Stratford Renewable Energy Hub *Litoria brevipalmata* (Green-thighed Frog) Expert Report

Yancoal/GHD

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Template 2.8.1

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Abbreviations

Abbreviation	Description
BC Act	NSW *Biodiversity Conservation Act 2016*
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Calculator
BDAR	Biodiversity Development Assessment Report
DC	Direct current
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
DPI	Former NSW Department of Planning and Infrastructure
DPIE	Former NSW Department of Planning, Infrastructure and Environment
EIS	Environmental Impact Statement
ELA	Eco Logical Australia
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ETL	Electricity Transmission Lines
GHD	GHD Pty Ltd
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature and Natural Resources
LGA	Local Government Area
NPWS	National Parks and Wildlife Service
NSW	New South Wales
PCT	Plant Community Type
PHES	Pumped Hydro Energy Storage
SED	Stratford East Dam
SMC	Stratford Mining Complex
SREH	Stratford Renewable Energy Hub
Yancoal	Yancoal Australia Limited

1. Introduction

1.1 Background

The Scoping Report for this project (Yancoal Australia Limited [Yancoal] 2023) states that Yancoal proposes to develop the Stratford Renewable Energy Hub (SREH) at the site of the Stratford Mining Complex (SMC; Figure 1) following the scheduled completion of mining in 2024. This provides an opportunity to transition the site from a coal mine to a beneficial post-mining land use comprising a proposed Pumped Hydro Energy Storage (PHES) with an indicative capacity of 3.6 gigawatt-hours (GWh) (300 megawatts [MW] over 12 hours) alongside a photovoltaic solar farm facility (Solar Farm). The proposed Solar Farm would produce 330 MW direct current (DC) electricity to supply a portion of the energy requirements of the PHES.

A species of frog, *Litoria brevipalmata* (Green-thighed Frog or GTF), is listed as a Vulnerable species under the NSW *Biodiversity Conservation Act 2016* (BC Act), but is not listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). There are no records of this species within a 10 km radius of the SMC (the locality). There are suitable Plant Community Types (PCTs) recorded on site such that the GTF could be present and it has been listed as a candidate species under the Biodiversity Assessment Method (BAM; DPIE 2020a).

Surveys as required under the BAM survey guidelines (DPIE 2020b) have not been completed for this species due to night land access restrictions. Therefore, the presence and any need for offsets have not been able to be established as part of the Biodiversity Development Assessment Report (BDAR) prepared by GHD Pty Ltd (GHD).

This expert report has been written to be included as a component of the BDAR to adequately assess the likelihood of the GTF being present in the Project Area and, if so, provide an assessment of where this species would be located. The Project Area covers the lands that are to be subject to direct impacts by the proposed works. The assessment also takes into consideration a 200 m buffer around those impacted areas where indirect impacts may occur. This information can be used to determine any final offset requirements, if needed, for the species.

1.2 Project infrastructure

The Project is proposed to include the following elements, based on the Scoping Report (Yancoal 2023):

- Construction of an upper reservoir.
- Construction of a tunneled waterway comprising a vertical shaft and inclined headrace tunnel between the upper reservoir intake and powerhouse, and a tailrace tunnel connecting the powerhouse to the lower reservoir.
- Augmentation of the existing Stratford East Dam (SED) to serve as the lower reservoir.
- Construction and operation of a “behind the meter” Solar Farm to supply up to 330 MW to the PHES, with optionality to export electricity to the grid in times of surplus solar generation.
- Re-alignment of the existing Electricity Transmission Lines (ETL) across previously disturbed mine areas.
- Construction of an on-site electrical substation, to connect the PHES and the Solar Farm to the TransGrid ETL.

- Minor works in the public road network, such as intersection upgrades and installation of an ETL.
- Other associated construction and operational activities.

The proposed location of this infrastructure is provided in Figure 2.

1.3 Purpose of the expert report

Section 6.5.2 of the BAM (DPIE 2020a) sets out the following essential requirements for the preparation of an expert report:

- Identify the relevant species or population.
- Justify the use of an expert report.
- Indicate and justify the likelihood of presence of the species or population.
- Estimate the number of individuals or area of habitat (whichever unit of measurement applies to the species/individual) for the biodiversity development assessment area, including a description of how the estimate was made.
- Demonstrate what information was considered, rejected and discounted in relation to the determination made in the expert report.
- Identify the expert and provide evidence of their expert credentials.

The report needs to determine whether:

- The target species is unlikely to be present, in which case no further assessment is required, or
- The target species is likely to be present in which case the expert report must provide estimates of habitat area within the impact assessment area.

1.4 Impact assessment area

The location in NSW of the proposed SREH is provided in Figure 1. The area potentially being impacted is referred to as the Project Area and comprises the Development Footprint and areas of the existing SMC within the Development Footprint (Excluded Areas), as shown in Figure 2. The available records of the GTF for NSW and the region around the Project Area are depicted in Figure 3. The vegetation and water bodies mapped within the Project Area are provided in Figure 4 and Figure 5 respectively. Information for the Project Area encompassed by this infrastructure and the locality of the SMC (10 km around the infrastructure) was obtained from a range of data layers including:

- Native vegetation: provided by GHD
- Waterbodies: NSW LPI
- GTF Records: NSW BioNet and the Atlas of Living Australia (NSW DCCEEW 2024).

