

Appendix M

Survey methodology and results

For listed threatened species and ecological communities that have the potential to occur in the Exploratory Works Survey area, the following sections provide:

- Information on the desktop assessment methodology used to identify target species for field surveys.
- Information on the survey methodology used, including maps of survey points or transects, how the survey points or transects were selected, when surveys were conducted (e.g., dates, time of day, season, etc.) and search effort.
- An assessment of the adequacy of any surveys undertaken with reference to any relevant scientific literature and/or statutory documents. In particular, the extent to which these surveys were appropriate for the species and undertaken in accordance with relevant survey guidelines.

Desktop assessment

A comprehensive desktop assessment was undertaken to identify the terrestrial ecological values that may occur within the Project footprint and within the locality of the Project (<30 km) and region (<50 km). The following tools were utilised for the assessment:

- DCCEEW Protected Matters Search Tool (PMST)
- the Queensland Government WildNet database.
- Species distribution data was obtained from the following portals:
 - Atlas of Living Australia (ALA)
 - Australian Virtual Herbarium (AVH)
- DCCEEW Species Profile and Threats Database (SPRAT) for individual species profiles
- Queensland Government Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development Vegetation Mapping Supporting Map including Essential Habitat (EH) Mapping
- DoR Regional Ecosystem Map (Version 12)
- eBird and Birdlife Australia databases.

Published and unpublished ecology reports and community data were also used where available to collect the necessary habitat and distribution information required for the impact assessment.

A likelihood of occurrence assessment was undertaken to identify the threatened species and communities likely to occur within the Project footprint. The full results of the Likelihood of Occurrence can be found in Appendix D.

Field surveys

The field surveys conducted for the Project have been located within the Project footprint and a 100 m buffer to same between 2022 and 2024 and covering all seasons. The surveys were conducted by ecologists and botanists from SMEC, Umwelt, Attexo and EMM Consulting. The surveys were conducted during periods recommended by the respective survey guidelines. The survey program was developed to target the threatened species or communities identified as likely or known to occur in the likelihood of occurrence assessment. Table M-1 to Table M-4 provide further details on the surveys, including the dates the surveys were undertaken and the survey effort.

The surveys were undertaken in accordance with the following guidelines and Conservation Advices:

- EPBC Act survey guidelines for Australia's threatened reptiles (DSEWPaC, 2011)
- EPBC Act survey guidelines for Australia's threatened birds (DEWHA, 2010)
- Target Survey Guidelines – Glossy black-cockatoo *Calyptorhynchus lathami* (DCCEEW, 2022)
- EPBC Act survey guidelines for Australia's threatened bats (DEWHA, 2010)
- EPBC Act survey guidelines for Australia's threatened mammals (DSEWPaC, 2011)
- EPBC Act Survey guidelines for Australia's threatened fish (DSEWPaC, 2011)

- EPBC Act Survey guidelines for Australia's threatened frogs (DEWHA, 2010)
- Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (Commonwealth of Australia, 2015)
- Flora Survey Guidelines – Protected Plants (DES, 2020)
- Guide to determining terrestrial habitat quality – Methods for assessing habitat quality under the Queensland Environmental Offsets Policy Version 1.2 (DES, 2017)
- Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas (*Phascolarctos cinereus*) (Phillips, 2011)
- Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (DES, 2022)
- Optimal survey designs for environmental DNA sampling (Lugg, 2017)
- Biocondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland Assessment Manual (Eyre, 2015)
- Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 7.0 (Neldner, et al., 2023)
- Terrestrial Ecology EIS Information Guideline (DES, 2022)
- Aquatic Ecology EIS Information Guidelines (DES, 2022)
- AusRivAS protocols for Queensland streams (DNRM, 2001)
- Australian River Assessment System: AusRivAS Physical Assessment Protocol (Parsons et al 2001)
- Monitoring and sampling manual (DES, 2018).

Limitations

While the field surveys are spatially and temporally comprehensive and have been conducted in accordance with relevant guidelines, there remain some limitations, including:

- Limited access due to steep terrain, lack of adequate access tracks, thick vegetation, boat access required and private property.
- Areas which were mostly cleared and therefore less likely to contain suitable habitat for threatened species were not surveyed.
- Cryptic species can be difficult to detect. Absence of detection does not equate to absence of the species.
- Surveys involving acoustic devices rely on the target species vocalising while the devices were deployed.
- Species with expansive home ranges may not occur on site during survey periods.

Methodology

Terrestrial Flora

Vegetation mapping

Quaternary and secondary vegetation surveys: Quaternary and secondary surveys were undertaken in accordance with the Methodology for Surveying and Mapping Regional Ecosystems and Vegetation Communities in Queensland (Nelder, et al., 2023). The surveys were completed to assess the vegetation communities present and confirm the distribution and extent of REs mapped within the Exploratory Works Survey area, including the Project footprint. The vegetation mapping was updated to reflect the ground-truthed data including the RE, its extent and the size based on the Queensland Herbarium Regional Ecosystem Description Database. The information collected during these surveys has an accuracy of approximately 1:10,000 although it is noted that this is not uniform across the Project area. Where ground-truthing field work was not undertaken Queensland Government regional ecosystem mapping was used. The information collected during these surveys was used in conjunction with the habitat assessments to map suitable habitat for identified MNES values.

BioCondition assessment: BioCondition assessments were undertaken in accordance with the BioCondition Assessment Manual (Eyre et al. 2015) within and immediately adjacent to the Project footprint. The assessments involved the collection of structural, floristic and habitat data within a 100 x 50 m plot. The sites of each assessment were determined by the RE.

TEC assessments

TEC assessments were undertaken to verify if the mapped TECs were present within the Project footprint. The associated mapped RE's were first ground-truthed to validate their existence. Where associated REs were present, the vegetation composition and structure were assessed against the key diagnostic criteria and condition thresholds within the respect TEC Conservation or Listing Advice.

Targeted flora searches

Protected plant survey: Protected plant meanders were undertaken in accordance with the Flora Survey Guidelines – Protected Plants (DES, 2020). Timed 30-minute meanders were undertaken within areas of suitable habitat where the Project footprint (and 100 m buffer) and the protected plant trigger mapping intersected. There is a margin of error of 10 m for protected plant records, which has been taken into account in identifying the number of records within the Project footprint.

Threatened flora searches: Opportunities searches for threatened species likely or known to occur were undertaken while traversing the Project footprint.

Table M-1: Flora survey methods

Method	Target MNES	Team	Survey length	Survey date	Survey effort	Total survey effort
Quaternary and secondary vegetation surveys	TECs and threatened flora	SMEC	2 days	April 2022	18 quaternary sites	578 quaternary sites 31 secondary sites
		Umwelt	2 days	21 – 22 June 2022	20 quaternary sites	
		Umwelt	1 day	18 July 2022	10 quaternary sites	
		Attexo	5 days	8-12 August 2022	31 quaternary sites	
		Attexo	4 days	13-16 September 2022	12 quaternary sites 14 secondary sites	
		SMEC	1 day	October 2022	3 quaternary sites	
		Attexo	2 days	3-4 November 2022	14 quaternary sites	
		Umwelt	5 days	7 – 11 November 2022	50 quaternary sites	
		Umwelt	4 days	5 – 8 December 2022	40 quaternary sites	
		Attexo	8 days	14 – 21 December 2022	13 quaternary sites	
		Umwelt	3 days	18 – 20 January 2023	30 quaternary sites 4 secondary sites	
		Umwelt	1 day	24 January 2023	2 secondary sites	
		Umwelt	3 days	19-21 July 2023	40 quaternary sites	
		Umwelt	3 days	21-23 November 2023	40 quaternary sites 3 secondary sites	
		Umwelt	4 days	11-14 December 2023	40 quaternary sites	
		Attexo	9 months	December 2023 – August 2024	100 quaternary sites	
		Umwelt	10 days	5-16 February 2024	80 quaternary sites 8 secondary sites	
		Umwelt	1 day	1 March 2024	3 quaternary sites	
		Umwelt	3 days	12-14 March 2024	20 quaternary sites	
		EMM	5 days	29 July 2024 – 2 August 2024	14 quaternary sites	

