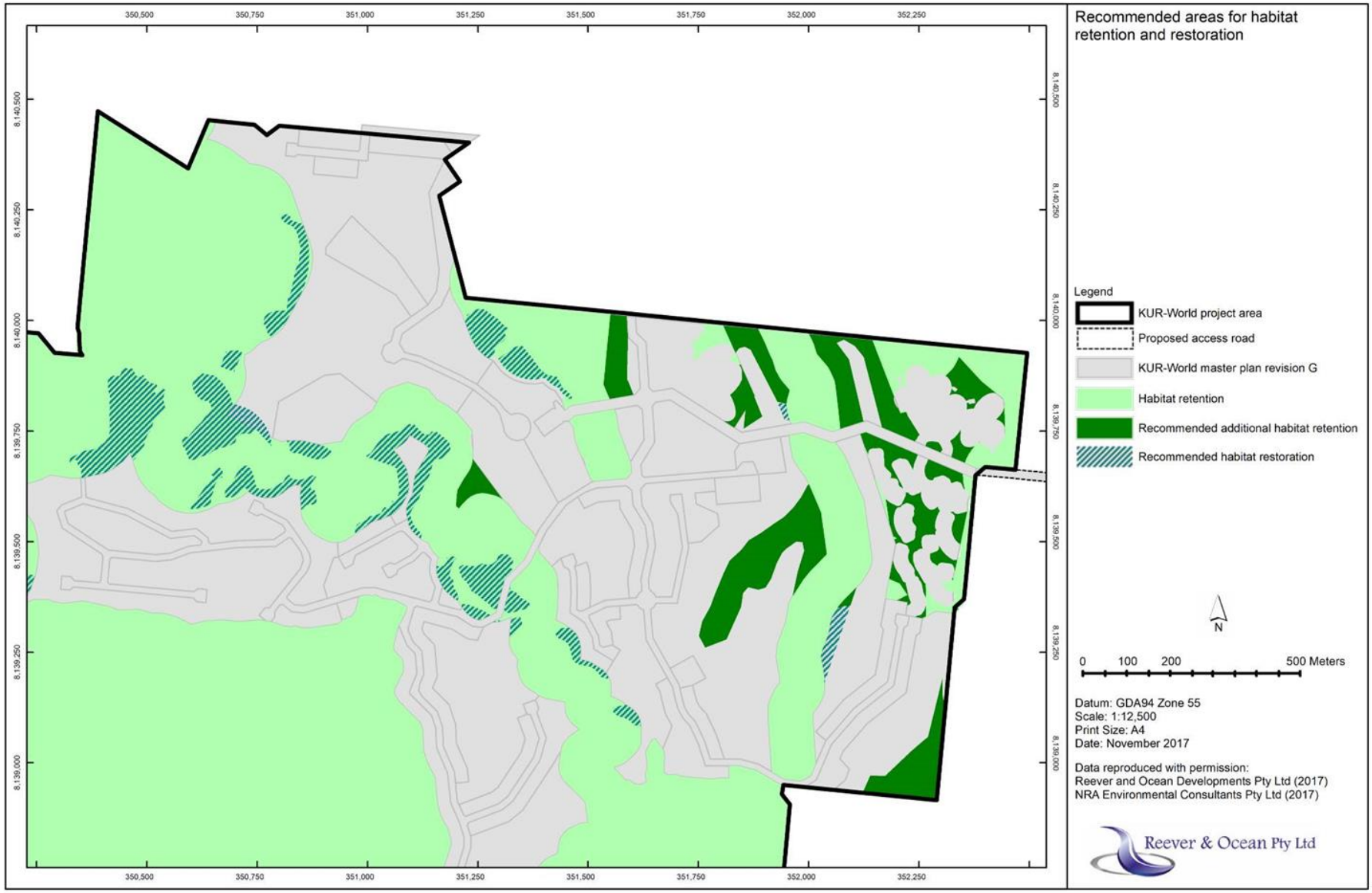

Figure 8-11 Recommended areas for habitat retention and restoration.

8.7.4 Potential impacts to landscape integrity values

The broad landscape in which the project area occurs is an important corridor for a variety of wildlife, including T/NT&M species. The project area contributes to the Kuranda-Myola-Kowrowa rainforest corridor and also contributes habitat to a sclerophyll forest corridor to the west of the project area (Figure 8-6). The potential project-related impacts for flora and fauna are also relevant to impacts to landscape level values. These impacts have been discussed in detail in previous sections.

In summary, the proposed development has the potential to further decrease the value and functionality of the eastern portion of the Kuranda-Myola-Kowrowa rainforest corridor via direct and indirect threats and processes. It may also indirectly impact to the western portion of this corridor, with impacts likely to be most pronounced along the edge of development and attenuating with distance from the development edge. Therefore, appropriate management measures need to be deployed to avoid degradation of the value of these corridors.

8.7.4.1 Management measures for impacts to landscape integrity values

All previous Management Measures are relevant to managing threats to landscape integrity values.

8.7.5 Potential residual impacts and legislative considerations

The project has been designed to predominantly occur in non-remnant vegetation as shown on DNRM (2017) mapping (Figure 8-2). This approach was taken during the preliminary design and planning phases of the project, and prior to the completion of the flora and fauna studies (Appendix 5). The design intention was to reduce the potential project-related environmental impacts. Potential residual impacts are the impacts predicted to occur following implementation of the management measures.

Commonwealth and Queensland Government policies are available to assist in determining whether a potential residual impact is 'significant' (hereafter, significant residual impact (SRI)). These include generic and value-specific policies, some of which overlap. The relevant generic polices are as follows.

- Significant Residual Impact Guideline. For matters of state environmental significance and prescribed activities assessable under the Sustainable Planning Act 2009. Queensland Environmental Offsets Policy (DSIP 2014).
- Queensland Environmental Offsets Policy. Significant Residual Impact Guideline. Nature Conservation Act 1992, Environmental Protection Act 1994 and Marine Parks Act 2004 (EHP 2014).
- Matters of National Environmental Significance. Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999 (DoE 2013).

One value-specific significant impact policy is potentially relevant as follows.

- Significant impact guidelines for the endangered southern cassowary (*Casuarius casuarius johnsonii*) Wet Tropics population. EPBC Act policy statement 3.15 (DEWHA 2010).

8.7.5.1 Potential residual impacts to flora

The potential impacts with respect to remnant vegetation clearing may vary subject to Management Measure 21 (relating to habitat retention in the north-east of the project area).

Woody vegetation clearing associated with the master plan will result in the loss of REs and habitat for T&NT plants as described in Table 8-2 and Table 8-3, respectively. Surveys for T&NT plants have been conducted and identify the NC Act Near Threatened Slender Ginger as the only species likely to be directly impacted by the proposed clearing. On the available information, the potential loss is predicted to be relatively minor.

Implementation of Management Measure 21 (Figure 8-11) will reduce estimated clearing extents in relation to the NRA revised RE mapping. The estimated clearing extents for DNRM (2017) are unaffected by this Management Measure. The revised estimated clearing extents are shown in Table 8-6 and represent residual impacts. The proportion of potential loss of each RE when assessed at the local area scale (that is area within 5 kilometres of the project area boundary, including project area) and Kuranda area (as defined by Queensland Government locality mapping) scale are detailed in Table 8-6.

Table 8-6 Estimated clearing extents (Regional Ecosystems) and proportion of loss relative to the local and regional (Kuranda area) scales.

Regional Ecosystem Code	Estimated Project-related Woody Vegetation Clearing (ha)[A]		Proportion of Regional Ecosystem Loss (%)[B]			
			Local Area		Kuranda Area	
	DNRM (2017)	NRA revised RE mapping[C]	DNRM (2017)	NRA revised RE mapping	DNRM (2017)	NRA revised RE mapping
7.11.1a-b	1	15	<1%	<1%	<1%	<1%
7.11.7a-b	2	9	<1%	<1%	<1%	1%
7.11.13	0	<1	0%	0%	0%	<1%
7.11.33	0	0	0%	0%	0%	0%
7.11.44	1	3	1%	2%	1%	2%
7.11.51a	0	0	0%	0%	0%	0%
Total Remnant Vegetation	4	27	<1%	<1%	<1%	<1%

A: Area estimates are rounded to the nearest whole number. They are estimates because area determinations are based on work that involves the interpretation of aerial photographs that are rectified for use, the delineation of boundaries between vegetation communities may not be precise, and that delineation is defined by a line on a map, the width of which also constitutes a source of imprecision. Values calculated based on DNRM (2017) mapping (Figure 8-2) and revised mapping (Figure 8-3).

B: The 'local area' is the area within 5 kilometres of the project area boundary. The 'Kuranda area' is the locality boundary as defined by Queensland Government mapping.