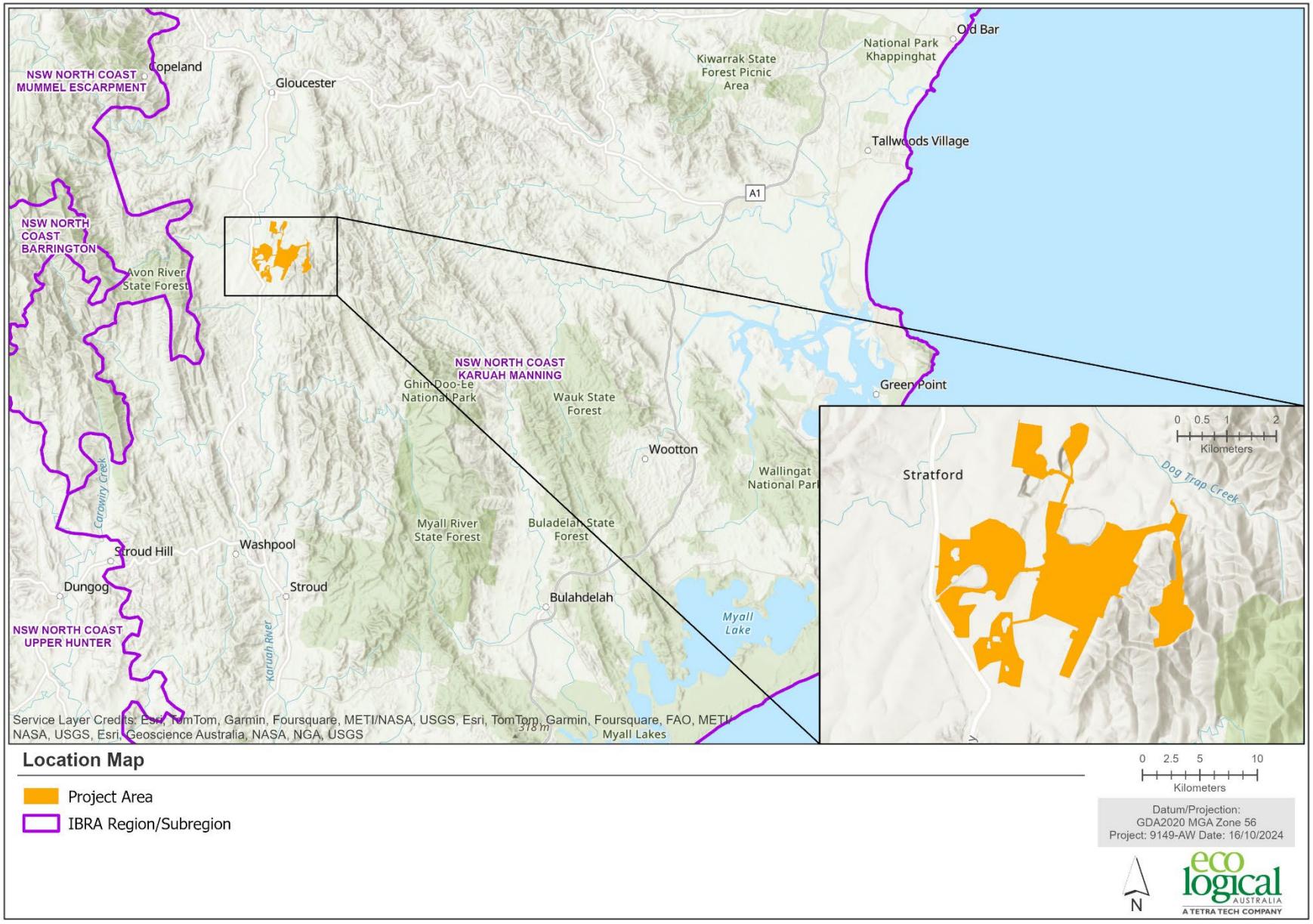

Figure 1. Location of the Project Area within the region

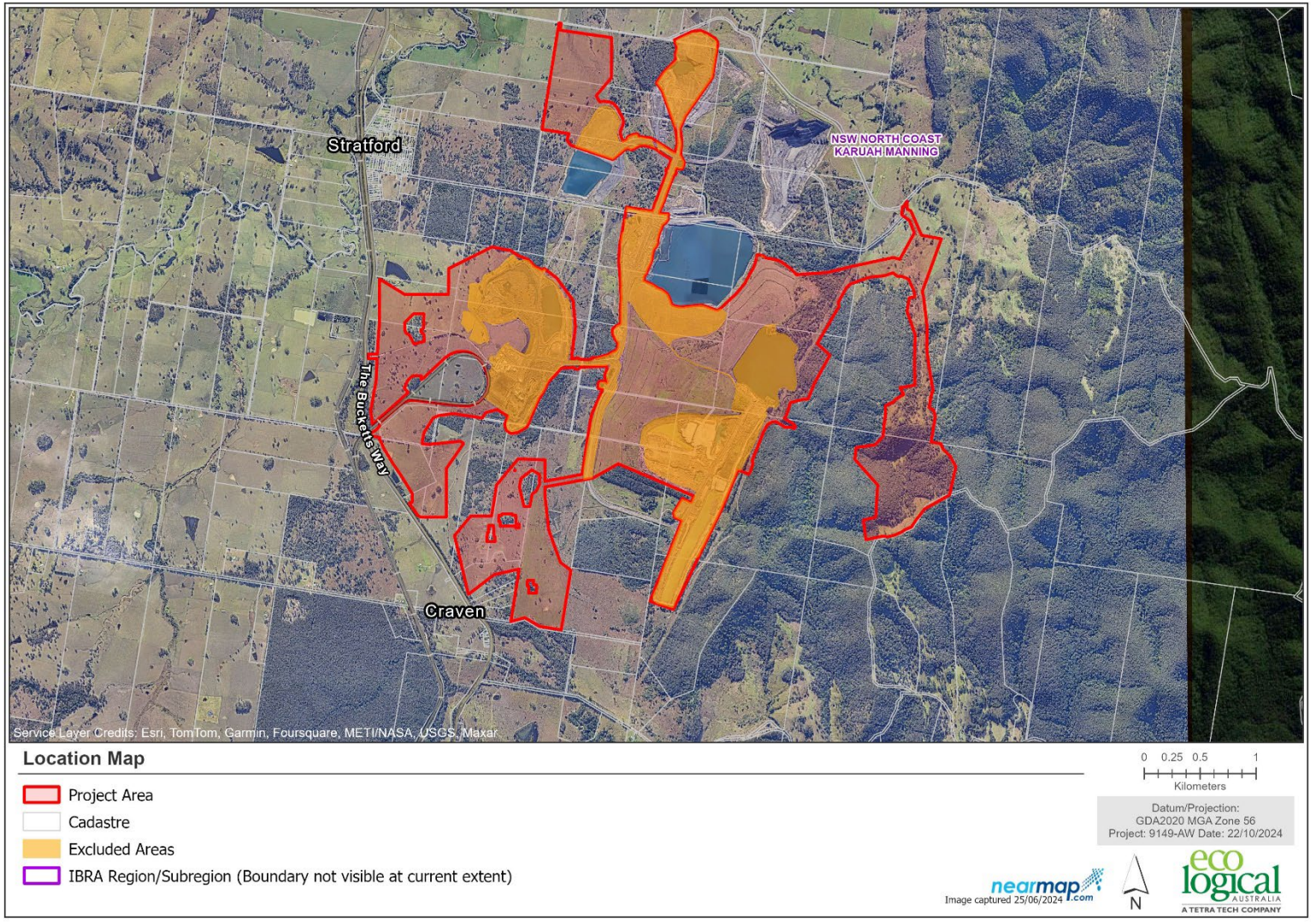

Figure 2. Detailed mapping of the Project Area

1.5 Reasons for use of an expert report

Section 5.2.3(2)(b) and 5.2.4(2)(c) of the BAM (DPIE 2020a) places two specific requirements for where an expert report can be used instead of surveys:

- An expert report can only be used instead of a survey for species to which species credits apply.
- An expert report may be obtained instead of undertaking a species survey at a development site, clearing site, land to be biodiversity certified or a biodiversity stewardship site.

The GTF meets the first criteria, being a species credit species under the BC Act.

In this case, an expert report has been provided in relation to the GTF, which is listed as vulnerable under the BC Act, and is a species credit species. An expert report has been prepared due to the difficulty in meeting the survey requirements set out in the BAM Survey Guidelines (DPIE 2020b). The area to be covered is inaccessible as a mine site area, especially during the necessary wet conditions for surveys, necessitating that an expert report be produced to consider the potential for this species to be present and extent of any possible occurrence.

1.6 Credentials of expert

Dr Frank Lemckert is an Ecologist who has been undertaking studies into the ecology and management of frogs since 1986 and has been an ecological consultant since 2011. His skills include survey design/ implementation/ targeted species surveys, data handling, analysis and interpretation and the production of high level reports including papers published in international peer-reviewed journals and technical reports and recovery plans for the Commonwealth and NSW Governments. He has also been an expert witness for the assessment of the impacts of alleged illegal clearing for the Commonwealth, NSW and Local Governments (Hornsby Council) and provided expert advice to NSW Department of Primary Industry for legal considerations over the potential for forestry operations to impact on rock outcrop dependent species.

Dr Lemckert represented Forests NSW (now Forestry Corporation NSW) as a reptile and amphibian expert in the Comprehensive Regional Assessments and Regional Forest Agreement Process carried out between 2000 and 2002 and as an expert in fauna management for negotiations over a new Threatened Species License for harvesting operations in 2014 that included consideration of this species.

Dr Lemckert is an acknowledged expert on eastern Australian frogs having completed his MSc and PhD on the ecology and management of frogs in this region and has published over 70 papers (or book chapters) in Australian and International peer-reviewed journals. He has been used by both the NSW and Commonwealth Governments as an expert witness in court cases assessing the impacts of land clearing on threatened frogs.

He is a member of the Amphibian Specialist Group of the International Union for Conservation of Nature and Natural Resources (IUCN), secretary of the NSW Declining Frog Working Group of NSW and past president of the Australian Society of Herpetologists. He co-supervised two PhD students, a Master of Applied Science Student and three Bachelor of Science (Honours) students who

completed theses addressing issues of frog biology and conservation. He is listed as an accredited expert by the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) to provide expert reports under the BAM. Dr Lemckert wrote the survey guidelines for NSW threatened frog species to be used in assessments under the BAM (DPIE 2020b).

1.6.1 *Litoria brevipalmata* (Green-thighed Frog)

Dr Lemckert has a long association working with the GTF having in 1995 commenced a research and monitoring program for this species associated with Upgrades of the Pacific Highway around Bulahdelah that included monitoring of the population over 3-4 years and investigations into habitat requirements and habitat use patterns. He co-supervised an Honours Student who undertook an assessment of preferred breeding site characteristics as part of this study. The work around Bulahdelah ultimately led to recommendations of management of the species in road areas, which was followed by additional monitoring. He also completed surveys for the species for Upgrades of the Pacific Highway from the Oxley Highway to Kempsey and Woolgoolga to Ballina and reviews of the associated threatened frog management plans. Dr Lemckert has conducted targeted research into movements using radio-tracking and broader habitat relationships through GIS based projects.

Dr Lemckert can demonstrate his expertise on the GTF and its management through the following publications and reports:

- Mahony, M., Gould, J., Beranek, C., Callen, A., Clulow, J., Clulow, S., Klop-Toker, K., Mahony, S., Wallace, S., Stock, S., Garnham, J., Lemckert, F., Thumm, K., Moses, B. & Pickett, E. (2022). A trait-based analysis for predicting impact of wildfires on frogs. Australian Zoologist 42:326-351. https://doi.org/10.7882/AZ.2022.021.
- Geyle, H.M, Hoskin, C.J., Bower, D.S., Catullo, R., Clulow, S., Driessen, M., Daniels, K., Garnett, S., Gilbert, D., Heard, G.W., Hero, J-M., Hines, H.B., Hoffmann, E.P., Hollis, G. Hunter, D.A. Lemckert, F.L., Mahony, M., Marantelli, G., McDonald, K.R., Mitchell, N.J., Newell, D., Roberts, J.D., Scheele, B.C., Scroggie, M., Vanderduys, E., Wassens, S., West, M., Woinarski, J.S.C. & Gillespie, G.R. (2021). Red hot frogs: identifying the Australian frogs most at risk of extinction. Pacific Conservation Biology. https://doi.org/10.1071/PC21019.
- Gillespie, G.R., Roberts, J.D., Hunter, D., Hoskin, C.J., Alford, R.A., Heard, G.W., Hines, H. **Lemckert, F.**, Newell, D. & Scheele, B.C. 2020. Status and Priority Conservation Actions for Australian Frog Species. Biological Conservation 247, 108543. https://doi.org/10.1016/j.biocon.2020.108543.
- **Lemckert, F.L.**, & Mahony, M.J. 2018. The status of Decline and Conservation of Frogs in Temperate Coastal South-eastern Australia. **Pp 59-72** In: *Amphibian Biology Volume 11 - Conservation and Decline of Amphibians: Eastern Hemisphere (Australia, New Zealand and Pacific Islands)*. H. Heatwole and J. Rowley (Eds.). CSIRO Publishing, Melbourne.
- **Lemckert, F.**, Mahony, M., Brassil, T. & Slatyer, C. 2006. The biology of the threatened Green-thighed Frog *Litoria brevipalmata* (Anura: Hylidae) in the central and mid-north coastal areas of New South Wales. Australian Zoologist 33:337-344.
- **Lemckert, F.** 2003. Old green-thighed frogs? Herpetofauna 33:13-15.
- **Lemckert, F.** 2003. Tonight's the night – the life of a Green-thighed Frog. Australian Nature 27:24-25.