Method	Target MNES	Team	Survey length	Survey date	Survey effort	Total survey effort
Protected plant survey	Threatened flora	SMEC	2 days	April 2022	9 meanders	230 meanders
		SMEC	4	May 2022	6 meanders	
		SMEC	3 days	22 – 24 June 2022	5 meanders	
		Attexo	5 days	8-12 August 2022	5 meanders	
		Attexo	2 days	3-4 November 2022	5 meanders	
		Attexo	9 months	December 2023 – August 2024	200 meanders	
BioCondition survey	TEC	Umwelt	5 days	7-11 November 2022	26 bioconditions	156 bioconditions
		Attexo	9 months	December 2023 – August 2024	120 bioconditions	
		EMM	5 days	1 – 5 July 2024	5 bioconditions	
		EMM	5 days	8 – 12 July 2024	5 bioconditions	

Terrestrial fauna

Habitat assessments: Habitat assessments were undertaken in accordance with the Guide to determining terrestrial habitat quality – A toolkit for assessing land-based offsets under the Queensland Environmental Offsets Policy Version 1.2 (DES, 2017) and the modified habitat quality assessment (MHQA) developed by DCCEEW. Assessments were undertaken across the Exploratory Works Survey area, including the Project footprint, primarily focused on representative habitat and impact areas. The purpose of these surveys was to characterise the suitability of the various habitats present and identify whether they are likely to support populations of MNES flora and/or fauna species or communities. Incidental observations of other species and ecological values were also noted during these assessments.

Koala Spot Assessment Technique (SAT) points: The SAT as described in Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas (*Phascolarctos cinereus*) (Phillips & Callaghan, 2011) were used to assess if Koalas were present within the Exploratory Works Survey area. This survey method involved a search around a central tree, and the nearest 29 suitable trees for koala scats. Surveys were undertaken in areas of Eucalypt woodland considered to be suitable habitat.

Diurnal searches: Diurnal searches were conducted within each habitat type identified within the Exploratory Works Survey area. These searches primarily focused on detecting the potential presence of Koalas, however the searches also aimed to detect other threatened flora and fauna species.

Terrestrial spotlighting surveys: Spotlighting was undertaken within and adjacent to the Project footprint in areas of suitable habitat informed by the desktop survey. These surveys targeted the larger nocturnal species and any other values that may occur on site. A combination of walking and vehicle spotlighting was undertaken.

Passive and active acoustic detection surveys: Anabat swift units were deployed in representative habitats that may provide potential roosting habitat or act as flyways for Microchiropteran bats. Detection was conducted across the Exploratory Works Survey area between dusk and dawn across all habitat types.

Targeted amphibian surveys: Targeted amphibian surveys were undertaken by two observers at drainage features and watercourses at the Walkers Top area. Amphibian species were detected both visually and by call.

Bioacoustic surveys: Bioacoustics recording devices (BARs) were deployed across the Exploratory Works Survey area along creek lines associated with suitable habitat for target threatened amphibian species. BAR devices were set to a night-time recording schedule sampling for 10 minutes every hour from sunset to sunrise for a total of 50 minutes per night. Acoustic recordings collected during this survey included non-targeted species including non-targeted amphibian species, vocalising nocturnal mammals and vocalising nocturnal bird species.

Diurnal bird surveys: Full compositional bird surveys were undertaken usually during periods of peak bird activity (early morning or late afternoon) across the Exploratory Works Survey area. Birds were recorded aurally or visually with the aid of binoculars.

Camera trapping: Automated camera traps were deployed in areas of representative habitats to record visitation by nocturnal and diurnal animals. The cameras were baited with universal mammal bait (oats and peanut butter). Other bait types including chicken necks and sardines were also used in combination to capture a broader range of species. The camera trapping was used to detect the target threatened species and pest species.

Elliot trap surveys: Aluminium Elliot traps were placed at approximately 10 m intervals along two transects (10 per transect) at 23 sites. Traps were baited with universal mammal bait (a mixture of rolled oats, peanut butter, honey and vanilla essence), and checked each morning to identify and release captured fauna.

Pitfall trapping: Pitfall trapping was undertaken using three 20 litre (L) buckets at each site, spaced approximately 10 m apart and dug into the ground so they are flush with the surface. A drift fence, approximately 30 cm high, was erected between each bucket to direct small animals towards the pitfall traps. Traps were checked in the morning and evening to identify and release captured fauna.

Thermal drones and koala detection dogs: Thermal drones were used to detect nocturnal arboreal species including koalas and greater gliders across most of the Exploratory Works Survey area and Borumba PHES Survey area (apart from the lower reservoir inundation area within the national park). Koala detection dogs along with thermal drones have been used to collect genetic material in support of the Main Works EIS.

Table M-2: Terrestrial fauna survey methods

Method	Target MNES	Team	Survey length	Survey date	Survey effort	Total survey effort
Habitat assessments	All MNES	Umwelt	5 days	4 – 8 May 2022	40 sites	240 sites
		Attexo	5 days	8 – 12 August 2022	9 sites	
		Attexo	2 days	3-4 November 2022	5 sites	
		Umwelt	5 days	5 - 9 December 2022	46 sites	
		Umwelt	11 days	11 - 21 December 2022	100 sites	
		SMEC	5 days	1-5 July 2024	40 sites	
Koala Spot Assessment Technique (SAT) points	Koala	Umwelt	4 days	30 May – 2 June 2022	12 sites	12 sites
Active diurnal searches	Koala Yellow-bellied glider (south-eastern) Greater glider (southern and central) Glossy black-cockatoo (south-eastern) Black-breasted button-quail Spotted-tail quoll (SE mainland population) Long-nosed potoroo (northern) Grey-headed flying-fox	Umwelt	5 days	4 – 8 May 2022	41 sites (8.13 hours)	81 sites (28.13 hours)
		SMEC	5 days	1-5 July 2024	40 sites (20 hours)	

Method	Target MNES	Team	Survey length	Survey date	Survey effort	Total survey effort
Spotlighting surveys	Koala Greater glider (southern and central) Yellow-bellied glider (south-eastern) Long-nosed potoroo (northern) Grey-headed flying-fox Giant barred frog	Umwelt	3 nights	30 May – 2 June 2022	25 sites (5 hours)	91.28 hours
		Umwelt	4 nights	5 – 9 December 2022	25 sites (5 hours)	
		Umwelt	4 nights	5 – 9 February 2024	25 sites (4.28 hours)	
		EMM	4 nights	1 – 4 July 2024	45 hours	
		EMM	2 nights	17 – 18 July 2024	32 hours	
Call playback	Koala Yellow-bellied glider (south-eastern) Giant barred frog	Umwelt	3 nights	30 May – 2 June 2022	1 hour	4 hours
		Umwelt	4 nights	5 – 9 December 2022	1 hour	
		SMEC	4 nights	1-4 July 2024	1 hour	
		Umwelt	4 nights	5 – 9 February 2024	1 hour	
Acoustic bat call detection	Grey-headed flying-fox	Umwelt	5 days	4 – 8 May 2022	50 trap nights	133 trap nights
		Umwelt	4 days	30 May – 2 June 2022	33 trap nights	
		Umwelt	11 days	11 – 21 December 2022	50 trap nights	