C: Area estimate assumes implementation of Management Measure 21 (Figure 8-11).

The potential for SRI on REs was assessed with reference to DSIP (2014). This was achieved via SRI criteria relating to Regulated Vegetation as defined under the VM Act. SRIs are likely when:

- clearing of more than 5 hectares of VM Act Endangered or Of Concern RE vegetation
- clearing that results in an overall area (not confined to property boundaries) of Endangered or Of Concern RE vegetation of less than 5 ha
- clearing that results in the physical separation[8] of Endangered and Of Concern RE communities within and on adjoining sites.

Project-related vegetation clearing will potentially impact one or two VM Act Of Concern REs (RE 7.11.13 and RE 7.11.44) depending on which map is applied; that is DNRM (2017) mapping (Figure 8-2) or NRA revised mapping (Figure 8-3).

- **RE 7.11.13**. Proposed clearing of RE 7.11.13 is minor (Table 8-6) and SRIs will not occur.

[8] Physical separation refers to any clearing that would result in the separation of an otherwise intact area of vegetation (source: DSIP (2014)).

- **RE 7.11.44**.
  - ***Clearing extents***. Proposed clearing of RE 7.11.44 is estimated as 1 hectare to 3 hectares (Table 8-6) depending on which mapping data are applied; and in either case the estimates are lower than 5 hectares and the SRI will not occur.
  - ***Spatial separation***. The proposed access road to the Rainforest Education Centre and Adventure Park has been designed to follow an existing vehicle track (approximately 3 metres to 5 metres wide). The existing vehicle track has created physical separation between blocks of RE 7.11.44; however, the canopy above the track is touching along most of this area and, from an ecological function perspective, a habitat disjunction does not occur at these points. Vegetation clearing will create separation in the forest canopy.

DSIP (2014) has defined eight exceptions to the above SRI criteria – item (b) of these exceptions is relevant to the SRI determination.

> '*(b) clearing of less than 10% of the total mapped area of 'endangered' or 'of concern' REs intersecting the property boundaries of the project, if total clearing is under 5 ha; and where an equivalent area which can be mapped as endangered or of concern in the future, is rehabilitated through other locations on the subject site.*' (source: DSIP 2014).

From a regulatory perspective, it is understood that remnant vegetation on the project area is defined by the Property Map of Assessable Vegetation (PMAV) (PMAV 2016), which mirrors DNRM (2017). On this basis a SRI on Regulated Vegetation can be avoided because the clearing of the Of Concern RE 7.11.44:

- is approximately 1 hectare (that is <5 hectare)
- is approximately 2% (that is <10%) of what is available elsewhere on the project area
- >1 hectare of RE 7.11.44 regrowth (non-remnant vegetation on the PMAV and DNRM 2017) exists on the project area and can be protected from development.

On the available information, the potential for SRI on Regulated Vegetation is unlikely.

With respect to T&NT plants, DSIP (2014) and EHP (2014) have SRI criteria relating to NC Act Endangered and Vulnerable plant species. On the available information, SRIs are not anticipated because the Near Threatened Slender Ginger is the only T&NT plant species known to occur within the proposed clearing area, and the proposed clearing extents are relatively minor (Table 8-2 and Table 8-6)[9].

8.7.5.1.1 *Additional Management measures*

The following Management Measure is provided within the same context, and additional to that, already provided.

- **Management Measure 43:** Protect and restore at least 1 hectare of regrowth RE 7.11.44 on the project area. This figure should be reviewed if development plans affecting RE 7.11.44 change. Areas of potential RE 7.11.44 regrowth can be identified using DNRM pre-clearing RE mapping and NRA revised RE mapping (Figure 8-3).

In summation, the information presented in the preceding sections can be presented as a Vegetation Clearing and Retention Plan for the project. Clearing areas required for development are influenced by the following:

- Disturbance areas (derived from the master plan)

[9] Protected plant surveys may be necessary to satisfy other regulatory requirements, specifically in relation to clearing proposed in the Rainforest Education Centre and Adventure Park, and may be required in the vicinity of the Golf Course, KUR-World Campus, Business and Leisure Hotel and Function Centre, Queenslander Lots and farm-stay accommodation in the Farm Theme Park and Equestrian Centre.

- Areas of vegetation to be retained and restored, in accordance with:
  - Habitat retention (Environmental Area on the master plan with minor additions from NRA (2017C))
  - Recommended additional habitat retention (Recommendation 21, NRA 2017c)
  - Recommended habitat restoration (Recommendation 22, NRA 2017c)
- Infrastructure Exclusion Areas, comprising the area between the edge of remnant vegetation and extending horizontally 1.5 times the height of the tallest remnant vegetation as categorised through LIDAR (in consideration of potential VM Act exemptions).
- Zip Line**:**
  - Disturbance areas have been included for Zip Line option 1 only, as this is the preferred option of the three available options.

The vegetation clearing and retention plan for the Masterplan precincts is provided on Figure **8**-**12**. Project-related clearing extents are itemised in Table 8-7. The KUR-World Project will prioritise retention and restoration of existing vegetation in the project area, whilst avoiding impacts to remnant vegetation as much as possible. The total impact to remnant vegetation (approximately 4 ha) reflects that described by NRA (2017c).

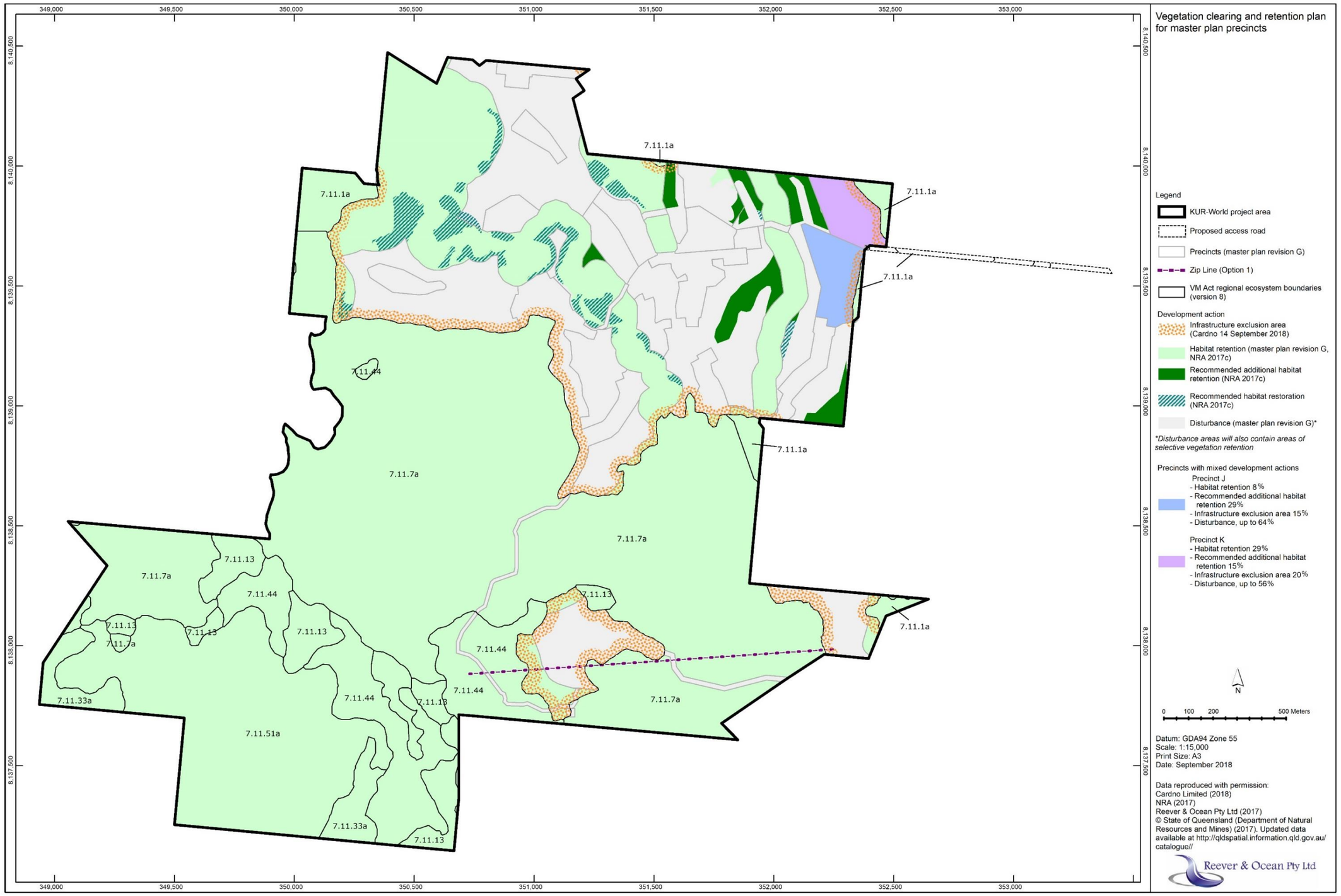

Figure 8-12: Vegetation clearing and retention plan for the Masterplan precincts

Table 8-7: Breakdown of habitat retention, recommended additional habitat retention, recommended habitat restoration, disturbance and infrastructure exclusion areas for each master plan precinct