- **Lemckert, F.L.** & Slatyer, C. 2002. Short-term movements and habitat use of the green-thighed frog, *Litoria brevipalmata* (Anura: Hylidae). Australian Zoologist 32:56-61.
- Lemckert, F.L., M. Mahony, and C. Slatyer. 1997. Biological Study of the Green-thighed Frog in the Bulahdelah Region. Report to the RTA and NSW NPWS.
- Jean-Marc Hero, Harry Hines, Ed Meyer, **Frank Lemckert**, David Newell, John Clarke. 2004. *Litoria brevipalmata*. The IUCN Red List of Threatened Species: e.T12144A3325725. https://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T1214

In addition, he is recognised as an expert in the species having been engaged by and prepared the following:

- Completed an expert report for the GTF for a development on the Central Coast of NSW.
- Expert assessment on the presence of the GTF for the Kurri Smelter re-development project (2021).
- NSW Office of Environment and Heritage to be part of the expert panel determining the categorisation of this species under the SOS program and in determining the populations requiring specific management to meet the SOS requirement to have a viable population maintained 100 years into the future.
- Provided expert opinion on the status of this species during assessments undertaken for the IUCN in 2001 and 2016.
- Provided expert opinion on the habitat requirements, sub-population status and reservation requirements for the Green-thighed Frog during the NSW Government's Comprehensive Regional Assessment program (2000-2001).

Dr Lemckert's full CV is provided as Appendix A of this report.

2. Species information

2.1 *Litoria brevipalmata* (Green-thighed Frog)

2.1.1 Species description

The GTF is a member of the Australian frog family Pelodryadidae (formerly Hylidae) (Cogger 2018). They are a relatively small hylid frog, growing up to 45mm in length, with a brown upper body and thick blackish stripe that extends from the snout to their flank and is lined by a pale stripe along the bottom (NSW DEECCW, 2024). Some individuals may also have black speckles across the dorsal surface and they can go almost a grey colour during the day (F. Lemckert Pers. Obs., NSW DEECCW, 2019). The species draws its common name from the bright lime green colour located on the thighs, groin and flanks (Plate 1), with that colouring being much more obvious in males when they are in breeding condition. The toe-discs are small which is in keeping with their more terrestrial habits.

Plate 1. Typical adult GTF male calling and amplexing pair – note the lime green inner thigh and flank colour that gives the frog its common name

2.1.2 Broad distribution and abundance

This species range extends through central and coastal areas of eastern Australia starting at the Hawkesbury River in central coastal New South Wales (NSW) and extending upwards to around the Gympie area of South-East Queensland (NSW OEH, 2024). Figure 3 shows available records for the species in NSW and demonstrates that the GTF is found scattered across this coastal range. However, GTF records are often patchy within a local area and may predominantly be found in apparently isolated subpopulations, potentially now due to habitat fragmentation (NSW OEH, 2024). It is an enigmatic species that can be found occasionally in large numbers before disappearing from sites (Barker et al. 1995; Cogger 2013) and, along with its very brief calling period, this means that detection of the GTF is quite difficult to make with any certainty and its distribution and status is likely not very well understood. AmphibiaWeb (2008) lists the extent of occurrence of the species as approximately 72,500 km^2.

Of note also is the recent genetic work of the GTF that has provided two interesting and potentially important facts about the species (M. Mahony Pers. Comm). Firstly, the species is much more closely related to the New Guinea lineage of tree frogs (Nyctimystines) and is not closely related to endemic Australian Pelodryadidae. It appears that the ancestors of the GTF migrated into Australia during one of the recent ice-ages and established populations that were cut off from New Guinea as the climate changed again. There is now a very large gap between the northern point of distribution in Queensland and its most closely related species in New Guinea. Thus the GTF is very likely to be reclassified into a new genus, likely Nyctimystes.

Secondly, the genetics strongly indicates that there are actually two species of GTF within the currently recognised single species, with a geographical split appearing to occur in northern NSW. This does fit in with some apparent habitat preference differences seen between populations present in QLD and northern NSW compared to those populations studied towards the southern end of the range in NSW. This information is not likely to have any bearing on the longer-term conservation listing.

The GTF is only a relatively recently recognised species, being described in 1972 (Tyler et al. 1972) and this may have an effect on our understanding of the historic abundance of the species. There are no estimates of the number of GTFs present in the wild or any estimate of the number of discrete populations, if any. Typically, the number of calling males recorded at breeding sites is less than 10 (Lemckert et al. 2006), which would indicate a relatively small population in most instances. However, there are instances of hundreds of males being recorded on a few occasions (Lemckert et al. 2006, Lemckert Pers. Obs.) and the species was considered to be very common in the Ourimbah Valley (100 km north of Sydney) when first described (Barker et al. 1995), although it appears to be rarer there now. It may be a boom and bust type of species that increases significantly in numbers in good rainfall years and then declines when rainfall is low and restricts their flood dependent reproduction. Anstis (2013) notes that successful reproduction may depend on follow up rainfalls to allow tadpole development to succeed and this may only happen regularly in higher rainfall years. Such patterns of population decline and increase are considered quite typical of many frog species that have been studied (Alford and Richards 1999).

Within areas that the GTF is known to occur, it is often only present in a small percentage of the apparently suitable habitat, as is evident in and around Ourimbah where less than 20% of apparently suitable habitat and breeding sites have been found to contain the species (F. Lemckert Pers. Obs.). The reasons for this patchiness of presence have yet to be properly understood.

Although the GTF has declined at Ourimbah, declines in other areas have not been noted and populations are thought to have remained relatively stable across its range (AmphibiaWeb 2008). This contrasts markedly with many other Australian species (Gillespie et al. 2020) and some work has been completed that indicates that the GTF may not be so severely affected by the amphibian Chytrid fungus (Portway et al. 2020) that has caused major declines in frog populations around the world.

2.1.3 Breeding

GTF exhibit “explosive breeding” (Lemckert et al. 2006) where calling occurs very intensely over a short period of time and in response to rainfall. Calling periods usually occur only once or twice per year, usually between September and April, and is highly reliant on heavy rainfall events that

flood their breeding sites (NSW OEH, 2024). A study by Lemckert et al. (2006) found that the calling period for GTF is short lived, usually only lasting one to two nights, although calling will persist for longer if rain keeps falling (F. Lemckert Pers. Obs.). GTF's calls comprise of 'wok' and 'quack' sounds (NSW OEH, 2024), but is typically mostly a rapidly repeated and constant high pitched and ongoing "Yap, yap, yap". GTF breeding and calling is found to occur in both natural and man-made ephemeral pools which form after rainfall (NSW OEH, 2024). These breeding sites are typically associated with forested habitats, being either within or immediately adjacent to forest (Lemckert et al., 2006).

Eggs are laid in clutches of loose floating rafts (Plate 2) and usually laid amongst heathy and aquatic vegetation and leaf litter (Anstis 2013, Lemckert et al., 2006). These eggs sink to the bottom of the pool within 24 hours of them being laid. Anstis (2013) indicates the clutch size for GTFs is usually between 366 to 582 eggs. Hatching of embryos occurs within a 24 hr period and tadpole metamorphosis takes place between 40 and 100 days later, dependent on the temperature of the water (Anstis 2013, Lemckert et al., 2006).

Individuals are likely to be able to breed after one year and they have been recorded to reach an age of at least 5 years (Lemckert 2003).