Method	Target MNES	Team	Survey length	Survey date	Survey effort	Total survey effort
Bioacoustic surveys	Koala Yellow-bellied glider (south-eastern) Giant barred frog Fleay's barred frog (<i>Mixophyes fleayi</i>) Cascade tree frog (<i>Litoria pearsoniana</i>) Tusked frog (<i>Adelotus brevis</i>)	Umwelt	5 days	5 – 9 December 2022	300 trap nights	1,298 trap nights
		Umwelt	11 days	11 – 21 December 2022	563 trap nights	
		Umwelt	4 days	17 – 20 January 2023	300 trap nights	
		SMEC	1 day	18 June 2024	135 trap nights	
Targeted amphibian surveys	Giant barred frog	Umwelt	11 days	11 – 21 December 2022	7 sites	7 sites
Diurnal bird surveys	Glossy black-cockatoo (south-eastern) – Black-breasted button-quail Australian painted-snipe Squatter pigeon White-throated needletail Red Goshawk Coxen's fig-parrot	Umwelt	5 days	4- 8 May 2022	31 sites (2 hours)	6.39 hours (91 sites)
		Umwelt	11 days	11 – 21 December 2022	60 sites (4.39 hours)	

Method	Target MNES	Team	Survey length	Survey date	Survey effort	Total survey effort
Camera trapping	Koala Greater glider (southern and central) Yellow-bellied glider (south-eastern) Long-nosed potoroo (northern) Spotted-tail quoll (SE mainland population) Black-breasted button-quail	Umwelt	4 nights	4 – 8 May 2022	503 trap nights	2,863 trap nights
		Umwelt	3 nights	30 May – 2 June 2022	450 trap nights	
		Umwelt	10 nights	11 – 21 December 2022	1100 trap nights	
		Umwelt	3 nights	17 – 20 January 2023	450 trap nights	
		SMEC	12 nights	8 -19 July 2024	360 trap nights	
Elliot trap surveys	Long-nosed potoroo (northern) Spotted-tail quoll (SE mainland population)	Umwelt	3 nights	30 May – 2 June 2022	155 trap nights	855 trap nights
		Umwelt	10 nights	11 – 21 December 2022	700 trap nights	
Pitfall trapping	Reptiles Amphibians	Umwelt	4 nights	11–15 March 2024	107 trap nights	295 trap nights
		Umwelt	4 nights	18-22 March 2024	188 trap nights	
Thermal drones and koala detection dogs	Koala Greater glider	Ninox	17 nights	17 June – 31 July 2024	1,792 ha	24 nights, 7 days (2,527 ha)
		University of the Sunshine Coast	7 days and nights	31 July – 27 August 2024	735 ha	

Aquatic assessments

eDNA: Sal (Smith-Root, 2022). Samples were collected using a Smith-Root eDNA sampler with 5 µm Smith-Root self-preserving filters following Smith-Root protocol (Smith-Root, 2022). Three filters were processed at each site, approximately 2 L per filter. Samples were collected from areas of likely fish and platypus habitat (amongst snags, large woody debris, macrophytes, downstream of riffles and boulders, undercut banks, etc.). Filtration was undertaken on-site to reduce DNA degradation during transport of whole water samples (Yamanaka et al. 2016).

Fyke netting: Where sufficient water levels were present, two paired fyke nets were deployed at each waterway site, with entrances facing downstream. Two fyke net sizes were used in this study. One had two 5 m wings, with a 0.9 m drop and the other with a single 5 m wing and a 0.6 m drop. Both nets had 2 mm mesh. A float was placed in the cod end of each fyke net to provide an air space for air breathing fauna (turtles, platypus etc). Fyke nets were set in the afternoon and cleared the following morning. The combination of fykes used in each site varied on prevailing depth and width of available macrohabitat at each site.

Electrofishing (backpack): Backpack electrofishing was in wadable areas using a Smith-root APEX backpack electrofisher fitted with a 28 cm anode ring and a tightly covered dip net (10 mm stretched mesh). Both frequency (300 Hz) and duty cycle (~50%) was fixed to maintain a constant pulse width, with voltage varying according to conductivity levels. Sampling effort aimed to be consistent across habitats, with approximately 600 seconds 'on time' at sites. Backpack electrofishing sampling were undertaken by senior electrofishing operators. Due to prevailing depths, backpack electrofishing was not undertaken at Lake Borumba.

Electrofishing (boat): Boat electrofishing was undertaken via the use of a 5 m boat fitted with a 5 KVA generator and Smith-Root control box. Each standard boat electrofishing shot was completed in a structured fashion over a fixed area of 50 m by 15 m for a defined period of power-on time of approximately 300 seconds (± 5%). Where adequate sampling area was available this was repeated five times. Applied voltage varied according to the prevailing conductivity and temperature conditions. Stunned fish were blind sweep-netted from the water with a 3 mm open-mesh dip net fitted to a fibreglass pole.

Cathedral traps: Cathedral traps were deployed overnight. Two vertically-set traps (small and large sizes) were baited with a combination of fruit (apple and banana) and meat (beef heart and liver and washed sardines) to target herbivorous, carnivorous and omnivorous fish and turtles. Traps were deployed to ensure sufficient basking room was available the upper sections of the net for any air breathing fauna that might be captured.

Gill netting: Finnish gill nets of mesh sizes 13 mm, 19 mm and 25 mm were deployed. Nets were checked every 20 minutes to ensure that air-breathing fauna had not become entangled. Nets were retrieved and catch collected after one hour.

Angling: Angling was undertaken at dawn and dusk during peak cod activity. Angling techniques can be particularly useful for catching larger, predatory threatened fishes such as freshwater cod (Faragher et al. 1993; Douglas et al. 1994). Angling methods included actively fishing with a rod and reel using live and dead baits, and lures. Angling occurred for approximately 30 minutes.

Hydroacoustics: Hydroacoustic surveys were conducted using a Biosonics DT-X echosounder package with a 6.4° circular beam transducer operating at 201 kHz. The transducer was used at a ping rate of 5 s⁻¹, a pulse length of 0.4 ms, a data collection threshold of -130 dB and salinity, temperature. Hydroacoustic 'pings' were positioned using a differential GPS. The transducer was attached to the port side of the survey vessel's transom at a depth of approximately 0.6 m, sufficient to avoid cavitation as a result of prop wash and water flowing underneath the hull and past the transducer and mount. The transducer was angled vertically so that the sound beam was directed straight down towards the lake bed.

Sonar data were analysed to provide mean values every 180 pings which, depending on boat speed resulted in a data point every 50 to 100 m.

Aquatic spotlighting: Nocturnal spotlighting involved searching suitable substrates for reptiles and platypus, using spotlights or head torches with a bright focussed beam. Suitable habitat was the primary focus of spotlighting efforts including, fallen logs and branches, rock outcrops and tree trunks, especially along roads and tracks. Other areas assessed were targeted including downstream of riffles in pool habitat and where macrophytes were noted.

Crab pots: During the spotlighting surveys, a total of three crab pots baited with pilchards were deployed within the previously identified areas of interest, usually around 7-8 pm, over a period of three nights. The traps were left in place for four hours and monitored hourly, though some were retrieved early due to the high abundance of

Mixophyes sp. tadpoles present in the watercourse. These tadpoles quickly consumed the bait, rendering the traps ineffective.