Precincts and ancillary areas	Total area (ha)[1]	Development actions	DNRM (2017b,c) vegetation mapping area (ha)[2]							
			Remnant (Category B) Regional Ecosystem[3]				Non-remnant			
			7.11.13[4] (Of Concern)	7.11.33a (Of Concern)	7.11.44[4] (Of Concern)	7.11.1a[4] (Least Concern)	7.11.7a[4] (Least Concern)	7.11.51a (Least Concern)	Category R	Category X
Precinct A Farm theme park and equestrian centre	22.8	Recommended habitat restoration	-	-	-	-	-	-	-	0.3
		Disturbance	-	-	-	-	-	-	-	22.5
		Infrastructure exclusion area	-	-	-	-	-	-	-	<0.1
Precinct B Produce garden	2.5	Disturbance	-	-	-	-	-	-	-	2.5
Precinct C Business and leisure hotel and function centre	3.3	Disturbance	-	-	-	-	-	-	-	3.3
Precinct D KUR-village	3.4	Disturbance	-	-	-	-	-	-	-	3.4
Precinct E Rainforest education centre and adventure park	17.2	Disturbance	-	-	-	-	-	-	-	17.2
		Infrastructure exclusion area	-	-	-	-	-	-	-	7.2
Precinct F KUR-World campus	4.6	Habitat retention	-	-	-	-	-	-	-	0.4
		Recommended additional habitat retention	-	-	-	-	-	-	-	0.3
		Disturbance	-	-	-	-	-	-	-	3.9
		Infrastructure exclusion area	-	-	-	-	-	-	-	<0.1
Precinct G Sporting precinct	3.3	Disturbance	-	-	-	-	-	-	-	3.3
Precinct H Golf-clubhouse and function centre	0.9	Disturbance	-	-	-	-	-	-	-	0.9

Precincts and ancillary areas	Total area (ha)[1]	Development actions	DNRM (2017b,c) vegetation mapping area (ha)[2]							
			Remnant (Category B) Regional Ecosystem[3]				Non-remnant			
			7.11.13[4] (Of Concern)	7.11.33a (Of Concern)	7.11.44[4] (Of Concern)	7.11.1a[4] (Least Concern)	7.11.7a[4] (Least Concern)	7.11.51a (Least Concern)	Category R	Category X
Precinct I Golf course	49	Habitat retention	-	-	-	-	-	-	-	<0.1
		Recommended additional habitat retention	-	-	-	-	-	-	-	8.2
		Recommended habitat restoration	-	-	-	-	-	-	-	0.5
		Disturbance	-	-	-	-	-	-	-	40.3
		Infrastructure exclusion area	-	-	-	-	-	-	-	2.0
Precinct J Five-star resort	6.5	Habitat retention	-	-	-	-	-	-	-	0.5
		Recommended additional habitat retention	-	-	-	-	-	-	-	1.9
		Disturbance	-	-	-	-	-	-	-	4.2
		Infrastructure exclusion area	-	-	-	-	-	-	-	1.0
Precinct K Health and well-being retreat	5.9	Habitat retention	-	-	-	-	-	-	-	1.7
		Recommended additional habitat retention	-	-	-	-	-	-	-	0.9
		Disturbance	-	-	-	-	-	-	-	3.3
		Infrastructure exclusion area	-	-	-	-	-	-	-	1.2
Precinct L Premium villas	25.9	Disturbance	-	-	-	-	-	-	-	25.9
		Infrastructure exclusion area	-	-	-	-	-	-	-	4.4
Precinct M Lifestyle villas	16.7	Disturbance	-	-	-	-	-	-	-	16.7
		Infrastructure exclusion area	-	-	-	-	-	-	-	2.9
Precinct N Queenslander lots	2.1	Disturbance	-	-	-	-	-	-	-	2.1
		Infrastructure exclusion area								<0.1

Precincts and ancillary areas	Total area (ha)[1]	Development actions	DNRM (2017b,c) vegetation mapping area (ha)[2]							
			Remnant (Category B) Regional Ecosystem[3]				Non-remnant			
			7.11.13[4] (Of Concern)	7.11.33a (Of Concern)	7.11.44[4] (Of Concern)	7.11.1a[4] (Least Concern)	7.11.7a[4] (Least Concern)	7.11.51a (Least Concern)	Category R	Category X
Precinct O Services/ infrastructure	3.4	Recommended additional habitat retention	-	-	-	-	-	-	-	1.3
		Disturbance	-	-	-	-	-	-	-	2.1
		Infrastructure exclusion area	-	-	-	-	-	-	-	0.2
Precinct P Environmental area	499.6	Habitat retention	19.3	10.6	41.9	11.2	256.5	70.1	59	30.8
		Recommended habitat restoration	-	-	-	-	-	-	5.7	5.3
		Infrastructure exclusion area	-	-	-	-	-	-	6.4	2.5
Precinct Q Open space	2.3	Disturbance	-	-	-	-	-	-	-	2.3
Road through environmental area	4.7	Disturbance	-	-	1.0	-	2.3	-	0.8	0.8
		Infrastructure exclusion area	-	-	-	-	-	-	-	0.2
Proposed access road	2.1	Disturbance	-	-	-	0.8	-	-	-	1.2
Helipad	0.1	Disturbance	-	-	-	0.1	-	-	<0.1	<0.1
Zip line towers and zip line	<0.1	Disturbance	-	-	<0.1	-	-	-	-	<0.1
		Infrastructure exclusion area (-)	-	-	0[5]	-	0[5]	-	-	0[5]

[1] Area calculations for the precincts include internal roads adjacent to those precincts in some cases.

[2] In some instances, recommended habitat restoration areas overlap habitat retention and disturbance areas (see **Figure 8-12**), and the area calculations are rounded to nearest 0.1 ha. As a result, the sum of area calculations from all development actions within a precinct is sometimes higher than the total area of the precinct.

[3] Regional Ecosystems (REs) and status as defined under the Queensland *Vegetation Management Act* 1999.

[4] Essential habitat mapped for this RE in the project area.

[5] These structures will be made of fireproof materials and will not result in qualified or warranted clearing of remnant vegetation surrounding the zip line or towers.

Green shading indicates habitat retention/restoration areas.

Blue shading indicates disturbance and infrastructure exclusion areas.

8.7.5.2 Potential residual impacts to fauna

The potential core habitat loss for T/NT&M fauna based on the current master plan and adoption of Management Measures presented in this chapter (specifically Management Measure 21) is discussed in Appendix 5 (refer to Section 6.1.2). Estimates of potential habitat loss were calculated and presented for T/NT species, for Migratory-listed species, and for clearing extents of habitat types (Appendix 5: refer to Table 18, Table 19 and Table 20 respectively). The State (DSIP 2014 and EHP 2014) and Commonwealth (DoE 2013) criteria for assessing potential SRI on Threatened species are presented and discussed in Appendix 5 (refer to Table 21).

Assessment of the T/NT&M fauna under the state and commonwealth criteria determined that SRIs were not anticipated for the following:

- DSIP (2014) and EHP (2014) only consider the potential for SRI on Threatened and Special Least Concern (non-Migratory) species. On this basis, the potential for SRI on the following Near Threatened fauna is not considered further. These species comprise: Blue-faced Parrot-finch, Diadem Leaf-nosed Bat and Lumholtz's Tree-kangaroo.
- The fauna species least vulnerable to the potential threats of the project are those predicted to have an intermittent occurrence on the project area, and whose core habitats or areas of activity are likely to be remote to the main area of potential impacts (considering direct and indirect threats). These species comprise: White-throated Needletail, Fork-tailed Swift, Greater Glider, Northern Bettong, Northern Quoll, Red Goshawk, Grey Falcon, Ghost Bat, Oriental Cuckoo and Barn Swallow.
- SRIs on Migratory fauna are not anticipated based on consideration of DoE (2013) SRI criteria. The project area may occasionally, and temporarily, support ecologically significant proportions of White-throated Needletail, Fork-tailed Swift and Spectacled Monarch populations; however, their habitats are unlikely to be substantially modified by the proposed action. The management of biosecurity items (that is Tramp Ants) is of critical importance for avoiding the potential for SRI on the Spectacled Monarch.