Plate 2. Egg mass of the GTF floating on surface before sinking

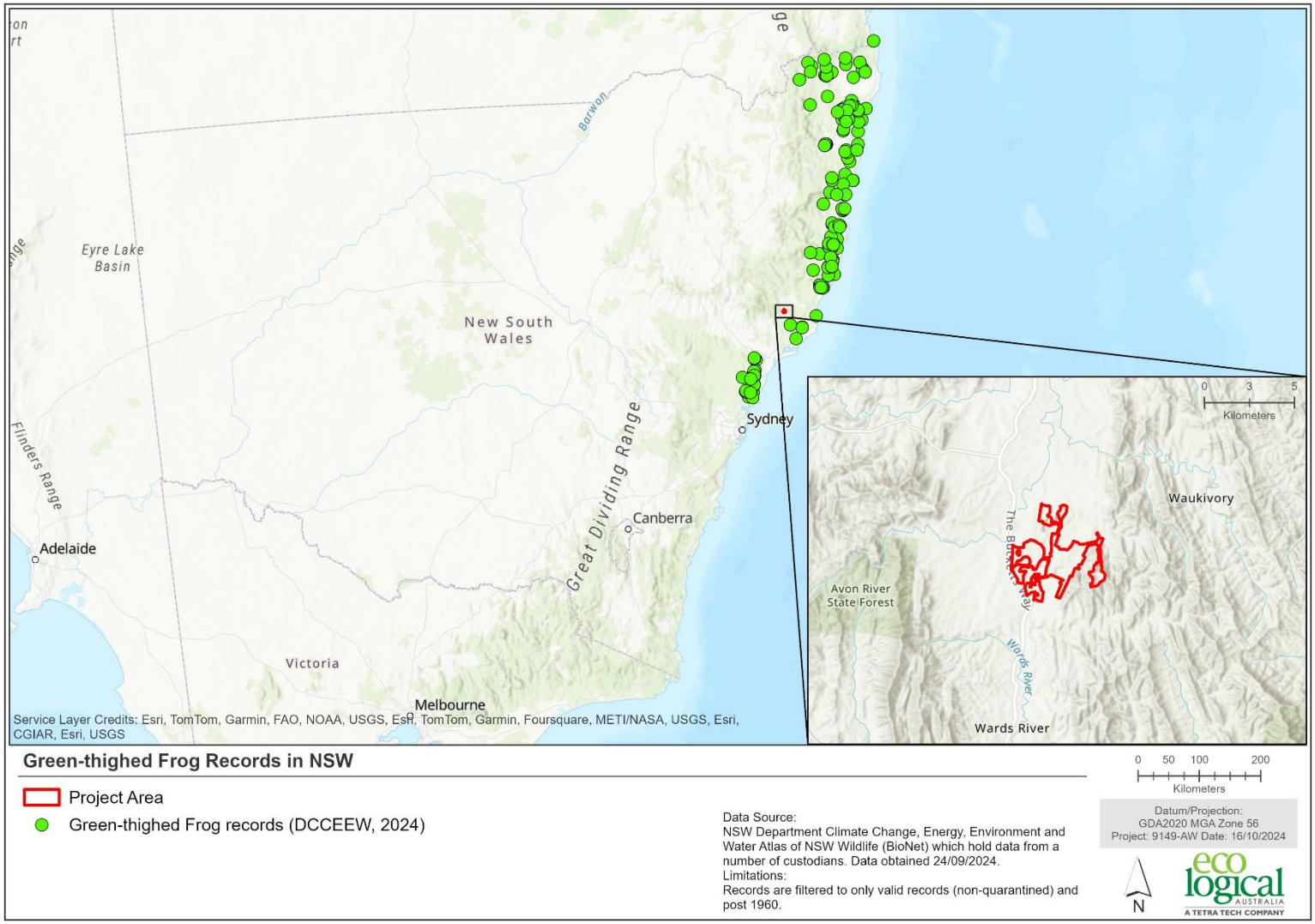

Figure 3. BioNet records of the GTF in NSW and (inset) the region around the Project Area

2.1.4 Ecology and habitat requirements

The species is one of only a handful of eastern temperate Australian species that exhibit "explosive breeding". Males congregate around larger, temporary pools that form only after very heavy rainfall events (Barker et al. 1995; Lemckert et al. 2006) and calling generally lasts for only one or two nights and reproduction is potentially highly variable between years. Based on the work of Ledlin (1997) and Lemckert et al. (2006), this species appears to breed mainly in relatively large ephemeral pools – typically sites that are at least 10 m long, 5 m wide and have water depths of greater than 30 cm. These sites fill only after sustained rains or bursts of heavy rain, usually being identified by falls of over 50 mm and often closer to 100 mm over 24-48 hours. The use of such larger ephemeral pools appears likely to reflect breeding being concentrated to only once or twice a year so that the breeding site needs have certainty that they will hold water long enough for tadpoles can reach metamorphosis.

Lemckert et al. (2006) recorded that the GTF typically call and breed in depressions adjacent to streams (e.g. old billabongs), but that human-created depressions, such as flooded road verges or excavated hollows were also used. Most pools contained relatively little emergent vegetation and contained a base made up of leaf litter and woody debris (Lemckert et al. 2006). A couple of known sites were located immediately adjacent to forest in grassy depressions in paddocks. In the area from Coffs Harbour down to the Central Coast of NSW Lemckert et al. (2006) found breeding sites for the GTF were typically partly or wholly within rainforest or wet sclerophyll forest or in wet gully lines. The species appears to move into more open forests in the northern half of its distribution including quite open *Corymbia maculata* (Spotted Gum) forest around Grafton.

The impacts on non-native fish on the presence and reproduction of the GTF has received little attention. Presumably the species chooses temporary pools to avoid fish and invertebrate predation present within permanent ponds. Hence the ability of non-native fish to enter into a breeding site is likely to lead to a site being unsuitable for successful breeding. Fish were absent in the ponds studied by Ledlin (1997) and Lemckert et al. (2006), which supports this idea. The Plague Minnow (*Gambusia holbrooki*) was found to have been able to invade breeding habitat in Nerong State Forest (south of Bulahdelah) at the end of a 10-year monitoring program (F. Lemckert pers. Obs.), but the work did not carry on to determine if this caused abandonment of the breeding site. It seems highly likely that the presence of fish, and particularly non-native species, is a significant detriment to breeding by the GTF.

The non-breeding habitat used by the GTF is not well known as the species is rarely seen outside of breeding events. Lemckert and Slatyer (2002) provide the only direct study of non-breeding habitat through radio-tracking of individuals after breeding had occurred. This study found tracked frogs remained within areas of forest no further than 100 m from the breeding site. Within this habitat individual GTF foraged and moved through low vegetation 59% of the time, at heights between 10 cm and 150 cm above the ground. Daytime shelter sites were either under dense leaf litter or in thick vegetation, both of which provide good camouflage and cover and moist conditions that minimise desiccation risks. The work indicated that cover, in the form of thick leaf litter or dense low vegetation, may be a critical requirement for the survival of the GTF.

2.1.5 Diet

The diet of the adults has not been studied. Presumably the species is a generalist and frogs feed on a wide range of invertebrates. They are not likely to have any specific dietary requirements.

2.2 Vegetation associations

In the NSW North Coast Bioregion, NSW DCCEEW lists in their profile (NSW OEH 2024) that the GTF is associated with the following vegetation formations and classes:

1. Dry sclerophyll forests (shrub/grass sub-formation)
    - Clarence Dry Sclerophyll Forests
    - Hunter-Macleay Dry Sclerophyll Forests
    - Northern Gorge Dry Sclerophyll Forests
    - North-west Slopes Dry Sclerophyll Woodlands
2. Dry sclerophyll forests (shrubby sub-formation)
    - North Coast Dry Sclerophyll Forests
    - Sydney Coastal Dry Sclerophyll Forests
    - Sydney Sand Flats Dry Sclerophyll Forests
3. Forested wetlands
    - Coastal Floodplain Wetlands
    - Coastal Swamp Forests
    - Eastern Riverine Forests
4. Freshwater wetlands
    - Coastal Freshwater Lagoons
5. Grasslands
    - Temperate Montane Grasslands
6. Grassy woodlands
    - Coastal Valley Grassy Woodlands
7. Miscellaneous ecosystems
    - Water bodies, rivers, lakes, streams (not wetlands)
8. Rainforests
    - Dry Rainforests
    - Northern Warm Temperate Rainforests
    - Subtropical Rainforests
9. Wet sclerophyll forests (grassy sub-formation)
    - Northern Hinterland Wet Sclerophyll Forests
10. Wet sclerophyll forests (shrubby sub-formation)
    - North Coast Wet Sclerophyll Forests
    - Northern Escarpment Wet Sclerophyll Forests.

2.3 Conservation Status and Threats

This species is listed as Vulnerable in NSW under the BC Act, but is not listed under the EPBC Act and is listed as of Least Concern by the IUCN (IUCN 2023).