Macroinvertebrates: AusRivAS sampling of both bed and edge habitats in watercourse sites. Van veen grab collection within Lake Borumba.

Microalgae: Surface sediment scrapes of biofilm in depositional microhabitats within watercourses. Deep water benthic grab samples within Lake Borumba.

Water quality: Physicochemical parameters were measured with a multi-parameter water quality meter (YSi ProDSS), which was calibrated prior to use. Measured physicochemical parameters included: temperature (°C); pH; electrical conductivity ($\mu\text{S}/\text{cm}$); dissolved oxygen (mg/L and % saturation); and turbidity (NTU).

General observations: opportunistic records of other flora/fauna species were also made throughout the survey program.

Table M-3: Aquatic fauna survey methods

Method	Target species	June 2022	Nov 2022	May 2023	Nov/Dec 2023	May 2024
eDNA	Fish (Mary River cod, lungfish), platypus	9 sites	16 sites	7 sites	43 sites	52 sites
Fyke netting	Fish, turtles, platypus	10 sites	17 sites	8 sites	12 sites	
Electrofishing (backpack)	Fish, macrocrustaceans	11 sites	16 sites	7 sites	15 sites	
Electrofishing (boat)	Fish	4 sites	4 sites			
Angling	Fish	7 sites	12 sites	5 sites	1 site	
Box traps	Fish	3 sites		3 sites	1 site	12 sites
Hydroacoustics	Fish					11 sites
Snorkelling	Aquatic vertebrates and macrocrustaceans	3 sites		8 sites	5 sites	4 sites
Spotlighting	Reptiles and platypus	Site-wide				
Crab pots	Crayfish	11 sites		17 sites	6 sites	15 sites
Macroinvertebrates	Macroinvertebrates	15 sites		22 sites	9 sites	4 sites
Microalgae	Microalgae	15 sites		14 sites	1 site	2 sites
Habitat	All MNES (subset of AusRivAS and State of the Rivers, and Likelihood of occurrences for threatened species)	15 sites	21 sites	8 sites	33 sites	
Water quality	All MNES	14 sites	21 sites	8 sites	12 sites	

Survey adequacy

An assessment of survey adequacy against the relevant survey guidelines for the threatened species with potential to occur within the Exploratory Works Survey area is provided in Table M-4.

Table M-4: Fauna survey adequacy against relevant guidelines

Species	Recommended survey guidelines	Survey adequacy*
Glossy black-cockatoo (South-eastern)	<p>Targeted species survey guidelines for glossy black-cockatoos recommend at a minimum:</p> <ul style="list-style-type: none"> • Diurnal bird survey – minimum effort 5 hours per 50 ha • Active search for foraging and nesting signs minimum effort 20 hours per 50 ha. 	<p>Surveys undertaken:</p> <ul style="list-style-type: none"> • 240 habitat assessments • 81 sites (8.13 hours) active diurnal searches • 91 sites (6.39 hours) diurnal bird survey <p>Survey requirements met.</p>
Greater glider (southern and central)	<p>There are currently no national guidelines outlining survey methods targeting greater gliders. However, the Victorian Department of Sustainability and Environment Approved Survey Standards: Greater glider <i>Petauroides volans</i> (DSE, 2011) recommends spotlighting (40 person minutes per 2 ha for two nights along a 1 km transect).</p>	<p>Surveys undertaken:</p> <ul style="list-style-type: none"> • 240 habitat assessments • 81 sites (8.13 hours) active diurnal searches • 91.28 hours spotlighting • 3,268 camera trap nights <p>Survey requirements met.</p>
Grey-headed flying-fox	<p>The Survey guidelines for Australia's threatened bats (DEWHA, 2010) outline the following survey methods be undertaken when surveying for the grey-headed flying-fox (<i>Pteropus poliocephalus</i>):</p> <ul style="list-style-type: none"> • review known flying fox camps in the area based on government databases • undertake field survey for unknown roosts during daylight • undertake surveys of vegetation communities and food plants • nocturnal surveys (spotlighting). 	<p>Surveys undertaken:</p> <ul style="list-style-type: none"> • 240 habitat assessments • 578 quaternary sites, 31 secondary sites • 81 sites (8.13 hours) active diurnal searches • 91.28 hours spotlighting • 133 nights of acoustic bat call detection <p>Survey requirements met.</p>
Koala	<p>There are currently no national guidelines outlining survey methods targeting koalas (<i>Phascolarctos cinereus</i>). However, the following techniques are outlined within the <i>A review of Koala habitat assessment criteria and methods</i> (Kara N. Youngentob, 2021) and endorsed by the EPBC Act referral guidelines for the Endangered Koala combined populations of Queensland, New South Wales and the Australian Capital Territory:</p>	<p>Surveys undertaken:</p> <ul style="list-style-type: none"> • 240 habitat assessments • 81 sites (8.13 hours) active diurnal searches • 12 KSATs • 91.28 hours spotlighting • 4 hours call playback • 3,268 camera trap nights

Species	Recommended survey guidelines	Survey adequacy*
	<ul style="list-style-type: none"> spotlighting – 30 person minutes on two occasions during the survey period scat surveys (i.e. spot assessment technique or SAT surveys). 	<ul style="list-style-type: none"> 1,298 trap nights bioacoustic surveys <p>Survey requirements met.</p>
Long-nosed potoroo (northern)	<p>The Survey guidelines for Australia's threatened mammals (DSEWPaC, 2011) recommend the following methods be undertaken:</p> <ul style="list-style-type: none"> daytime searches for potentially suitable habitat resources, such as areas with a dense understorey camera traps in areas of suitable habitat, baited with universal bait collection of predator scats. 	<p>Surveys undertaken:</p> <ul style="list-style-type: none"> 240 habitat assessments 81 sites (8.13 hours) active diurnal searches 3,268 camera trap nights 91.28 hours spotlighting 855 Elliot trap nights <p>Survey requirements met.</p>
Yellow-bellied glider (southern subsp.)	<p>There are currently no national guidelines outlining survey methods targeting yellow-bellied gliders. However, survey guidelines for similar species recommend the following methods be undertaken:</p> <ul style="list-style-type: none"> call playback (two sessions of call playback) active search for foraging and nesting signs - minimum effort 20 hours over 5 days (for potential nesting and feeding trees) per 50 ha spotlighting (two 30 person-minute spotlight surveys within a 100 m x 100m survey site). 	<p>Surveys undertaken:</p> <ul style="list-style-type: none"> 240 habitat assessments 81 sites (8.13 hours) active diurnal searches 91.28 hours spotlighting 4 hours of call playback 1,298 trap nights bioacoustic surveys 3,268 camera trap nights <p>Survey requirement met.</p>
Black-breasted button-quail	<p>The Survey guidelines For Australia's threatened birds (DEWHA, 2010) recommend land-based area searches or line transects through suitable habitat (15 hours over three days) per 50 ha.</p>	<p>Surveys undertaken:</p> <ul style="list-style-type: none"> 240 habitat assessments 81 sites (8.13 hours) active diurnal searches 91 sites (6.39 hours) diurnal bird survey 3,268 camera trap nights <p>Survey requirement met.</p>
Giant barred frog	<p>The Survey guidelines for Australia's threatened frogs (DEWHA, 2010) recommend the following surveys are undertaken during times of peak activity for the species (September to March following a week of heavy rainfall) in a stream transect of a minimum of 200 m:</p> <ul style="list-style-type: none"> Call playback and spotlighting in riparian rainforest and wet sclerophyll forest Multiple sweeps of dip netting for larvae in pools. 	<p>Surveys undertaken:</p> <ul style="list-style-type: none"> 240 habitat assessments 1,298 trap nights bioacoustic surveys 295 pitfall trap nights 7 targeted amphibian surveys 91.28 hours spotlighting