For the remaining Threatened fauna (hereafter 'priority Threatened fauna'), the extents and relative proportion of potential core habitat loss are either minor (Appendix 5 refer to Table 18 and Table 19), or are mostly affecting habitats dominated by regrowth vegetation (that is not optimal or climax condition states). Potential core habitat loss is minor or nil for Kuranda Tree Frog, Australian Lacelid and Bare-rumped Sheathtail Bat. Habitat loss predominantly relates to regrowth vegetation[10] for Tapping Green-eyed Tree Frog, Greater Large-eared Horseshoe Bat, Spectacled Flying Fox, Macleay's Fig-parrot, Tube-nosed Insectivorous Bat and Southern Cassowary. With the exception of Tapping Green-eyed Tree Frog, this habitat loss is unlikely to have significant impacts on populations of these species at the site, local or regional scales. This habitat loss will reduce the Tapping Green-eyed Tree Frog population at the site scale, though the loss is unlikely to be significant at the local or regional population scales. Further, the magnitude of impact on all the above species (including Tapping Green-eyed Tree Frog[11]) will be reduced by Management Measure 22 (habitat restoration as shown in Figure 8-11). SRI on the above-described species as a consequence of habitat loss is unlikely.

The likelihood of SRIs on most priority Threatened fauna as a consequence of indirect threats is low if the Management Measures for protection of flora and fauna are implemented; however, for a few species, the risk for SRI is less clear due to the following.

[10] This explains the large differences in estimated clearing extents derived from NRA habitat mapping compared with DSITI habitat (that is BVG) mapping (NRA 2017c: refer to Table 18).

[11] Residual habitat loss for Tapping Green-eyed Frog following implementation of Recommendation 21 (habitat retention) and Recommendation 22 (habitat restoration) is approximately 38 ha, which is 10% of the species' habitat available on the project area.

- While the mitigation measures will reduce the potential magnitude of impact, a residual impact will remain. This is applicable to most species though certain fauna populations will be more sensitive (for example species with small populations).
- Given the size, complexity and duration of the project it is possible that certain aspects of management will fail at some time, or unforeseen eventualities may occur. This is applicable to most species though certain fauna populations will be more sensitive (for example species with small populations).

The issues described in the above points are relevant to assessing the potential for SRI and are discussed below.

- The performance outcomes recommended in Appendix 5 (refer to Section 5.3.3), with respect to water quality, are for no adverse change in the aquatic receiving environment as a consequence of development (construction and operation). This performance outcome was set because significant receptors occur in the receiving environment (notably Threatened frogs). The species most at risk are the Kuranda Tree Frog and Tapping Green-eyed Frog. The Australian Lacelid is also within the downstream receiving environment, though is less vulnerable due to the population being remote from the potential pollution source. Although these frogs are sensitive to pollution, species-specific thresholds for impacts do not exist. Maintaining the *status quo* with respect to water quality is therefore the only option for avoiding impacts. This advice was factored into project designs for stormwater and wastewater treatment systems. The fact that Threatened stream-dwelling frogs occur along Jum Rum Creek, the receiving environment for the Kuranda township, indicates these species can exist near urban environments. In practice, it is not possible to achieve conformity with standards all the time; for example, unplanned events or extreme events occur. The Kuranda Tree Frog is the most sensitive to potential impacts because it is present in the direct receiving environment and its population is small.
- Biosecurity incursions or proliferation can require substantial investment and commitment to prevent, and greater investment and commitment to contain or eradicate incursions. Even when best practice is operating, a residual threat is likely to persist. Yellow Crazy Ants are of particular concern because they are present in Kuranda, there are numerous potential pathways for incursions into the project area (construction and operation), and their impacts can be devastating. Serious incursions of Yellow Crazy Ants have the potential to impact all Threatened fauna species, though particularly ground-dwelling species such as the Kuranda Tree Frog, Tapping Green-eyed Frog and Southern Cassowary. The magnitude of any potential impact will be commensurate with the spatial and temporal scale of the incursion, and the location of the incursion relative to core habitats for the Threatened species of interest.
- The proposed access roads via Myola Road and Mount Haren Road will traverse forested habitats known to support Threatened fauna and introduce the risk of vehicle strike to fauna populations in these areas. Careful planning and design can greatly reduce the risk of fauna being killed or harmed by vehicle strike; however, a residual threat is likely to remain. For most species, the potential residual impact at the population level is likely to be sustainable. The residual impact is of concern for the Southern Cassowary because the local population is apparently small, and therefore sensitive to additional threats. There is opportunity to offset this impact by implementing a wild dog control programme, though the degree to which this may offset project-related threats is uncertain.

The potential for SRI on the Kuranda Tree Frog, Tapping Green-eyed Frog, Australian Lacelid and Southern Cassowary is assessed as follows. All project-related threats are considered.

- **Kuranda Tree Frog**. There is some uncertainty about potential residual impacts in relation to the management of water quality and biosecurity. The scale, complexity and duration of the project contribute to uncertainty. Knowledge gaps in the ecology of the species contribute to uncertainty. The

plausible worst-case scenario is that impacts that are serious at the project area, local area and regional scales may occur; under this scenario a SRI is likely (Appendix 5: refer to SRI Criteria (a), (b)[12], (e), (i) and (k) in Table 21). The plausible best-case scenario is that impacts that are serious at the project area, local area and regional scales do not occur; under this scenario a SRI is unlikely.

- **Tapping Green-eyed Frog**[13]. There is some uncertainty about potential residual impacts in relation to the management of water quality and biosecurity items (as per Kuranda Tree Frog), and project-related habitat loss will occur; however, serious impacts at the local or regional population scales are unlikely. A SRI is unlikely.
- **Australian Lacelid**. There is some uncertainty about potential residual impacts in relation to the management of water quality and biosecurity items (as per Kuranda Tree Frog); however, the species is remote from the area most likely to be impacted upon. A SRI is unlikely.
- **Southern Cassowary**. Residual impacts in the form of habitat loss, vehicle strike and biosecurity exist. These residual impacts may interfere with the recovery of the local population and therefore species specific management measures are important. Wild dog control will mitigate residual impacts; however, the degree to which wild dog control will mitigate impacts is uncertain. It is uncertain because it is not possible to predict the residual project-related impacts at the population scale or predict the degree to which the population would benefit from wild dog control. The plausible worst-case scenario is that residual impacts remain after wild dog control; under this scenario a SRI is likely (NRA 2017c: refer to SRI Criterion (g) in Table 21). The plausible best-case scenario is that wild dog control effectively mitigates project-related impacts and that the project does not inhibit the recovery of the Southern Cassowary population; under this scenario a SRI is unlikely.

8.7.5.2.1 *Additional Management measures*

The following Management Measure is provided within the same context, and additional to that, already provided.

- **Management Measure 44:** Prepare a Species Management Plan for Kuranda Tree Frog, Australian Lacelid, Tapping Green-eyed Tree Frog, Bare-rumped Sheathtail Bat, Greater Large-eared Horseshoe Bat, Tube-nosed Insectivorous Bat, Spectacled Flying Fox, Macleay's Fig-parrot and Southern Cassowary.

- **Management Measure 45:** The project-specific biosecurity management plan (*see* Management Measure 6) should include wild dog control. The management methods should consider potential non-target impacts, especially if toxic baiting is considered (*see* Management Measure 33). The purpose and effectiveness of wild dog control should be reviewed regularly.

The best-case scenario outcome (*i.e.* mitigation of residual impacts and the avoidance of an SRI) is achieved through the effective implementation of technical management plans and specifications. Technical management plans and specifications, including species specific management plans, can be reliably prepared based on existing knowledge and experience. The technical aspects include:

- overarching management plans, such as a Bio-security Management Plan,
- environmental management procedures, for example a Permit to Clear procedure,
- general management actions, including for example waste reduction, and
- species specific management actions, such as speed limits.

[12] Specific to area of occupancy (DoE 2013). Reduction in extent of occupancy (DSIP 2014 and EHP 2014) is unlikely.
[13] Tapping Green-eyed Frog is not a Threatened species under the EPBC Act, and therefore DoE (2013) does not apply.

The EMP (refer to Chapter 21) describes the management approach to avoid or mitigate negative impacts and to promote beneficial outcomes. The significance of this EMP to the achievement of a best-case outcome is the consideration of, and weight given to, the administrative aspects that influence outcomes. The principles of management have been distilled and described in the EMP. Instilling these principles in the organisations and workforces that will contribute to project delivery is required to achieve the best case outcome. This approach is simple in concept yet it is not routine. It is a necessary approach and has demonstrably worked for development projects in Far North Queensland. For example, in the construction sector the integration of ESCP principles and resultant specifications and practices in the construction sequence for property development and transport infrastructure has evolved from virtual nil consideration in the early 90's through to the sophisticated approach now common and informs the EMP for this project. The achievement of the best outcome is facilitated by implementing required EMP tasks in an appropriate time frame. Timely implementation minimises risk, avoids costly retrofits and achieves the desired outcome.