The species profile from NSW DCCEEW lists the following threats to the GTF:

- *Changes to drainage patterns which reduce periodic local flooding.*
- *Damage to semi-permanent and ephemeral ponds and flood-prone vegetation.*
- *Clearing of habitat for development.*
- *Clearing of habitat for agriculture.*
- *Habitat disturbance through timber harvesting.*
- *Reduction in water quality through pasture fertilisation.*
- *Reduction in habitat and water quality as a result of grazing.*
- *Reduction of leaf-litter and cover of fallen logs through burning for agricultural purposes.*
- *Lack of knowledge on threats to the species including susceptibility to chytrid fungus and the impact of development activities.*
- *Lack of knowledge on the species distribution, persistence in locations, abundance, and population trends (particularly as the species is cryptic and only calls after large rainfall). Habitat use of adults outside of breeding times and movement of the frog in the landscape is not known.*

The GTF is recognised as of Least Concern on the IUCN Red List of Threatened species (IUCN 2023), however, the following threats to its survival are still listed:

- Residential & commercial development - Housing & urban areas.
- Transportation & service corridors - Roads & railroads.
- Biological resource use - Logging & wood harvesting.
- Human intrusions & disturbance - Work & other activities.
- Natural system modifications - Fire & fire suppression.
- Pollution – Domestic and urban waste water.
- Invasive and other problematic species, genes & diseases - Invasive non-native/alien species/diseases.

Of the above potential threats, the ones likely to be of a significant consideration in the construction area of the SREH Project Area are:

- Changes to drainage patterns which reduce periodic local flooding.
- Damage to semi-permanent and ephemeral ponds and flood-prone vegetation.
- Clearing of habitat for development/ Transportation & service corridors - Roads & railroads.
- Residential & commercial development - Housing & urban areas.
- Natural system modifications - Fire & fire suppression.

2.4 Variables determining GTF presence

This information provides the following important points when trying to assess the potential presence of the GTF in any area:

- The GTF is likely to be present where depressions flood and produce large temporary pools that are located within or immediately adjacent to areas of native vegetation.
- The presence of cleared areas does not exclude the species, but a site should have a significant extent of natural vegetation present as the species has been identified as declining due to land clearing (Mahony 1996).
- The presence or likely presence of fish in the potential breeding habitat is likely to result in the species not being present.

3. Description of the Project Area

The SREH is situated within the existing Stratford Mining Complex (SMC) located approximately 95 km north of Newcastle (Figure 1). The SMC is an open cut coal mine owned by Yancoal that is scheduled to complete mining operations in 2024. It is roughly bounded by the North Coast Railway line in the west, Wenham Cox Road in the north and Glen Road to the south. The Glen Nature Reserve is located to the east, but does not directly adjoin the Project Area.

The Project Disturbance Footprint is currently approximately 870 ha, comprising approximately 468 ha (54%) within the SMC. The final Project disturbance footprint will be confirmed following the completion of environmental studies and described in the Environmental Impact Statement (EIS). All of this land is owned by Yancoal. These lands are zoned as either RU1, Primary Production Zone, or IN3, Heavy Industrial Zone under the Gloucester Local Environment Plan (LEP).

Key infrastructure components of the SREH include:

- Upper reservoir.
- Powerhouse area.
- Lower reservoir (at the location of the existing SED).
- Solar Farm.
- Electrical substation.
- Relocated existing 132 kV ETL around the powerhouse and lower reservoir.
- Upgraded access roads to the upper reservoir.
- Existing and new internal roads and infrastructure corridors to be used for the Project, particularly to connect the Solar Farm to the electrical substation.
- Enhanced or new vegetation screens along The Bucketts Way.
- Other ancillary infrastructure such as offices, carparks, laydown areas and water treatment facilities, to be located within the extent of the Project Area and/or final EIS disturbance footprint.
- Water stored in existing SMC voids would be used to supply the PHES. Some of the existing SMC voids would also be used to emplace excess spoil material from the Project (e.g. from the tunnel and powerhouse excavations). These voids do not currently form part of the Project Area.

The Project Area is located between just over 100 m above sea level at ground level in western sections around the pit (lower in the pit) to over 460 m above sea level in the area proposed for the upper reservoir.

The Avon River is located downstream to the west of the Project Area (Figure 5), with Avondale Creek and a number of unnamed ephemeral drainage lines and smaller creeks flowing west and north-west across the Project Area towards the Avon River. Avondale Creek, as a 4th order stream, is the only significant steam located within the boundary of the Project Area. The other streams and drainage lines within the Project Area are smaller and those in the elevated areas exhibit low to zero flow for extended periods during dry weather, while heavy rainfall events result in short duration, high flow events. Some streams in the western part of the Project Area fall within lowland flooding areas and hold water for longer, but have essentially no flow and are narrow. The Project Area also includes numerous artificial water bodies including the several large dams created as part of the SMC and there are also a number of smaller farm style dams located in the Project Area (Figure 5). These all provide relatively permanent areas of water.

The Project Area is located within the Mid-Coast Local Government Area (LGA). The land in and around the Project Area is mainly designated RU1 Primary Production, in keeping with the rural landuse for farming. Other land uses within the area surrounding the Project Area include RU5 – Village, RE1 Public Recreation, SP1 Special Activities associated with a cemetery, C1 National Parks and Nature Reserves, C3 Environmental Management and E5 Heavy Industrial (the existing coal mine).

3.1 Landscape features

The following landscape features, as defined by the BAM, are relevant to the project.

3.1.1 Bioregions

The Project Area is located within the NSW North Coast Interim Biogeographic Regionalisation for Australia (IBRA) Region. The following description for the region is taken directly from NSW NPWS (2003) "The Bioregions of New South Wales: their biodiversity, conservation and history":

The North Coast Bioregion runs up the east coast of NSW from just north of Newcastle to just inside the Qld border. The total area of the bioregion is 5,924,130 ha (IBRA 5.1) and the NSW portion is 5,692,351.6 ha or 96.1% of the bioregion. The NSW portion of North Coast Bioregion occupies 7.11% of the state.

The North Coast Bioregion covers northern NSW from the shoreline to the Great Escarpment. Typically, there is a sequence from coastal sand barrier, through low foothills and ranges, to the steep slopes and gorges of the Escarpment itself, with rainfall increasing inland along this transect.

3.1.2 Subregions

The Project Area is located within the Karuah-Manning IBRA subregion (Figure 1). Details on this subregion are also taken from NSW NPWS (2003) and provided in Table 1.

Table 1. Description of the subregion covering the Project Area (from NSW NPWS 2003)

Subregion	Geology	Characteristic landforms	Typical Soils	Vegetation
Karuah-Manning	Extremely complex faulted terrain where the New England Fold belt over-thrusts the Sydney Basin. Main rocks present are: Silurian and Devonian slates, quartzites and acid volcanics, Carboniferous mudstones and lithic sandstones, and less deformed Permian shales and sandstones. Small areas of granite and plateaus of Tertiary basalt on Barrington and Comboyne Plateaus. Quaternary coastal sands.	Complex pattern of ridges and valleys running to the Great Escarpment, strong structural control along fault lines. Coastal beach, dune and lagoon barrier systems reach their maximum development at Myall Lakes.	Red brown structured loams on basalt. A range of other soil types relating to geology but poorly known. Deep siliceous sands and very well developed podsols in dunes, particularly the older high dunes. Organic sands in estuaries..	Wet sclerophyll forest with white mahogany, small-fruited grey gum, Sydney blue gum, blackbutt, tallowwood and brush box. White gum, blackbutt, forest red gum and grey box on dry open flats. Dense Antarctic beech on Barrington tops and patches of mixed cool temperate and warm temperate rainforest on Comboyne Plateau on basalt. Coastal complex of banksia, paperbark, smooth-barked apple, and blackbutt with numerous shrubs and areas of heath and swamp on dunes. Mangroves in estuaries.