Species	Recommended survey guidelines	Survey adequacy*
		<ul style="list-style-type: none"> 4 hours call playback Survey requirement met.
Australian painted snipe	Survey guidelines for Australia's threatened birds (DEWHA, 2010) recommend the following methods be undertaken: <ul style="list-style-type: none"> targeted stationary observations – minimum effort 10 hours over 5 days land-based area searches or line transects for sites less than 50 ha when wetland holds water but is not flooded – minimum effort 10 hours over 3 days. 	Surveys undertaken: <ul style="list-style-type: none"> 240 habitat assessments 81 sites (8.13 hours) active diurnal searches 91 sites (6.39 hours) diurnal bird survey
Coxen's fig-parrot	Survey guidelines for Australia's threatened birds (DEWHA, 2010) recommend the following methods be undertaken: <ul style="list-style-type: none"> active search for foraging and nesting signs - minimum effort 20 hours over 5 days (for potential nesting and feeding trees) per 50 ha targeted searches 15 hours over 4 days (in areas where potential nesting and feeding trees have been located) per 50 ha. 	Surveys undertaken: <ul style="list-style-type: none"> 240 habitat assessments 81 sites (8.13 hours) active diurnal searches 91 sites (6.39 hours) diurnal bird survey
Spotted-tail quoll (SE mainland population)	Survey guidelines for Australia's threatened mammals (DSEWPaC, 2011) recommend the following methods be undertaken across a study area size of approximately 100 ha: <ul style="list-style-type: none"> daytime searches for potentially suitable habitat resources, such as areas with a dense understorey camera traps in areas of suitable habitat baited with universal bait hair sampling device (hair funnels) surveys. 	Surveys undertaken: <ul style="list-style-type: none"> 240 habitat assessments 81 sites (8.13 hours) active diurnal searches 3,268 camera trap nights 855 Elliot trap nights
Australian lungfish	The Survey guidelines for Australia's threatened fish (DSEWPaC, 2011) do not identify a recommended effort for this species, but recommend electrofishing as the most effective sampling method, with angling also suggested.	Surveys undertaken: <ul style="list-style-type: none"> 57 electrofishing (boat and backpack) sites 25 angling sites 77 aquatic habitat sites
Mary River cod	The Survey guidelines for Australia's threatened fish (DSEWPaC, 2011) do not identify a recommended effort for this species, but rather state that best methods for this species include a combination of angling, electrofishing and visual observation via snorkelling during the daylight hours.	Surveys undertaken: <ul style="list-style-type: none"> 57 electrofishing (boat and backpack) sites 25 angling sites 20 snorkelling sites 77 aquatic habitat sites
Mary River turtle	The Survey guidelines for Australia's threatened reptiles (DSEWPaC, 2011) do not state a recommended effort for turtles but rather state that effort should match the environmental conditions and species	Surveys undertaken: <ul style="list-style-type: none"> 47 fyke netting sites

Species	Recommended survey guidelines	Survey adequacy*
	behaviours.	<ul style="list-style-type: none"> • 55 water quality sites • 77 aquatic habitat assessment sites
White-throated snapping Turtle	The Survey guidelines for Australia's threatened reptiles (DSEWPaC, 2011) do not state a recommended effort for turtles but rather state that effort should match the environmental conditions and species behaviours.	Surveys undertaken: <ul style="list-style-type: none"> • 47 fyke netting sites • 55 water quality sites • 77 aquatic habitat assessment sites
Red Goshawk	Survey guidelines for Australia's threatened birds (DEWHA, 2010) recommend the following methods be undertaken: <ul style="list-style-type: none"> • Area searches – 8 hours over 10 days. 	Surveys undertaken: <ul style="list-style-type: none"> • 240 habitat assessments • 81 sites (8.13 hours) active diurnal searches • 91 sites (6.39 hours) diurnal bird survey
White-throated needletail	Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (Commonwealth of Australia, 2015) notes there are no standard survey techniques.	Surveys undertaken: <ul style="list-style-type: none"> • 240 habitat assessments • 81 sites (8.13 hours) active diurnal searches • 91 sites (6.39 hours) diurnal bird survey
Squatter pigeon	Survey guidelines for Australia's threatened birds (DEWHA, 2010) recommend the following methods be undertaken: <ul style="list-style-type: none"> • Area searches or transect – 15 hours over 3 days. • Flushing surveys in areas less than 50 ha – 10 hours over 3 days. 	Surveys undertaken: <ul style="list-style-type: none"> • 240 habitat assessments • 81 sites (8.13 hours) active diurnal searches • 91 sites (6.39 hours) diurnal bird survey

* Note that some survey sites may overlap (i.e. multiple methods used at a location) and some sites may have been surveyed more than once (i.e. in different survey events).

Results

Regional ecosystems

REs were confirmed in the field via Quaternary surveys and were found to be generally consistent with the Vegetation Management Supporting Map; however, there were small- and large-scale deviations in the extent of REs and localised variations in canopy species dominance. All mapped polygons of HVR were confirmed in the field as meeting remnant status.

A total of 12 REs were ground-truthed as present within the Exploratory Works Survey area. Table M-5 lists the ground-truthed REs (GTRE), while Figure 36 shows the distribution of the GTRE within the Exploratory Works Survey area.

Table M-5: Ground-truthed regional ecosystems in the Exploratory Works Survey area and their extent in the Borumba PHES Survey area

Regional Ecosystem	VM Act Status	Description	Area (ha) within Exploratory Works Survey area	Area (ha) within Borumba PHES Survey area
12.3.1a	Endangered	Gallery rainforest (notophyll vine forest) on alluvial plains	0.4	12.8
12.3.7	Least concern	<i>Eucalyptus tereticornis</i> , <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> +/- <i>Melaleuca</i> spp. fringing woodland.	52.4	209.0
12.11.3^	Least concern	<i>Eucalyptus siderophloia</i> , <i>E. propinqua</i> +/- <i>E. microcorys</i> , <i>Lophostemon confertus</i> , <i>Corymbia intermedia</i> , <i>E. acmenoides</i> open forest on metamorphics +/- interbedded volcanics	242.1	1,089.7
12.11.9	Of concern	<i>Eucalyptus tereticornis</i> subsp. <i>Tereticornis</i> or <i>E. tereticornis</i> subsp. <i>Basaltica</i> open forest on metamorphics +/- interbedded volcanics	15.4	74.6
12.11.10	Least concern	Notophyll vine forest +/- <i>Araucaria cunninghamii</i> on metamorphics +/- interbedded volcanics	32.1	718.8
12.11.14	Of concern	<i>Eucalyptus crebra</i> , <i>E. tereticornis</i> , <i>Corymbia intermedia</i> woodland on metamorphics +/- interbedded volcanics	117.9	822.3
12.11.15	Of concern	<i>Eucalyptus tereticornis</i> , <i>Corymbia intermedia</i> open woodland with <i>Xanthorrhoea johnsonii</i> understorey on serpentinite	2.3	27.3
12.12.12	Of concern	<i>Eucalyptus tereticornis</i> , <i>Corymbia intermedia</i> , <i>E. crebra</i> +/- <i>Lophostemon suaveolens</i> woodland on Mesozoic to Proterozoic igneous rocks	21.4	124.7
12.12.15	Least concern	Mixed open forest including combinations of <i>Eucalyptus propinqua</i> , <i>E. siderophloia</i> , <i>Corymbia intermedia</i> , <i>E. microcorys</i> , <i>Lophostemon confertus</i> open forest on Mesozoic to Proterozoic igneous rocks	196.4	429.1