In consideration of the EMP, and that uncertainty exists regarding potential residual impacts for the Kuranda Tree Frog, Tapping Green-eyed Frog, Australian Lacelid and Southern Cassowary, additional consideration is given to the species specific mitigation measures necessary to achieve an SRI of unlikely. To this end, overarching and species-specific management measures, to mitigate project related impacts have been identified and aligned with each phase of project delivery (Table 8-8).

This approach presents the mode of project delivery necessary to achieve the best-case outcome and it is a commitment of the proponent to adopt this approach.

Table 8-8: Overarching and species specific management actions to mitigate project related impacts

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions			
Broad	**Specific**		**Administrative**	**Behavioural**	**Physical**	**Southern Cassowary**	**Frogs**	Macleay's Fig-Parrot	**Bats**
PRE-CONSTRUCTION									
Concept Design		Design requirements and/or design needs not aligned and/or deficient. Project risk and opportunities are not appropriately addressed. Resultant negative outcomes.	Undertake Master Plan development process. Undertake EIS. Develop a communication plan to facilitate knowledge transfer. Engage in value management (planning, workshop, follow-up).			Identify habitat and develop concept plan to avoid, minimise, mitigate impact to habitat by consolidation of project infrastructure to minimise footprint of development. Identify areas suitable for habitat conservation as well as restoration.	Identify habitat and develop concept plan to avoid, minimise, mitigate impact to habitat by consolidation of project infrastructure to minimise footprint of development. Identify areas suitable for habitat conservation as well as restoration.		
Approvals and permitting		Absent or deficient process resulting in controls not fit for the intended outcome.	Adopt and follow the statutory process.		Implement and appropriately resource (capital, labour, time, equipment) a management system to ensure that EMP plans, procedures and actions are implemented. Consistent with the EMP define and report the lines of responsibility/accountability and encompass the life of project (construction and operation).				
Detailed Design		Failure to identify and address design risks. Deficient specifications. Resultant negative outcomes.	Engage in value management (planning, workshop, follow-up). Preliminary consideration of project delivery options and evaluate implications to the Design process. Design specifications prepared in accordance with relevant Australian Standard, and prepared in accordance with licence/permitting requirements.	The development should include a community/public education programme so that all residents and visitors are aware of the sensitivity of the receiving environment, and aware of any relevant rules or regulations.	Lighting in public spaces should be designed to minimise artificial light impacting natural habitats, in particular avoid artificial light impacts on riparian habitats. The use of lighting shields, directional lighting, timers and motion-sensors should be considered. The Environmental Area should be retained as a reserve for native wildlife with the primary function of nature conservation. A management plan for the Environmental Area should be developed by a suitably qualified and experienced ecologist. The management plan should aim to protect the	Traffic calming measures incorporated in design. Measures include though not limited to maximum speed limit of 40 km/hr in areas of designated habitat that are under the control of the proponent. A maximum 50 km/hour speed limit should	In addition to measures described for Cassowary, roads through forest areas, notably the proposed access roads, are to be designed to minimise the barrier effects to fauna movements and to reduce the likelihood of fauna being hit by vehicles. A suitably qualified and experienced ecologist is be involved with the designs. All fauna groups to be considered, though specific attention is to be given to threatened stream-dwelling frogs and Southern Cassowary. Clearing widths (construction and operation)	Barrier netting will not be used along the golf course unless it poses a negligible threat to flying fauna as determined by a suitably qualified ecologist.	Barrier netting will not be used along the golf course unless it poses a negligible threat to flying fauna as determined by a suitably qualified ecologist.

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions			
Broad	Specific		Administrative	Behavioural	Physical	Southern Cassowary	Frogs	Macleay's Fig-Parrot	Bats
PRE-CONSTRUCTION									
					value of the area as habitat for native flora and fauna, and protect its value as a wildlife corridor. The management plan should identify the values of the area, existing and emerging threats, and actions to address and monitor existing and emerging threats. The requirements of the Australian Standard AS2436-2010 Guide to noise and vibration control on construction, demolition, and maintenance sites to be integrated in design.	apply to the access roads, though the need for further speed reductions, and speed reduction furniture, should be considered during the design phase. Roads through forest areas, notably the proposed access roads, are to be designed to minimise the barrier effects to fauna movements and to reduce the likelihood of fauna being hit by vehicles. A suitably qualified and experienced ecologist is be involved with the designs. All fauna groups to be considered, though specific attention is to be given to threatened stream-dwelling frogs and Southern Cassowary. Clearing widths (construction and operation) are to be kept as low as possible and strategies to reduce the impact of light	are to be kept as low as possible and strategies to reduce the impact of light and acoustic pollution, especially near streams, are to be incorporated into designs. Bridges are to be used over larger streams, and designed to permit fauna movements (including Southern Cassowary) and minimise ground disturbance. Design and operate a wastewater treatment system to meet Barron River Water Quality Objectives or site-specific targets appropriate for the Barron River, Wet Tropics Water Quality Improvement Plan 2015 – 2020 and the Reef Water Quality Protection Plan 2013. Stormwater should be directed to water treatment systems or appropriately designed retention dams considering worst case discharge scenarios to achieve water quality performance objectives for the Wet Tropics nominated in Arup (2017). Reduce the extent of fauna habitat loss in the north-east of the project area. The primary objectives for habitat retention should be to: (a) reduce net Endangered Vulnerable Near Threatened (EVNT) species habitat loss; (b) reduce net Mesophyll to Notophyll Vine Forest (MNVF) habitat loss; & (c) retain a forest corridor along the Warril Creek tributary. Any adjustment in the configuration of retained habitats should optimise protection of habitats where listed frog species occur at high densities, which in the north-east of the project area		

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions			
Broad	Specific		Administrative	Behavioural	Physical	Southern Cassowary	Frogs	Macleay's Fig-Parrot	Bats
PRE-CONSTRUCTION									
						and acoustic pollution, especially near streams, are to be incorporated into designs. Bridges are to be used over larger streams, and designed to permit fauna movements (including Southern Cassowary) and minimise ground disturbance.	corresponds with the downstream reach of the Warril Creek tributary. Pathways through the development area will be designed to prevent pedestrian access to core Kuranda Tree Frog habitat, and areas immediately upstream of this habitat.		
Project delivery		Project Delivery Model not considered or inappropriate. Resultant negative outcomes.	Evaluate Project Delivery Models and select the option (or combination of options) that is the optimum method of project delivery given the complexity of this project. The selection process to be bias towards that model which achieves greatest reduction in the risk of non-conformance with licence/permitting conditions.						
Procurement		Project procurement model not considered or inappropriate. Resultant negative outcomes.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audit to confirm procurement process conforms to Project Delivery Model.						
Contract documentation		Deficient incorporation of design requirements into contractual documentation.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audit to confirm contractual documentation accurately reflects design specifications (which have been prepared in conformity with						

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions			
Broad	**Specific**		**Administrative**	**Behavioural**	**Physical**	**Southern Cassowary**	**Frogs**	Macleay's Fig-Parrot	**Bats**
PRE-CONSTRUCTION									
			licence/permitting requirements).						
Tendering and award		Inappropriate tendering and award of contract process leading to negative outcomes.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audit to confirm tendering and award conforms to Project Delivery Model.						

Dark Green highlight indicates completed
Light Green highlight indicates in progress
No highlight indicates to be completed

[#] The actions have been presented into four groups (i.e. Southern Cassowary, Frogs, Macleay's Fig Parrot and Bats). Where for "Frogs", Species Management Plans are required for: Kuranda Tree Frog, Australian Lacelid and Tapping Green-eyed Tree Frog. Where for "Bats", Species Management Plans are required for: Bare-rumped Sheathtail Bat, Greater Large-eared Horseshoe Bat, Tube-nosed Insectivorous Bat and Spectacled Flying Fox.