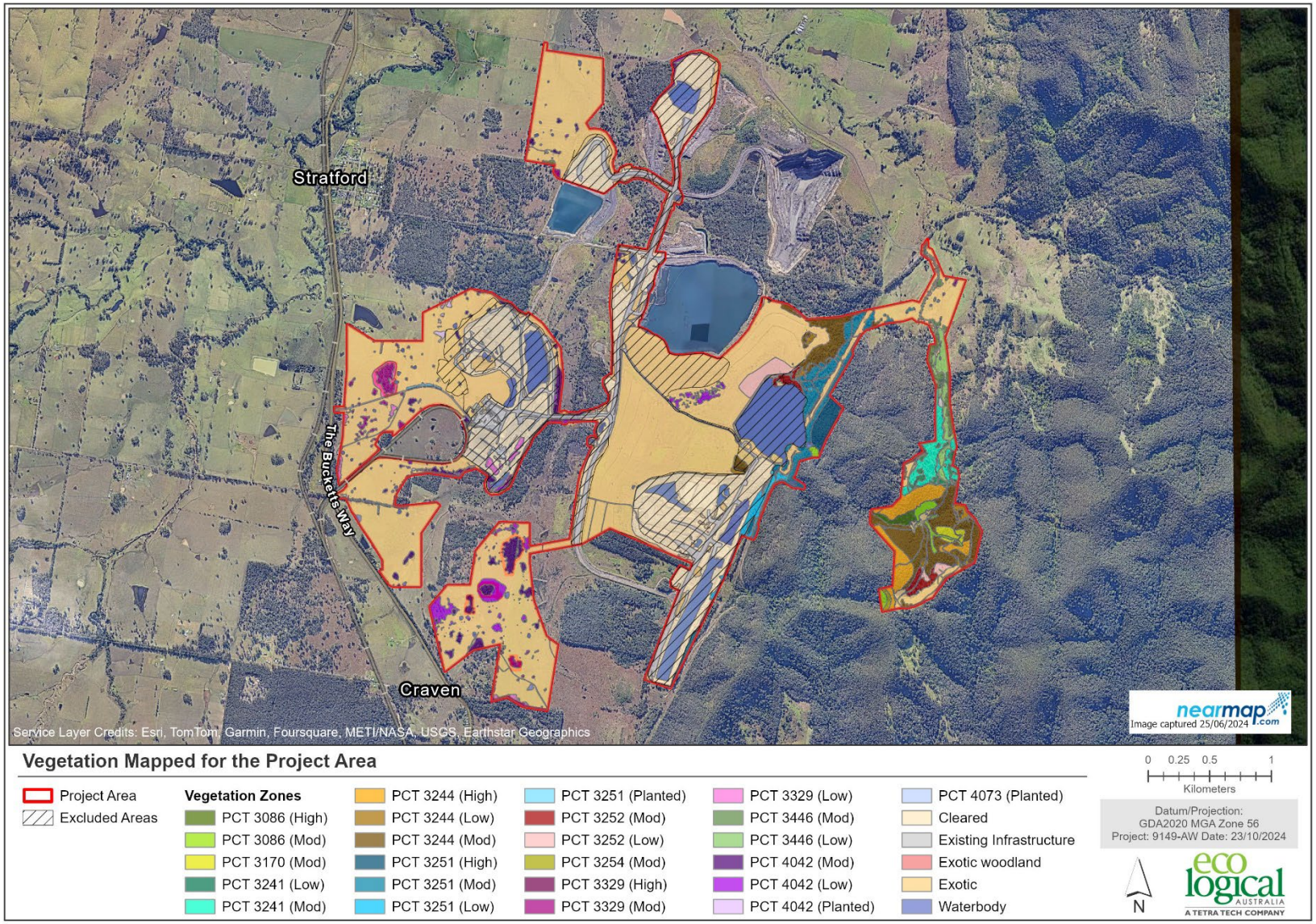

Figure 4. Mapped vegetation for the Project Area.

3.1.3 NSW (Mitchell) Landscape

The Project Area covers two NSW Mitchell Landscape Types, the Manning - Macleay Channels and Floodplains and Stroud Mountains. The following description of each is taken directly from DECC (2002).

Manning-Macleay Channels Mitchell Landscape

Beaches, dunes, swamps and lagoons on Quaternary coastal sands, with inner and outer barrier dune sequences, general elevation 0 to 25 m, local relief 10 to 20 m. Yellow or white single grain quartz sand on destabilised dunes, well developed iron and humic podsols with depth to pan varying with position in the dune sequence, topography and depth to groundwater. Outer barrier; foredune with coast Spinifex coast wattle (Acacia sophorae), and coast tea tree (Leptospermum laevigatum). Hind dunes with blackbutt (Eucalyptus pilularis), pink bloodwood (Corymbia intermedia), old man banksia (Banksia serrata) and rainforest elements including blue lilly pilly (Syzygium oleosum), green tamarind (Elattostachys nervosa), native guava (Rhodomyrtus psidioides), plum pine (Podocarpus elatus), tuckeroo (Cupaniopsis anacardioides), bauerella (Sarcomelicope simplicifolia) and vines. Swampy lagoon zone of wet heath and swamp forest between the barriers with; dense tea tree (Leptospermum spp.), paperbark (Melaleuca quinquenervia), swamp oak (Casuarina glauca), and swamp mahogany (Eucalyptus robusta). Inner barrier dunes tall forest of; blackbutt, northern scribbly gum (Eucalyptus signata), needlebark stringybark (Eucalyptus planchoniana) and red bloodwood (Corymbia gummifera). Wet heath with lemon scented tea tree (Leptospermum petersonii), prickly tea tree (Leptospermum continentale), swamp banksia (Banksia robur) rushes and sedges.

Stroud Mountains Mitchell Landscape

Northwest oriented ranges with high peaks and parallel valleys on extensively faulted and folded middle Devonian lithic sandstones, mudstone, chert and minor volcanics, Carboniferous conglomerate, lithic sandstone, mudstone, interbedded dacite and ignimbrite, Permian pebbly lithic sandstone, with interbedded rhyolite, dacite and basalt. Strong structural control, general elevation 50 to 680m, local relief 400m. Higher slopes with gradational structured loams merging to red-brown to yellow texture-contrast soils on lower slopes and in valleys. Mixtures of moist and dry forests and rainforest understorey with; brush box (Lophostemon confertus), flooded gum (Eucalyptus grandis), turpentine (Syncarpia glomulifera), scentless rosewood (Synoum glandulosum), lilly pilly (Acmena spp.), rose maple (Cryptocarya erythroxylon), narrow-leaved palm lily (Cordyline stricta), southern mahogany (Eucalyptus botryoides), spotted gum (Corymbia maculata) and grey ironbark (Eucalyptus paniculata). River oak (Casuarina cunninghamiana) along all major streams.

3.1.4 Native vegetation

The Scoping Report indicates that approximately 110 ha of the Project general arrangement located outside the SMC approved disturbance area comprises native vegetation (Yancoal 2023). The most contiguous intact native vegetation is located in the higher elevation eastern parts of the Project Area around the proposed upper reservoir.

GHD have identified 24 different vegetation zones within the Project Area, consisting of 11 Plant Community Types (PCTs) in various condition states (**Table 1**). GHD also identify other vegetation including exotic woodland and exotic. The GTF is listed as associated with six of the 11 PCTs within the Project Area, highlighted in bold:

- CT 3086 - Lower North Hinterland Riparian Dry Rainforest (6.14 ha)

- PCT 3170 - Northern Hinterland White Mahogany Moist Grassy Forest (2.02 ha)
- **PCT 3241 - Lower North White Mahogany-Spotted Gum Moist Forest (12.42 ha)**
- **PCT 3244 - Lower North Spotted Gum-Mahogany-Ironbark Sheltered Forest (50.15 ha)**
- **PCT 3251 - Northern Gorges Diverse Grassy Forest (30.14 ha)**
- **PCT 3252 - Northern Hinterland Grey Gum-Mahogany Grassy Forest (11.08 ha)**
- **PCT 3254 - Northern Hinterland Tallowwood-Forest Oak Grassy Forest (0.75 ha)**
- PCT 3329 - Northern Hinterland Valleys Red Gum Grassy Forest (9.21 ha)
- PCT 3446 - Lower North Foothills Ironbark-Box-Gum Grassy Forest (10.69 ha)
- **PCT 4042 - Lower North Riverflat Eucalypt-Paperbark Forest (23.95 ha)**
- PCT 4073 - Lower North Hinterland River Oak Forest (0.08 ha).

This indicates that there is suitable native vegetation present in the Project Area for the GTF. For the GTF, the elevated area in the east of the Project Area where the upper reservoir is planned to be located is of relevance as are also vegetated patches in the west that contain PCT 4042.

3.1.5 Water bodies

The GTF is not expected to use streams or permanent ponds as breeding habitat and therefore, the water bodies mapped in Figure 5 are not of specific relevance to assessing this species. However, the GTF is often found breeding in old oxbows and offshoots of streams and so they do provide a reference point for where to look for potential breeding sites. The southwestern area of the SMC, whilst mostly cleared, also contains patches of a PCT that indicates areas that are prone to flooding that may also provide suitable breeding habitat if suitable flooding depressions are present. There were no mapped areas of seasonally inundated ponds, but they may still be present in the wetter habitats indicated in the southwestern parts of the Project Area.

The Project Area does not contain any water bodies listed on the Directory of Important Wetlands in Australia or that are classified as a Ramsar wetland (see (https://www.awe.gov.au/water/wetlands/australian-wetlands-database/directory-important-wetlands).

3.2 Connectivity features

Habitat connectivity across the Project Area is very limited due to the clearing undertaken for the operation of the SMC and the historic use of the area for agricultural purposes. There is no clear corridor of retained vegetation across the Project Area that would link the better vegetated landscape in the eastern end associated with the Avon River and areas to the west. However, Figure 2 shows that there is high connectivity with contiguous areas of native vegetation to the east including The Glen Nature Reserve. The retained native vegetation may still allow for migration of the GTF during wetter periods, if a population was present.

The absence of an extensive road network in the Project Areas is a positive for maintaining connectivity and it appears unlikely that this will change in any significant way even with the proposed infrastructure for the Stratford REH, which is unlikely to be more than lightly trafficked.

3.3 Areas of geological significance

No important karsts or other geological formations are located within the Project Area.

3.4 Climate

Key climate statistics for the two closest available Bureau of Meteorology stations located for the Project Area

are provided in Table 2. The Project Area receives moderate rainfall and has a relatively temperate climate.