Regional Ecosystem	VM Act Status	Description	Area (ha) within Exploratory Works Survey area	Area (ha) within Borumba PHES Survey area
12.12.15b	Least concern	<i>Lophostemon confertus</i> open forest +/- <i>Eucalyptus microcorys</i> , <i>E. siderophloia</i> , <i>E. carnea</i> , <i>E. propinqua</i> and vine forest species often present in understorey. Occurs in gullies and exposed ridges on Mesozoic to Proterozoic igneous rocks often amongst vine forest. Not a Wetland.	2.2	5.8
12.12.16	Least concern	Notophyll vine forest on Mesozoic to Proterozoic igneous rocks	8.3	36.0
12.12.23	Least concern	<i>Eucalyptus tereticornis</i> subsp. <i>Tereticornis</i> or <i>E. tereticornis</i> subsp. <i>Basaltica</i> +/- <i>E. eugenioides</i> woodland to open forest on crests, upper slopes and elevated valleys and plains on Mesozoic to Proterozoic igneous rocks	26.4	125.8
Total (ha)			906.1	5,553.9

Threatened ecological communities

Lowland Rainforest of Subtropical Australia

The Subtropical rainforest habitat type was identified during the field surveys as having the potential of conforming to the Lowland Rainforest of Subtropical Australia TEC and was therefore subject to targeted surveys to assess the potential TEC against the key diagnostic criteria and condition thresholds of the Commonwealth Listing Advice on Lowland Rainforest of Subtropical Australia.

There are several patches of the Lowland Rainforest of Subtropical Australia TEC patches within the Exploratory Works Survey area; however, only a single patch of the Lowland Rainforest of Subtropical Australia TEC is present within the Project footprint at Area 1 (Borumba Dam).

An assessment has been undertaken in Table M-6 to confirm if the Subtropical rainforest habitat type within the Survey area conforms to the key diagnostic characteristics contained in the Commonwealth Listing Advice on Lowland Rainforest of Subtropical Australia.

Table M-6: Assessment against the key diagnostic characteristics of the listed ecological community

Key Diagnostic Characteristics of the Listed Ecological Community	Assessment Outcome
Distribution of the ecological community is primarily in the NSW North Coast and South Eastern Queensland bioregions, according to Interim Biogeographic Regionalisation for Australia (IBRA) version 6.1 (2004).	Conforms The rainforest vegetation community is present within the South Eastern Queensland bioregions.
The ecological community occurs on: soils derived from basalt or alluvium; or enriched rhyolitic soils; or basaltically enriched metasediments.	Uncertain The Subtropical rainforest vegetation community is mapped as on land zone 11 and occurring on several different geological units, with the main units being the Amamoor beds which includes basic metavolcanics, which can include basalt, the Marumba beds include rhyolite. In the absence of soil sampling and site-specific field validated geological data, a precautionary approach has been applied and the Subtropical rainforest vegetation community has been assumed to be present on either enriched rhyolitic soils or basaltically enriched metasediments.
The ecological community generally occurs at an altitude less than 300 m above sea level.	Conforms The rainforest vegetation community is generally present between the 150 m and 250 m contours; however, does extend above the 300 m contour in some places.
The ecological community typically occurs in areas with high annual rainfall (>1,300mm).	Does not conform The mean annual rainfall recorded at the Imbil Post Office weather station (40099) is 1,180.9 mm. The median annual rainfall recorded at the Imbil Post Office weather station is 1,121.4 mm.
The ecological community is typically more than 2 km inland from the coast.	Conforms The Subtropical rainforest vegetation community is approximately 50 km from the coast.
The structure of the ecological community is typically a tall (20 m–30 m) closed forest, often with multiple canopy layers.	Conforms The structure of the Subtropical rainforest vegetation community was assessed as having a median canopy height of only 21 m with a range of between 15 – 25 m. The canopy cover was typically greater than 80%.

Key Diagnostic Characteristics of the Listed Ecological Community**Assessment Outcome**

Patches of the ecological community typically have high species richness (at least 30 woody species from Appendix A).

Conforms

Targeted surveys were undertaken to confirm species richness of the patches of the Subtropical rainforest vegetation community. All patches contained a minimum of 30 woody species from Appendix A.

The assessment identifies that the Subtropical rainforest conforms to the key diagnostic characteristics of the Lowland Rainforest of Subtropical Australia TEC (noting the precautionary principle being applied due to the uncertainty around the underlying geology and soils).

Surveys were undertaken within the Subtropical rainforest to assess the condition of the vegetation community to confirm if the vegetation community also meets the condition thresholds, which identified that all patches achieved a Condition class of either A or B. A list of all species identified within the Subtropical rainforest habitat type and their listing status on Appendix A of the Commonwealth Listing Advice on Lowland Rainforest of Subtropical Australia is provided in Appendix K.

A total of 2.5 ha of the field validated TEC is present within the Project footprint, while a total of 632.4 ha is present in Borumba PHES Survey area.

The Commonwealth Listing Advice on Lowland Rainforest of Subtropical Australia identifies that a minimum buffer zone of 50 m beyond the trunks of the outermost trees in the patch should be applied to assist in assessing impacts to the TEC and assist in the preservation of the patch. The TEC buffer zone extends into the Project footprint at several locations.

Subtropical Eucalypt Floodplain Forest of the New South Wales North Coast and South East Queensland

The Eucalypt dominated forests and woodlands on alluvial flats habitat type was identified as having the potential to conform to the Subtropical Eucalypt Floodplain Forest and Woodland of the New South Wales North Coast and South East Queensland Bioregions TEC.

The Eucalypt dominated forests and woodlands on alluvial flats habitat type is widely distributed within the Borumba PHES Survey area and the Exploratory Works Survey area.

An assessment has been undertaken in Table M-7 to confirm if Eucalypt dominated forests and woodlands on alluvial flats habitat type conforms to the key diagnostic characteristics contained in the Approved Conservation Advice for the Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions.

Table M-7: Assessment against the key diagnostic characteristics of the listed ecological community

Key Diagnostic Characteristics of the Listed Ecological Community**Assessment Outcome**

It occurs in the New South Wales North Coast (NNC) and South Eastern Queensland (SEQ) IBRA2 bioregions, and on Curtis Island in the Brigalow Belt North IBRA Bioregion (BBN).

Conforms

The Eucalypt dominated forests and woodlands on alluvial flats is present within the South East Queensland bioregion.

It occurs in the catchments of the eastern watershed of the Great Dividing Range, typically in their lower reaches.

Conforms

The Eucalypt dominated forests and woodlands on alluvial flats is present in the catchments of the eastern watershed of the Great Dividing Range.

It occurs at elevations up to 250 m above sea level (ASL), most typically below 50 m ASL.

Conforms

The Eucalypt dominated forests and woodlands on alluvial flats is present on the 150 m contour.