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions #			
Broad	**Specific**		**Administrative**	**Behavioural**	**Physical**	**Southern Cassowary**	**Frogs**	Macleay's Fig-Parrot	**Bats**
CONSTRUCTION									
All activities	Contract administration	Deficient contractual administration leading to negative outcomes	Adopt a Quality Assurance System. Develop systems and procedures. Third party audits.		Implement and appropriately resource (capital, labour, time, equipment) a management system to ensure that EMP plans, procedures and actions are implemented. Consistent with the EMP define and report the lines of responsibility/accountability and encompass the life of project (construction and operation).				
	Equipment failure	Equipment failure e.g. leaks, spills. This could impact on soils, flora and fauna (death, loss of habitat) and adverse impacts on receiving waters values.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audits.	Training to raise awareness. The importance of compliance is covered in training programs, including for all contractors.	All mobile plant and equipment to be utilised onsite is to be certified in writing as appropriate for task and serviceable. Pre-start checks to completed prior to use of mobile plant and equipment on a per shift basis.				
	Maintenance and cleaning	Impact on land surface and receiving waters due to runoff from equipment or activities related to fuelling, servicing and maintaining plant and equipment.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audits.	Training to raise awareness. The importance of compliance is covered in training programs, including for all contractors.	All mobile plant and equipment to be refuelled, maintained and cleaned in designated areas that have been appropriately designed, constructed and maintained. Third party audits.				
	Air quality	Emissions adversely affect environmental values.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audits.		In the design phase, and adopt appropriate separation distances, incorporate relevant attenuation features.				
	Noise and Vibration	Emissions adversely affect environmental values.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audits.		In the design phase, and adopt appropriate separation distances, incorporate relevant attenuation features, including hours of operation.				

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions #			
Broad	**Specific**		**Administrative**	**Behavioural**	**Physical**	**Southern Cassowary**	**Frogs**	Macleay's Fig-Parrot	**Bats**
	Waste	Waste products adversely affect environmental values.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audits. Develop and implement a Waste Management Plan to align with waste handling and compliance requirements in accordance with legislation and industry best practice waste management strategies	Training to raise awareness. The importance of compliance is covered in training programs, including for all contractors.	Minimise waste generation by design (design out waste products where practicable; incorporate waste reduction requirements in procurement documentation). Provide appropriate waste disposal receptacles. Engage licenced entities to collect and remove waste (recycling) products from site. Irrigation practices should be managed to reduce run-off from irrigated water or the infiltration of potentially contaminated water (for example nutrients, pesticides, herbicides) to groundwater (prepare Irrigation Management Plan).				
	Monitoring	Failure to define required outcomes. Deficient specifications. Resultant negative outcomes.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audits.		Aquatic ecology surveys (fish) is be undertaken at a minimum of once annually, and aquatic ecology (aquatic macroinvertebrates) undertaken annually, along with sediment monitoring (prior to and during the construction stage). Groundwater monitoring is be undertaken quarterly (prior to during construction phase).		Surface water samples to be collected from reference (benchmark/background) and receiving sites on a monthly basis (prior to construction). All management and monitoring plans should consider the requirements of Kuranda Tree Frog and Tapping Green-eyed Frog.		

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions #			
Broad	**Specific**		**Administrative**	**Behavioural**	**Physical**	**Southern Cassowary**	**Frogs**	Macleay's Fig-Parrot	**Bats**
Site Establishment		Disturbance to land surface. This could impact on flora and fauna (death, loss of habitat), accelerate erosion and adverse impacts on receiving waters values.	An appropriately qualified professional engaged to perform flora and fauna pre-clearance surveys. An appropriately qualified professional engaged to prepare an Erosion and Sediment Control Plan (ESCP) for the construction and operational phases of the project. The ESCP to be certified by a Certified Professional in Erosion and Sediment Control (CPESC). The ESCP integrated into the planning, design, construction (including to the practical completion and defects period) and maintenance phases for each component of the project. Develop and implement a fire management plan (construction and operation). The plan should include methods for prevention of uncontrolled wildfire and emergency response. Develop and implement a project-specific Biosecurity and Pest Management Plan (construction and operation phases). The plan will include methods for prevention of introduction and/or spread of weeds, pests and pathogens, inspections/monitoring and control. The plan will be developed by a suitably qualified person.	Training to raise awareness (all site personnel to be introduced, through the site induction, to protected fauna that have potential to be encountered across the site). The importance of compliance is covered in training programs, including for all contractors. Procedures in place such that any animal requiring care or treatment will be immediately transported to a veterinarian or licenced wildlife carer.	Utilise designated access to site (purpose built and operated). Restrict site access and movement within the site. Survey farm dams on the property or in the relevant sub catchments to determine if the Giant *Gudgeon Oxyeleotris selheimi* is established in these habitats and eradicate it. On-site dams should not be stocked with species that are not endemic to the area.	Information describing the importance of not interacting with animals (including approaching, handling, feeding) prepared in different formats and distributed including signage, facts sheets, newsletters.	The project biosecurity management plan (Management Measure 6) will include specific focus on protecting riparian habitats, in particular core habitat for Kuranda Tree Frog (Figure 8-9). Develop and implement a Stormwater Management Plan designed to achieve no adverse change in environmental values of the aquatic receiving environment. The management plan should include a monitoring programme capable of detecting change in key indicators (that is indicators that are specific to potential project-related contamination sources and specific to known values of the receiving environment).		

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions #			
Broad	Specific		Administrative	Behavioural	Physical	Southern Cassowary	Frogs	Macleay's Fig-Parrot	Bats
		Introduction and/or dispersal of material that poses a biosecurity risk.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audits.	Training to raise awareness. The importance of compliance is covered in training programs, including for all contractors.	All equipment and materials intended to be brought to site is to be certified as free of biosecurity risk prior to site entry (and also free of harmful by products of any associated treatment to afford biosecurity free status). Restrict site access and movement within the site. Periodic surveys targeted to the early detection, and timely control, of biosecurity risks.				
Clearing & Grubbing		Disturbance to land surface. Impact on flora and fauna (death, loss of habitat), accelerated erosion and adverse impacts on receiving waters values. Loss of habitat impacts on conservation value of the area. Decrease in aesthetic appeal due to tree clearing. Impact on natural and cultural heritage due to loss of vegetation	Erosion and sediment control measures as described above. In areas which have not been surveyed, conduct surveys for threatened and near-threatened (T&NT) plants in accordance with the Queensland Protected Plant Survey Guidelines. Subsequent management of any T&NT plants threatened by development should occur in accordance with relevant legislation. Prepare and obtain approval of Species Management Program(s) as relevant.	Training to raise awareness. Make sure workers know what vegetation is approved for removal. The importance of compliance is covered in training programs, including for all contractors.	Restrict work areas (clearing is to be restricted to designated footprint (*i.e.* Permit to Clear procedure); identify stockpile locations for retaining soil and vegetation for rehabilitation purposes). Stage works i.e. do not open up the entire work area to achieve economies of scale, rather schedule works to limit amount of land disturbed and open to risk of accelerated erosion. Where practicable undertake works in the dry season. Where not practicable to limit works to the dry season, devote additional resources to erosion and sediment control.		In areas which have not been surveyed, conduct surveys for EVNT fauna species, in particular the Kuranda Tree Frog (*Litoria myola*) in accordance with Queensland Government Terrestrial Vertebrate Fauna Survey Guidelines. Woody vegetation clearing should occur progressively to give animals that survive the tree-felling activity a chance to move out of the area. This is especially important in areas of potential frog habitat. Where clearing within listed frog habitat cannot be avoided, manage bank stability and stormwater discharge to avoid no adverse change in the environmental values of the aquatic receiving environment.	Vegetation clearing to only occur in accordance with an approved Species Management Program (High risk and Low-risk species, as required). Plans should include requirement to inspect disturbance areas for roosting or nesting fauna prior to clearing. If nesting or roosting fauna are found, clearing at that location should cease until the appropriate management and approval requirements are ascertained and implemented. A fauna spotter/catcher is to be present during clearing activities.	Vegetation clearing to only occur in accordance with an approved Species Management Program (High risk and Low-risk species, as required). Plans should include requirement to inspect disturbance areas for roosting or nesting fauna prior to clearing. If nesting or roosting fauna are found, clearing at that location should cease until the appropriate management and approval requirements are ascertained and implemented. A fauna spotter/catcher is to be present during clearing activities.

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions #			
Broad	Specific		Administrative	Behavioural	Physical	Southern Cassowary	Frogs	Macleay's Fig-Parrot	Bats
Bulk earthworks	Excavation, handling and storage	Disturbance to land surface (soil excavation - handling, storage and transport). Accelerated erosion and adverse impacts on receiving waters values.	Erosion and sediment control measures as described above.		Restrict work areas. Stage works i.e. do not open up the entire work area to achieve economies of scale, rather schedule works to limit amount of land disturbed and open to risk of accelerated erosion. Where practicable undertake works in the dry season. Where not practicable to limit works to the dry season, devote additional resources to erosion and sediment control.				
Services, utilities and road infrastructure		Impacts on land and receiving water values if inappropriate practices and/or materials.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audit to confirm procurement process conforms to Project Delivery Model. Design plans for communal building and infrastructure facilities should consider the potential need for storage and handling of chemicals and hazardous substances (in accordance with applicable Australian Standards).		Restrict work areas. Stage works i.e. do not open up the entire work area to achieve economies of scale, rather schedule works to limit amount of land disturbed and open to risk of accelerated erosion. Where practicable undertake works in the dry season. Where not practicable to limit works to the dry season, devote additional resources to erosion and sediment control.				