Table 2. Climatic statistics for nearby (< 50 km) weather stations (data from the Bureau of Meteorology)

Rainfall station	Mean total rainfall (mm)	Mean January maximum (°C)	Mean January minimum (°C)	Mean July maximum (°C)	Mean July minimum (°C)
Lostock	972.6	29.3	17.2	16.4	6.5
Scone	636.0	30.9	16.9	16.3	4.6

3.5 Land use history

The original inhabitants of the Stratford area were the Kabook and Watoo First Nations People of the Gringai Barrington River Gloucester, NSW. Prior to European settlement, the local area would have been covered in native forests and woodlands and managed using traditional methods.

The changes that followed after the arrival of European settlement of the Stroud-Gloucester Valley, encompassing the Project Area, are summarised by Smith (2016). He reports the original settling of the area was undertaken by the Australian Agricultural Company (AAC), that received a grant of 1,000,000 acres of Crown Land in 1824 to breed livestock, establish a fine wool industry and cultivate crops. Extensive land clearing started in 1827 and the Booral and Stroud areas were developed for agriculture including wheat. Stroud was established in 1832 as the centre of AAC's activities during the 1830s. The AAC closed its Agricultural Department in 1843, letting out large parts of its land to tenant farmers before selling off land in small packages in 1860. A large portion was purchased and subdivided by the Gloucester Estate Syndicate in 1902 and dairy farming expanded. A railway was completed in 1913, allowing the expansion of dairy operations and the hardwood timber industry, which both further increased after World War 2. In the 1970s there was a decline in both the dairy and timber industries and an increase is tourism and people settling for lifestyle reasons.

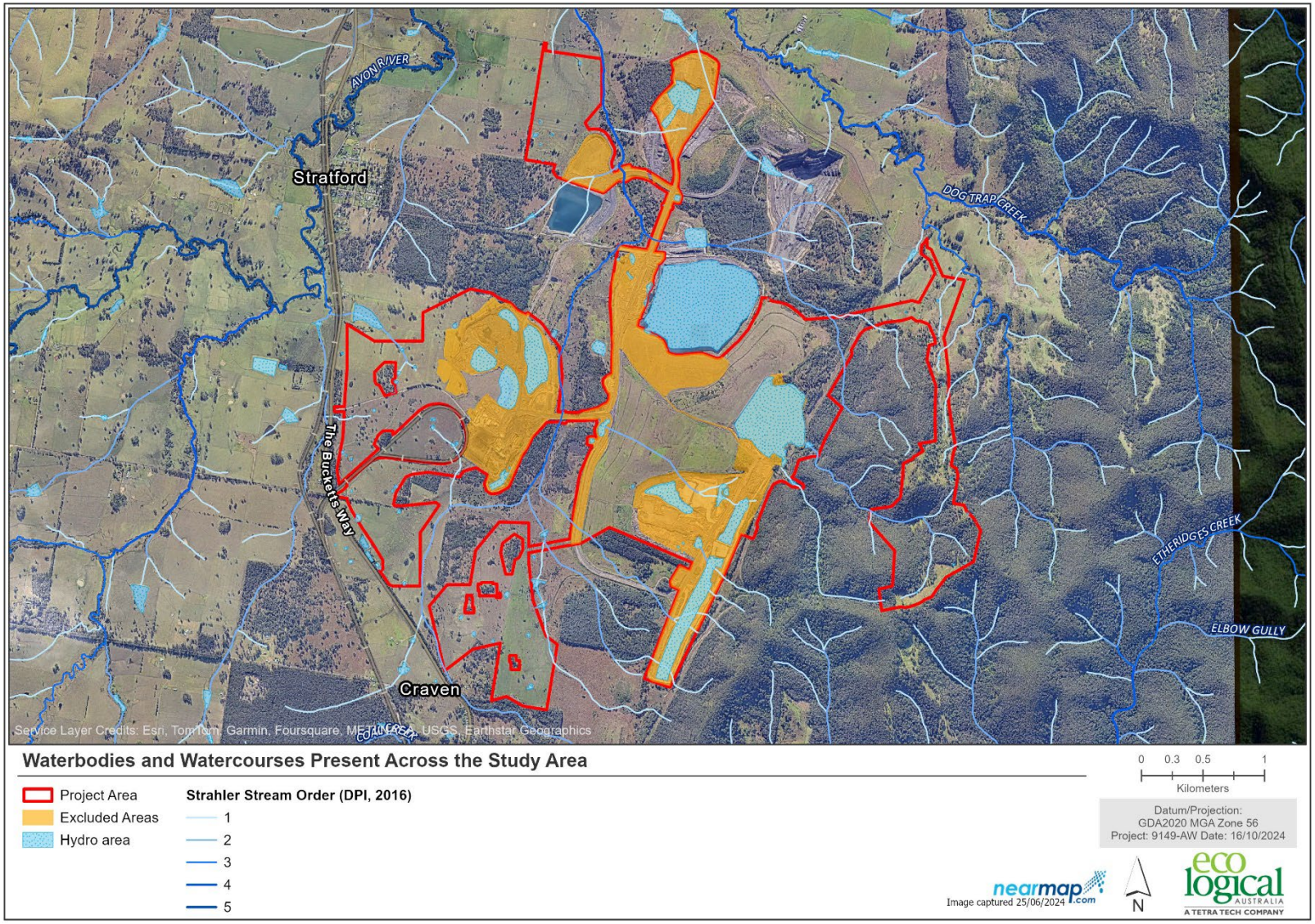

Figure 5. Mapped water courses and water bodies relative to the Project Area.

Plate 3. Partially cleared hillside grazing area in the eastern section of the Project Area

Plate 4. Swampy habitat in the southwest of the Project Area

Plate 5. Typical shallow and dry drainage line present at the eastern end of the Project Area

Plate 6. Dammed drainage line in eastern section of Project Area. Note no stream body evident flowing into dam

Plate 7. Water pooling at base of mountain in eastern section of the Project Area. Note the absence of a stream flowing in at the far end of the pool

Plate 8. Canal of water between the dam in Plate 7 and the Stratford East Dam

3.6 Site inspection

A site inspection was undertaken of the Project Area on Tuesday the 17th of September, 2024. This inspection allowed for me to traverse the Project Area to visually assess the landscape and confirm the broad environmental mapping available, confirming the quality of extent of both breeding and non-breeding habitats that were present for the GTF. The inspection started at the eastern end of the Project Area to check on the most likely suitable habitat, based on mapped vegetation features with potentially suitable creek lines and then continued further west to assess the lower lying and highly modified areas found through the majority of the SMC. The inspection allowed for the confirmation of the size and suitability of any areas that may provide breeding habitat for the GTF and also included checks on the waterbodies to search for the presence of introduced fish. The inspection targeted the forest environments to assess if there were flooding depressions present and adequate levels of shelter present (leaf litter and ground logs). I assessed if the PCTs showed significant signs of disturbance through human activities to determine if they would be unsuitable for the GTF. The focus was on whether the canopy and ground cover provided a suitable microclimate and suitable food sources for the species. The location of the survey track and various specific visual inspection points are provided in Figure 6.

The inspection did find a range of different water body types ranging from ponds/dams of various sizes, to larger reservoirs, to streams and canals and swampy areas (see Plates 2-10). However, although there were areas that flood located in the western area (e.g. Plate 4), there were no identifiable areas within the Project Area with larger depressions in which large longer-term (but not permanent) pools could form. The swampy areas would retain moisture, but were shallow in nature.