Key Diagnostic Characteristics of the Listed Ecological Community	Assessment Outcome
It occurs on alluvial landforms including river floodplains, riparian zones (e.g., along riverbanks, lake foreshores and creek lines), the floors of tributary gullies, floodplain pockets, alluvial flats, fans, terraces, and localised colluvial fans; as well as on localised depressions amongst low rises and on associated sites where water can pond.	<p>Conforms</p> <p>The Eucalypt dominated forests and woodlands on alluvial flats is present on the RE mapped land zone 3, which is an alluvial landform with alluvial soils, and on floodplain geology.</p> <p>Areas of the Eucalypt dominated woodlands and forests habitat type which is present on other land zones (i.e. land zone 8, 11, or 12) or other (non-floodplain geology) have been excluded from the TEC.</p>
It occurs on alluvial soils of various textures including silts, clay loams, sandy loams, gravel and cobbles.	<p>Conforms</p> <p>The Eucalypt dominated woodlands and forests is present on the RE mapped land zone 3, which is an alluvial landform with alluvial soils, and on floodplain geology.</p>
It does not typically occur on soils that are primarily marine or aeolian sands, but may occur on such substrates after they have been modified by fluvial activity.	<p>Conforms</p> <p>There were no areas of the Eucalypt dominated woodlands and forests present on marine or aeolian sands (i.e. RE land zone 1 or 2 or estuarine geology).</p>
It occurs as a tall closed-forest, tall open-forest, closed forest, open forest, tall woodland, or woodland (Specht 1970). The canopy has a crown cover of at least 20%.	<p>Conforms</p> <p>The Eucalypt dominated woodlands and forests is present as an open forest to woodland vegetation community with a crown cover of at least 20%.</p>
It has a canopy dominated by one or a combination of <i>Angophora</i> , <i>Corymbia</i> , <i>Eucalyptus</i> , <i>Lophostemon</i> and/or <i>Syncarpia</i> tree species, but NOT dominated by <i>Eucalyptus robusta</i> (swamp mahogany). Other canopy tree species may be present, and in some areas rainforest trees may be prominent.	<p>Conforms</p> <p>The Eucalypt dominated woodlands and forests was observed to be dominated by forest red gum (<i>Eucalyptus tereticornis</i>).</p> <p>Where the vegetation community was dominated or co-dominated by river sheoak (<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>) or <i>Melaleuca</i> spp., these areas were excluded from the TEC.</p> <p><i>Eucalyptus robusta</i> (swamp mahogany) is not dominant in the vegetation community.</p>
A mid-layer (including a sub-canopy, and/or shrub-layer) may be present, sparse, or absent; and fauna may be abundant or rare.	<p>Conforms</p> <p>The Eucalypt dominated woodlands and forests supported a mid-layer (including a subcanopy, and/or shrub-layer) which ranged from sparse to dense.</p> <p>A range of native fauna species were observed to during the field surveys.</p>

Table M-7 identifies that where the Eucalypt dominated woodlands and forests habitat type was dominated by *Eucalyptus* species, these patches conform to the key diagnostic characteristics of the Approved Conservation Advice for the Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions.

Surveys were undertaken within the Eucalypt dominated woodlands and forests to assess the condition of the vegetation community to confirm if the vegetation community also meets the condition thresholds. The surveys identified that two patches of the Eucalypt dominated woodlands and forests meet the minimum condition thresholds, achieving Condition Classes A2 and B3. Patches of the Eucalypt dominated woodlands and forests habitat type that did not conform to the condition thresholds generally did not meet the minimum ground cover species richness or number of very large or large trees.

A total of 4.6 ha of the field validated TEC is present within the Exploratory Works Survey area, while 14 ha is present within the Borumba PHES Survey area. The Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions TEC is not present within the Project footprint.

The Approved Conservation Advice for the Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions identifies that a buffer zone of at least 100 m of native vegetation contiguous with the TEC is required to protect patches of the TEC from potential adverse impacts.

Threatened flora

The following threatened flora species protected under the EPBC Act and NC Act were identified during the field surveys within the Borumba PHES Survey area:

- ball nut (*Floydia praealta*), listed as vulnerable under the EPBC Act and the NC Act
- brush sophora (*Sophora fraseri*), listed as vulnerable under the EPBC Act and vulnerable under the NC Act
- *Coleus omissus*, listed as endangered under the EPBC Act and endangered under the NC Act
- *Coleus torrenticola*, listed as endangered under the EPBC Act and endangered under the NC Act
- native guava (*Rhodomyrtus psidioides*), listed as critically endangered under the EPBC Act and the NC Act
- scrub turpentine (*Rhodamnia rubescens*), listed as critically endangered under the EPBC Act and the NC Act
- three-leaved bosistoa (*Bosistoa transversa*), listed as vulnerable under the EPBC Act and least concern under the NC Act

A summary of the occurrence and extent of suitable habitat for above listed threatened flora species is provided in Table M-8.

Table M-8: Summary of all threatened flora species

Common Name Scientific Name	EPBC Act Status	NC Act Status	Borumba PHES Survey area (no. of records)	Exploratory Works Survey area (no. of records)	Borumba PHES Survey area (ha)		Exploratory Works Survey area (ha)	
					Known	Potential	Known	Potential
Ball nut <i>Floydia praealta</i>	Vulnerable	Vulnerable	63	0	23.9	751.9	1.3	39.6
Brush sophora <i>Sophora fraseri</i>	Vulnerable	Vulnerable	31	22	2.2	2,298.2	1.4	494.2
<i>Coleus omissus</i>	Endangered	Endangered	15	0	0.0	149.3	0.0	19.7
<i>Coleus torrenticola</i>	Endangered	Endangered	246	214	4.0	142.9	3.4	50.1
Native guava <i>Rhodomirtus psidioides</i>	Critically endangered	Critically endangered	1,295	1,267	4.5	1,483.0	4.0	350.8
Scrub turpentine <i>Rhodamnia rubescens</i>	Critically endangered	Critically endangered	626	429	35.8	3,057.9	22.4	572.3
Three-leaved bosistoa <i>Bosistoa transversa</i>	Vulnerable	Least concern	14	0	9.2	1,195.7	0.0	237.3

Threatened terrestrial fauna

Fauna surveys recorded more than 200 terrestrial fauna species within the Exploratory Works Survey area, seven of which are MNES.

The following threatened fauna species protected under the EPBC Act and NC Act were identified during the field surveys within the Survey area:

- black-breasted button-quail (*Turnix melanogaster*), listed as vulnerable under the EPBC Act and the NC Act
- glossy black-cockatoo (south-eastern) (*Calyptorhynchus lathami lathami*), listed as vulnerable under the EPBC Act and the NC Act
- greater glider (southern) (*Petauroides volans*) – listed as endangered under the EPBC Act and the NC Act
- grey headed flying fox (*Pteropus poliocephalus*) – listed as vulnerable under the EPBC Act and least concern under the NC Act
- koala (*Phascolarctos cinereus*) – listed as endangered under the EPBC Act and the NC Act
- long-nosed potoroo (*Potorous tridactylus tridactylus*) – listed as vulnerable under the EPBC Act and the NC Act
- yellow-bellied glider (*Petaurus australis australis*) – listed as vulnerable under the EPBC Act and the NC Act

MNES fauna for which suitable habitat was observed:

- giant-barred frog (*Mixophyes iteratus*) – listed as vulnerable under the EPBC Act and the NC Act
- Australian painted snipe (*Rostratula australis*) – listed as endangered under the EPBC Act and the NC Act
- Coxen's fig-parrot (*Cyclopsitta diophthalma coxeni*) – listed as critically endangered under the EPBC Act and the NC Act
- northern quoll (*Dasyurus hallucatus*) – listed as endangered under the EPBC Act and least concern under the NC Act
- spotted-tail quoll (*Dasyurus maculatus maculatus*) – listed as endangered under the EPBC Act and the NC Act.

Nine introduced terrestrial fauna species recorded in field surveys are listed in below.

A summary of the occurrence and extent of suitable habitat for above listed threatened fauna species is provided in Table M-9.