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions #			
Broad	Specific		Administrative	Behavioural	Physical	Southern Cassowary	Frogs	Macleay's Fig-Parrot	Bats
Building and landscaping (including recreational areas and gardens)		Impacts on land and receiving water values if inappropriate practices and/or materials.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audit to confirm procurement process conforms to Project Delivery Model.		Restrict work areas. Stage works i.e. do not open up the entire work area to achieve economies of scale, rather schedule works to limit amount of land disturbed and open to risk of accelerated erosion. Where practicable undertake works in the dry season. Where not practicable to limit works to the dry season, devote additional resources to erosion and sediment control.		Develop and implement an appropriate project-wide landscaping plan (construction and operation phases). The plan should provide guidance on plant species selection and describe limitations or precautions with regard to the receiving environment (for example limitations or issues when landscaping in or near habitats for threatened stream-dwelling frogs). The plan should be developed by, or reviewed by, a suitably qualified person(s) to ensure it is appropriate for the setting (that is, consider activity-related threats and all values of the receiving environment).		
Rehabilitation	Plan	Failure to define required outcomes. Deficient specifications. Resultant negative outcomes.	Develop and implement a rehabilitation plan. The plan is to be prepared by a suitably qualified person and be appropriate for the setting (that is consider project and activity-related threats and all values of the receiving environment). All areas in the Environmental Area currently devoid of native vegetation should be rehabilitated to natural conditions. Areas disturbed during construction that are not needed for the operation phase should be rehabilitated as soon as they become available.				Restore riparian vegetation along Haren Creek, Owen Creek, Cain Creek and the tributary of Warril Creek. The recommended areas for habitat restoration are shown on Figure 8-11 (approximately 12 hectares). Habitat restoration should aim to improve the condition of riparian habitats for fauna and be of a habitat type that reflects pre-clearing conditions		
	Surface preparation	Pest species ingress or contamination if any imported materials is not clean.	Adopt a Quality Assurance System. Develop systems and procedures. Third party audit to confirm procurement process conforms to Project Delivery Model.		Only use appropriately certified materials.				

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions #			
Broad	Specific		Administrative	Behavioural	Physical	Southern Cassowary	Frogs	Macleay's Fig-Parrot	Bats
	Fertiliser application	Impacts on land and receiving water values if inappropriate agrichemical applications (fertilisers, pesticides, herbicides).	Adopt a Quality Assurance System. Develop systems and procedures. Provide appropriate resources (time, capital, labour). Third party audits.		Only use specified agrichemical applications, specified amounts and in accordance with manufacture's specified application method.				
	Plant species	Land surface changes from the planting of species e.g. ensure correct species, no weeds.	Adopt a Quality Assurance System. Develop systems and procedures. Provide appropriate resources (time, capital, labour). Third party audits.						
	Revegetation Success	Death of species planted or pest species overtaking the revegetation site.	Adopt a Quality Assurance System. Develop systems and procedures. Provide appropriate resources (time, capital, labour). Third party audits.		Periodic surveys targeted to the early detection and timely intervention of corrective measures.				

No highlight indicates to be completed

[#] The actions have been presented into four groups (i.e. cassowary, frogs, other birds and bats). Species Management Plans are required for Kuranda Tree Frog, Australian Lacelid, Tapping Green-eyed Tree Frog, Bare-rumped Sheathtail Bat, Greater Large-eared Horseshoe Bat, Tube-nosed Insectivorous Bat, Spectacled Flying Fox, Macleay's Fig-parrot and Southern Cassowary.

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions #			
Broad	**Specific**		**Administrative**	**Behavioural**	**Physical**	**Cassowary**	**Frogs**	**Other Birds**	**Bats**
OPERATIONS AND MAINTENANCE									
Habitation	All activities	Anthropogenic activities negatively impact on environmental values	Augment existing regulatory requirements (embodied for example in the *Environmental Protection Act 1994*) with requirements that attach to land title. The requirements would include exclusions (*e.g.* the keeping of cats) and inclusions (*e.g.* annual contribution to environmental levy to fund ongoing monitoring for example of the biosecurity risk). Prohibit cat and dog ownership and visitation, with the exception of certified assistance dogs.	Education	Restrict access to known sensitive areas.	Information describing the importance of not interacting with animals (including approaching, handling, feeding) prepared in different formats and distributed including signage, facts sheets, newsletters.	Implement education opportunities about frogs found in the area and provide access to nature-based activities to residents by providing supervised and approved frogging activities.		
	Waste	Waste products adversely affect environmental values.	Adopt existing regulatory mechanisms and controls.	Education	Upon termination of the defects liability period, management devolved to the Local Government.				
	Management of environmental area	Impacts on land and receiving water values if inappropriate practices and/or materials.	Augment existing regulatory requirements (embodied for example in the *Environmental Protection Act 1994*) with requirements that attach to land title. Document a land management plan developed in consultation with regulatory authorities.	Education	Upon termination of the defects liability period, management devolved to the appropriate Government or as relevant NGO entity.				
	Services, utilities and road infrastructure	Impacts on land and receiving water values if inappropriate practices and/or materials.	Adopt existing regulatory mechanisms and controls.	Education	Upon termination of the defects liability period, management devolved to the Local Government.				

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions [#]			
Broad	Specific		Administrative	Behavioural	Physical	Cassowary	Frogs	Other Birds	Bats
	Landscaping (recreational areas, gardens)	Impacts on land and receiving water values if inappropriate practices and/or materials.	Augment existing regulatory requirements (embodied for example in the *Environmental Protection Act 1994*) with requirements that attach to land title. Document a land management plan developed in consultation with regulatory authorities.	Education	Upon termination of the defects liability period, management devolved to the Local Government.				

No highlight indicates to be completed

[#] The actions have been presented into four groups (i.e. cassowary, frogs, other birds and bats). Species Management Plans are required for Kuranda Tree Frog, Australian Lacelid, Tapping Green-eyed Tree Frog, Bare-rumped Sheathtail Bat, Greater Large-eared Horseshoe Bat, Tube-nosed Insectivorous Bat, Spectacled Flying Fox, Macleay's Fig-parrot and Southern Cassowary.

Activity		Issue and Impact	Overarching Management Actions			Species Specific Management Actions [#]			
Broad	Specific		Administrative	Behavioural	Physical	Cassowary	Frogs	Other Birds	Bats
ALL ACTIVITIES									
Emergency Response		Deficient response to emergency event resulting in negative outcomes.	Develop Emergency Response Plan collaboratively with contractors and regulators. Update and review Emergency Response Plan in accordance with Quality Assurance System. Third party audits.	Undertake training of workforce, including contactors. Undertake training for mock emergency events.					

No highlight indicates to be completed

[#] The actions have been presented into four groups (i.e. Southern Cassowary, Frogs, Macleay's Fig Parrot and Bats). Where for "Frogs", Species Management Plans are required for: Kuranda Tree Frog, Australian Lacelid and Tapping Green-eyed Tree Frog. Where for "Bats", Species Management Plans are required for: Bare-rumped Sheathtail Bat, Greater Large-eared Horseshoe Bat, Tube-nosed Insectivorous Bat and Spectacled Flying Fox.

8.7.5.3 Potential residual impacts to landscape integrity values

DSIP (2014) and EHP (2014) have criteria for determining the likelihood for SRI in relation to connectivity. The considerations are specific to physical habitat loss and fragmentation; indirect threats are not considered. Given the relatively small extent of habitat loss, a SRI with respect to loss of connectivity is not anticipated. Key to avoiding SRI is the proposed retention of approximately 500 hectares of habitat in the Environmental Area (equates to approximately 74% of the project area). This habitat predominantly occurs in the western portion of the Kuranda-Myola-Kowrowa rainforest corridor (Figure 8-6), which is a potentially significant corridor for wildlife.

8.7.5.3.1 *Legislative considerations*

The proposed project will involve activities that will require authorisation under legislation relating to flora and fauna. The legislation that may be relevant to required authorisation or permits is presented below.

8.7.5.3.2 *Queensland Nature Conservation Act 1992*

Authorisations or permits under the NC Act that may be required are described below.