Table M-9: Summary of all threatened fauna species

Common Name Scientific Name	EPBC Act Status	NC Act Status	Borumba PHES Survey area (no. of records)	Exploratory Works Survey area (no. of records)	Borumba PHES Survey area (ha)	Exploratory Works Survey area (ha)
Black-breasted button-quail <i>Turnix melanogaster</i>	Vulnerable	Vulnerable	10	0	659.9 (suitable)	32.2 (suitable)
Glossy black-cockatoo (south-eastern) <i>Calyptorhynchus lathami lathami</i>	Vulnerable	Vulnerable	39	30	2,722.8 (breeding) 101.8 (foraging)	643.0 (breeding) 2.3 (foraging)
Greater glider (southern) <i>Petauroides volans</i>	Endangered	Endangered	7	4	3,066.2 (denning/foraging)	676.7 (denning/foraging)
Grey headed flying fox <i>Pteropus poliocephalus</i>	Vulnerable	Least concern	18	17	3,829.1 (foraging)	717.4 (foraging)
Koala <i>Phascolarctos cinereus</i>	Endangered	Endangered	67	33	3,026.6 (foraging/breeding) 1,516.0 (dispersal/refuge)	676.5 (foraging/breeding) 202.8 (dispersal/refuge)
Long-nosed potoroo <i>Potorous tridactylus tridactylus</i>	Vulnerable	Vulnerable	7	7	3,775.1	715.1
Yellow-bellied glider <i>Petaurus australis australis</i>	Vulnerable	Vulnerable	23	19	2,959.0 (denning) 94.4 (foraging)	676.3 (denning) 0.2 (foraging)
Giant-barred frog <i>Mixophyes iteratus</i>	Vulnerable	Vulnerable	-	-	118.0	7.6
Australian painted snipe <i>Rostratula australis</i>	Endangered	Endangered	-	-	10.4	1.7
Coxen's fig-parrot <i>Cyclopsitta diophthalma coxeni</i>	Critically endangered	Critically endangered	-	-	775.8	40.9
Northern quoll <i>Dasyurus hallucatus</i>	Endangered	Least concern	-	-	3,801.9	715.1
Spotted-tail quoll	Endangered	Endangered			3,801.9	715.1

Common Name Scientific Name	EPBC Act Status	NC Act Status	Borumba PHES Survey area (no. of records)	Exploratory Works Survey area (no. of records)	Borumba PHES Survey area (ha)	Exploratory Works Survey area (ha)
--------------------------------	--------------------	------------------	---	--	----------------------------------	---------------------------------------

<i>Dasyurus maculatus maculatus</i>						
-------------------------------------	--	--	--	--	--	--

Threatened aquatic flora and fauna

No aquatic flora considered to be MNES were recorded during field surveys, and none are documented to occur in the Yabba Creek catchment or more broadly in the Mary River system.

A total of 34 fish species were recorded during site surveys, representing 20 families. Two threatened fish species were recorded in field surveys:

- Australian lungfish (*Neoceratodus forsteri*) – listed as vulnerable under the EPBC Act and in Queensland, the Australian Lungfish is not listed as threatened under the state's *Nature Conservation Act 1992*, however, the taking of Australian Lungfish has been prohibited since it was declared a protected species under the *Queensland Fish and Oyster Act 1914*.
- Mary River cod (*Maccullochella mariensis*) – listed as endangered under the EPBC Act and not listed under NC Act.

Six species of freshwater turtle were recorded during field surveys. Two threatened turtle species were recorded in field surveys:

- Mary River turtle (*Elusor macrurus*) – listed as endangered under the EPBC Act and the NC Act.
- White-throated snapping turtle (*Elseya albagula*) – listed as critically endangered under the EPBC Act and the NC Act.

Six exotic aquatic fauna species were recorded in the Exploratory Works Survey area, together with two translocated species. Details are included in below.

A summary of the occurrence and extent of suitable habitat for above listed threatened fauna species is provided in Table M-10.

Table M-10: Summary of all aquatic fauna species

Common Name Scientific Name	EPBC Act Status	NC Act Status	Borumba PHES Survey area (no. of records)	Exploratory Works Survey area (no. of records)	Borumba PHES Survey area	Exploratory Works Survey area
Australian lungfish <i>Neoceratodus forsteri</i>	Vulnerable	Not listed	5	1	278.4 (foraging) 21.6 (spawning and foraging)	4.6 (foraging) 5.5 (spawning and foraging)
Mary River cod <i>Maccullochella mariensis</i>	Endangered	Not listed	6	1	269.7 (foraging) 26.1 (spawning and foraging)	4.1 (foraging) 4.5 (spawning and foraging)
Mary River turtle <i>Elusor macrurus</i>	Endangered	Endangered	6	5	178.5 (foraging) 5.9 (nesting)	9.9 (foraging) 2.9 (nesting)
White-throated snapping turtle <i>Elseya albagula</i>	Critically endangered	Critically endangered	7	0	184.2 (foraging) 6.0 (nesting)	11.1 (foraging) 2.9 (nesting)

Invasive flora and fauna

A broad range of invasive animals and plants are already established within and surrounding the Exploratory Works Survey area. In total, 52 invasive plant species were recorded in the Exploratory Works Survey area during field surveys. Of these, eight terrestrial species are listed as Category 3 Restricted Plants under the *Biosecurity Act 2014* (Qld), three of which are also listed as Weeds of National Significance (WoNS) (Table M-11). Lantana and cat's claw creeper are widespread; however, they generally occur in higher density within rainforest and wet sclerophyll communities where clearing or natural disturbance has resulted in opportunities for these species to rapidly colonise exposed areas.

Four aquatic invasive plants are also listed as either Category 3 Restricted Plants or WoNS (Table M-11).

Table M-11: Invasive plant species present in the Exploratory Works Survey area

Species	Restricted Plant / WoNS
Terrestrial	
Camphor laurel (<i>Cinnamomum camphora</i>)	Category 3 Restricted Plant
Cat's claw creeper (<i>Dolichandra unguis-cati</i>)	Both
Chinese celtis (<i>Celtis sinensis</i>)	Category 3 Restricted Plant
Parthenium (<i>Parthenium hysterophorus</i>)	Category 3 Restricted Plant
Lantana (<i>Lantana camara</i>)	Both
Prickly pear (<i>Opuntia stricta</i>)	Both
Rat's tail grasses including <i>Sporobolus fertilis</i> , <i>Sporobolus natalensis</i> and <i>Sporobolus pyramidalis</i>	Category 3 Restricted Plant
Sicklepod (<i>Senna tora</i>)	Category 3 Restricted Plant
Aquatic	
Cabomba (<i>Cabomba caroliniana</i>)	Both
Water hyacinth (<i>Eichhornia crassipes</i>)	Category 3 Restricted Plant
Hymenachne (<i>Hymenachne amplexicaulis</i>)	WoNS
Salvinia (<i>Salvinia molesta</i>)	Both

A total of 14 invasive animals were recorded within the Exploratory Works Survey area:

- Cattle (*Bos taurus*)
- Dog (*Canis familiaris*)
- Rusa Deer (*Cervus timorensis*)
- Cat (*Felis catus*)
- Mosquitofish (*Gambusia holbrooki*)
- European brown hare (*Lepus europaeus*)
- Tilapia (*Oreochromis mossambica*)
- Rabbit (*Oryctolagus cuniculus*)
- Guppy (*Poecilia reticulata*)
- Cane toad (*Rhinella marina*)
- Pig (*Sus scrofa*)
- Red fox (*Vulpes vulpes*)
- Swordtail (*Xiphophorus helleri*)
- Platy (*Xiphophorus maculatus*).