- A clearing permit under the NC Act will be required if the Near Threatened Slender Ginger in the north-east of the project area falls within the final clearing footprint. The need for a permit should be reviewed once final clearing plans are available.
- Protected Plant Surveys in accordance with the Protected Plant Survey Guidelines (EHP 2016) across large parts of the property were completed by Astrebla (2015) (Appendix 5: refer to Figure 6). Similar surveys are necessary in relation to clearing proposed in the Rainforest Education Centre and Adventure Park, and may be required in the vicinity of the Golf Course, KUR-World Campus, Business and Leisure Hotel and Function Centre, Queenslander Lots and farm-stay accommodation in the Farm Theme Park and Equestrian Centre. If Protected Plants are found in the 'clearing impact area' then a clearing permit under the NC Act will be required.
- Approval is required to tamper with the breeding places of native fauna. The need for a permit should be reviewed once final clearing plans are available, or if in the course of construction, a fauna breeding place is encountered in the proposed disturbance area. Approval may be subject to the preparation of a Species Management Programme (SMP).

8.7.5.3.3 *Queensland Water Act 2000*

A Riverine Protection Permit (RPP) may be required if the proposed works require excavation of, or placement of fill in, a watercourse. Watercourses as defined by the *Water Act* 2000 occur outside the proposed development footprint and on this basis the need for a RPP appears unlikely. This assessment should be reviewed when detailed development plans are available.

8.7.5.3.4 *Queensland Vegetation Management Act 1999*

The clearing of remnant vegetation will occur as part of the project and this clearing will likely require assessment under the VM Act. It is understood that the clearing of native vegetation would be assessed pursuant to State Code 16[14] with reference to provisions for Material Change of Use/Reconfiguration of a Lot, specifically Table 16.2.2 (PO 1-4) and Table 16.2.3 (PO 7, 11, 16, 20, 22-24, and 27). Further, the 'Property Map of Assessable Vegetation' (PMAV 2016), consistent with DNRM (2017) mapping, defines the area of remnant vegetation assessable under the Code.

The proposed project design may not directly satisfy the Acceptable Outcomes (AOs) with regard to PO 23 (VM Act Of Concern RE 7.11.44) and PO 24 (Essential Habitat for Southern Cassowary). These impacts relate

[14] Dated 1 August 2016 (source: http://www.dilgp.qld.gov.au/resources/policy/sdap/v2-1/state-code-16.pdf; accessed 20 October 2017.

to clearing (approximately 1 hectare) necessary to build and maintain a 15 metres wide access road that connects the Rainforest Education Centre and Adventure Park to precincts in the north. The AOs defined in the Code for PO 23 are the same as that defined for PO 24 (that is clearing to 10 metres wide and to 0.5 hectares in area). Where potential clearing cannot be avoided, and potential clearing has been reasonably minimised, AO 23.2 and AO 24.4 consider offsets for acceptable residual impacts. According to criteria in DSIP (2014), a SRI on Essential Habitat is unlikely because the proposed clearing will not result in >10% permanent reduction in the extent of Essential Habitat mapped on site. As described in Appendix 5 (refer to Section 6.1.1), a SRI on RE 7.11.44 can be avoided if 1 hectare of RE 7.11.44 regrowth vegetation on the property is protected from development and restored (Management Measure 44). According to DSIP (2014), this avoids a SRI because the proposed clearing is under 5 ha, is <10% of the total mapped area of RE 7.11.44 intersecting the project area and the area proposed for rehabilitation/restoration is equivalent to the impact area.

8.8 Conclusions

The KUR-World project area contains flora and fauna characteristics with important social, economic, cultural and environmental benefits. The project has been designed to predominantly occur in cleared parts of the site and in areas of non-remnant vegetation. Key to impact avoidance, is the proposed retention of approximately 500 hectares of habitat (equates to approximately 74% of the project area). This habitat predominantly occurs in the western portion of the Kuranda-Myola-Kowrowa rainforest corridor, which is a potentially significant corridor for a variety of wildlife. The design intention was to reduce the potential project-related environmental impacts. As a part of the EIS process, additional impact avoidance and mitigation measures have been identified.

On the available information, the potential for SRI on Regulated Vegetation is unlikely. With respect to T&NT plants, DSIP (2014) and EHP (2014) have SRI criteria relating to NC Act Endangered and Vulnerable plant species. On the available information, SRIs are not anticipated because the Near Threatened Slender Ginger is the only T&NT plant species known to occur within the proposed clearing area, and the proposed clearing extents are relatively minor. DSIP (2014) and EHP (2014) have criteria for determining the likelihood for SRI in relation to connectivity. Given the relatively small extent of habitat loss, a SRI with respect to loss of connectivity is not anticipated.

Assessment of the T/NT&M fauna under the state and commonwealth criteria determined that SRIs were not anticipated for the following: - Blue-faced Parrot-finch, Diadem Leaf-nosed Bat and Lumholtz's Tree-kangaroo, White-throated Needletail, Fork-tailed Swift, Greater Glider, Northern Bettong, Northern Quoll, Red Goshawk, Grey Falcon, Ghost Bat, Oriental Cuckoo and Barn Swallow. SRIs on Migratory fauna are not anticipated based on consideration of DoE (2013) SRI criteria. The project area may occasionally, and temporarily, support ecologically significant proportions of White-throated Needletail, Fork-tailed Swift and Spectacled Monarch populations; however, their habitats are unlikely to be substantially modified by the proposed action. For the remaining Threatened fauna, the extents and relative proportion of potential core habitat loss are either minor or are mostly affecting habitats dominated by regrowth vegetation. Potential core habitat loss is minor or nil for Kuranda Tree Frog, Australian Lacelid and Bare-rumped Sheathtail Bat.

Habitat loss predominantly relates to regrowth vegetation for Tapping Green-eyed Tree Frog, Greater Large-eared Horseshoe Bat, Spectacled Flying Fox, Macleay's Fig-parrot, Tube-nosed Insectivorous Bat and Southern Cassowary. With the exception of Tapping Green-eyed Tree Frog, this habitat loss is unlikely to have significant impacts on populations of these species at the site, local or regional scales. This habitat loss will reduce the Tapping Green-eyed Tree Frog population at the site scale, though the loss is unlikely to be significant at the local or regional population scales. Further, the magnitude of impact on all of the above

species (including Tapping Green-eyed Tree Frog) will be reduced by Management Measure 22 (habitat restoration as shown in Figure 8.7.4.1). SRI on the above-described species as a consequence of habitat loss is unlikely.

The likelihood of SRIs on most priority Threatened fauna as a consequence of indirect threats is low if the Management Measures for protection of flora and fauna are implemented; however, for a few species, the risk for SRI is less clear due to the following.

- While the mitigation measures will reduce the potential magnitude of impact, a residual impact will remain. This is applicable to most species though certain fauna populations will be more sensitive (for example species with small populations).
- Given the size, complexity and duration of the project it is possible that certain aspects of management will fail at some time, or unforeseen eventualities may occur. This is applicable to most species though certain fauna populations will be more sensitive (for example species with small populations).

Water quality, biosecurity and vehicle strike are all relevant to the potential for SRI on the Kuranda Tree Frog, Tapping Green-eyed Frog, Australian Lacelid and Southern Cassowary as follows.

- Kuranda Tree Frog. There is some uncertainty about potential residual impacts in relation to the management of water quality and biosecurity. The scale, complexity and duration of the project contribute to uncertainty. Knowledge gaps in the ecology of the species contribute to uncertainty. The plausible worst-case scenario is that impacts that are serious at the project area, local area and regional scales may occur; under this scenario a SRI is likely. The plausible best-case scenario is that impacts that are serious at the project area, local area and regional scales do not occur; under this scenario a SRI is unlikely.
- Tapping Green-eyed Frog. There is some uncertainty about potential residual impacts in relation to the management of water quality and biosecurity items (as per Kuranda Tree Frog), and project-related habitat loss will occur; however, serious impacts at the local or regional population scales are unlikely. A SRI is unlikely.
- Australian Lacelid. There is some uncertainty about potential residual impacts in relation to the management of water quality and biosecurity items (as per Kuranda Tree Frog); however, the species is remote from the area most likely to be impacted upon. A SRI is unlikely.
- Southern Cassowary. Residual impacts in the form of habitat loss, vehicle strike and biosecurity exist. These residual impacts may interfere with the recovery of the local population. Wild dog control will mitigate residual impacts; however, the degree to which wild dog control will reduce overall impacts is uncertain. It is uncertain because it is not possible to predict the residual project-related impacts at the population scale or predict the degree to which the population would benefit from wild dog control. The plausible worst-case scenario is that residual impacts remain after wild dog control; under this scenario a SRI is likely. The plausible best-case scenario is that wild dog control effectively mitigates project-related impacts and that the project does not inhibit the recovery of the Southern Cassowary population; under this scenario a SRI is unlikely.

As uncertainty exists regarding potential residual impacts for the Kuranda Tree Frog, Tapping Green-eyed Frog, Australian Lacelid and Southern Cassowary, additional consideration is given to the species-specific mitigation measures necessary to achieve an SRI of unlikely. To this end, overarching and species specific management actions, to mitigate project related impacts have been identified and aligned with each phase of project delivery.

8.9 References

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