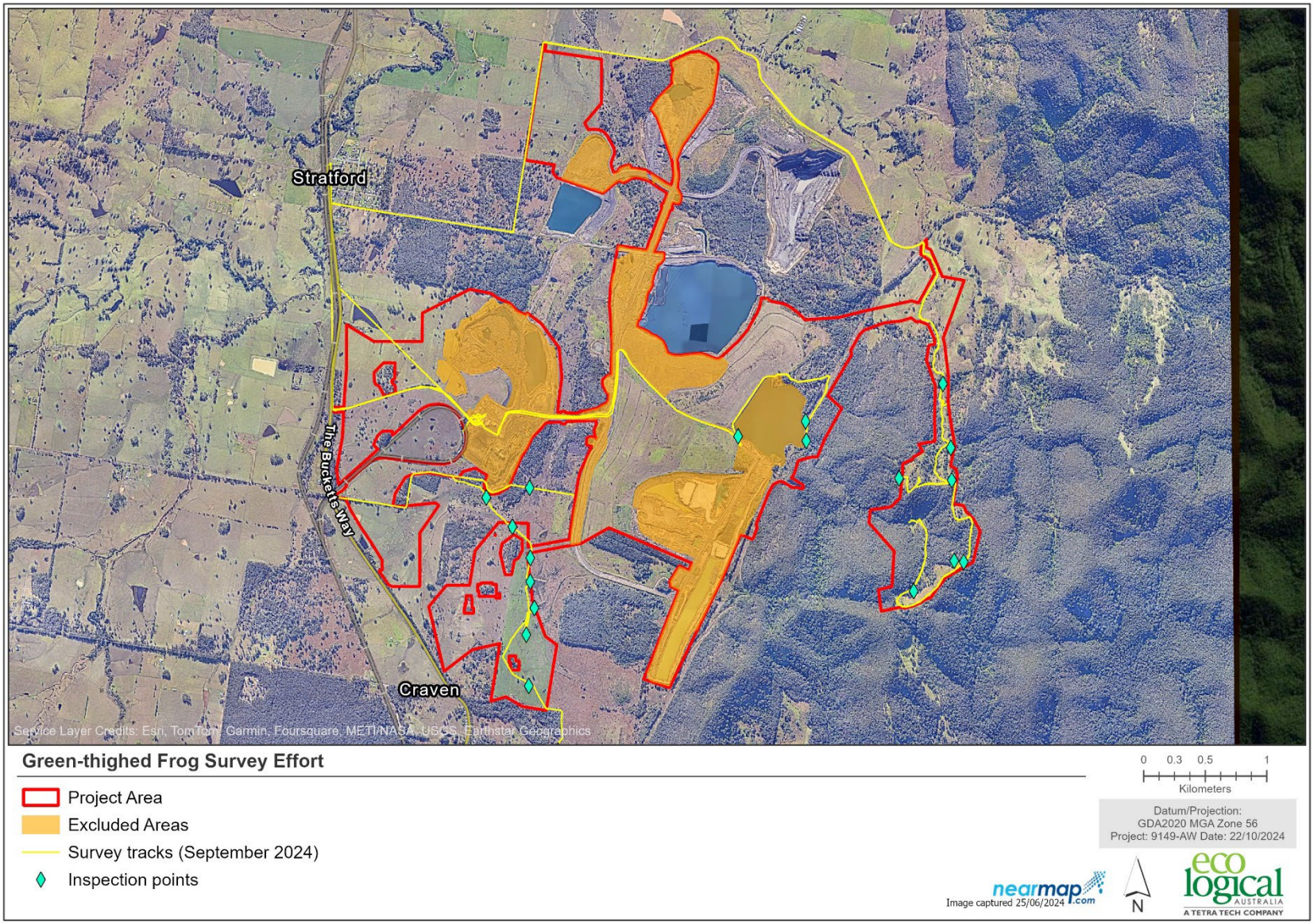

Figure 6. Survey track and location of inspection points completed for the Project Area

Plate 9. Stratford East Dam - looking east to proposed area for upper reservoir

Plate 10. Patch of Eucalypt and Paperbark present in the southwestern side of the Project Area

Plate 11. Permanent dams present in the southwest of the Project Area

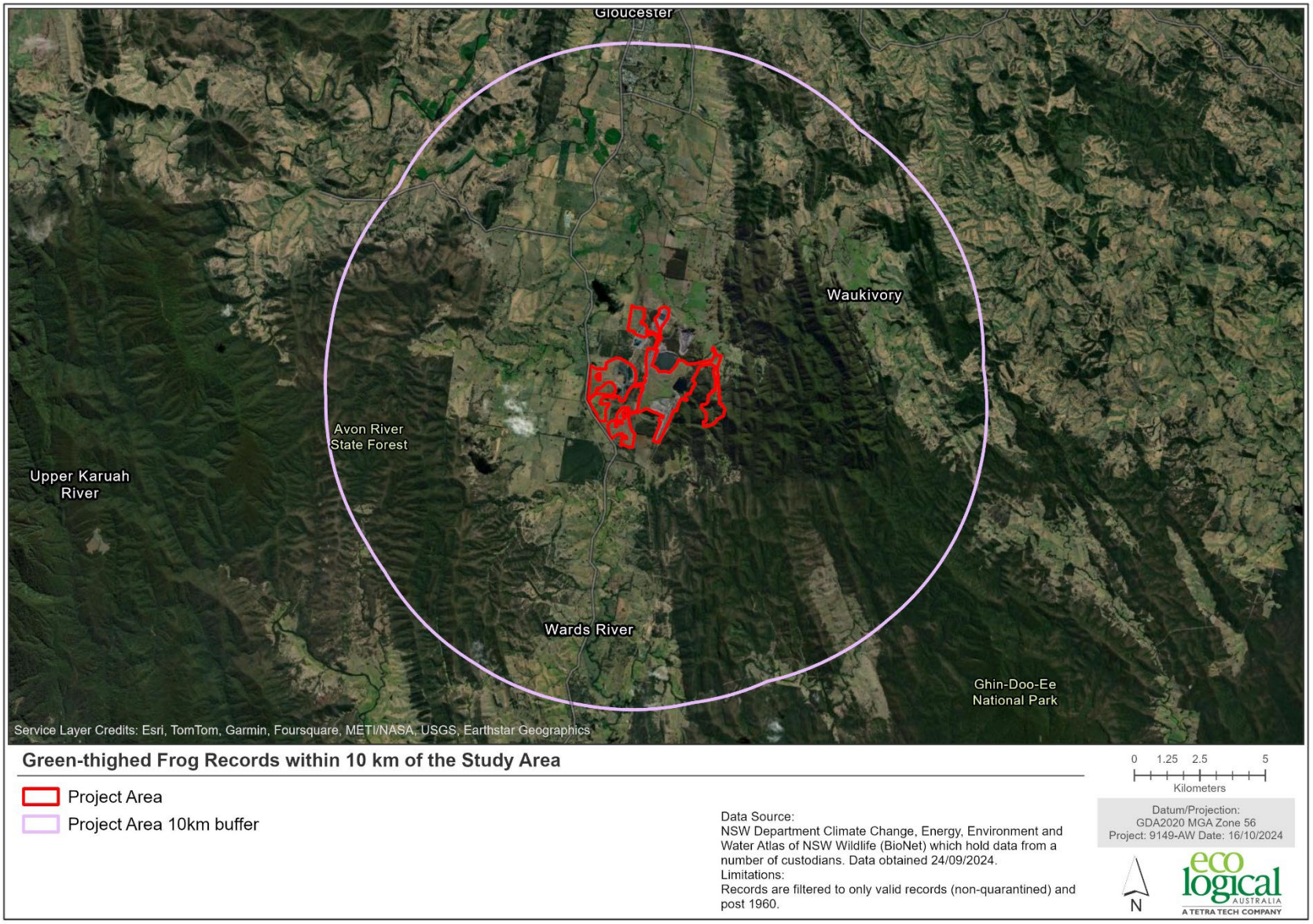

Figure 7. Location of GTF records in the locality of the Project Area

4. Potential for Green-thighed Frog presence in the Project Area

4.1 Green-thighed Frogs in the region

The NSW DCCEEW species profile for the GTF indicates that the species is predicted to occur within the locality of the Project Area, although it is close to the western limit of its predicted occurrence in this part of NSW. BioNet indicates that there are no records of this species within the locality of the Project Area (Figure 7). The area may be too far west for this predominantly coastal lowland species (Figure 3).

4.2 Subject land as potential habitat

4.2.1 Breeding habitats

In regards to the streams located in the eastern part of the Project Area, as noted in the Scoping Report (Yancoal 2023) and as was evident through the site inspection, the streams there are highly ephemeral in nature and there was no water flow at the time of inspection and no evidence of any semi-permanent pooling along those creeklines. There was also no evidence of suitable depressions being present to form larger temporary pools, with the topography typically being too steep to provide such an environment. The only pooling evident was in human-created dams for stock and these were all permanent and unsuitable for breeding for the GTF (e.g. Plate 6 & Plate 6). At the lowest point where the streams drop down from the hill into the SMC Stratford East Dam (e.g. Plate 7) there is no water flow or longer-term pooling present that might allow for larger ephemeral streams to form. A canal is present between the base of the hill and the Stratford East Dam (Plate 8), but this looks permanent and would not likely represent breeding habitat. This canal contained *Gambusia holbrooki* (Plague Minnow) in significant numbers.

The southwest of the Project Area contains limited patches of PCT 4042 (e.g. Plate 10) that provide potential habitat for the GTF. Although patchy and fragmented, the patches present did contain adequate intact vegetation to provide a good canopy cover and ground cover. However, there were no evident larger natural or man-made depressions observed anywhere across this landscape that could flood and provide suitable breeding habitat for the GTF. It was all very flat and, whilst boggy with very shallow temporary pools (Plate 4), did not form larger and deeper water bodies outside of the permanent dams and drains created for stock or water holding for the SRC (see Plate 11). Notably also for all of these lower and flatter areas, *Gambusia holbrooki* (Plague Minnow) were present in all of the water bodies inspected and would likely be a very significant negative influence on the potential for any successful breeding to take place.

The Plague Minnow was not evident in the ponds inspected in the eastern elevated area. However, none of these water bodies represent potential breeding habitat for the GTF and no areas that could form suitable temporary breeding pools were evident in this location. Hence the Plague Minnow is not of consideration for the eastern sites for this species.

4.2.2 Sheltering and foraging habitat

The majority of the Project Area has been cleared and such areas are not considered to be suitable non-breeding habitat for the GTF and do not contain associated PCTs. However, given that the GTF is known to breed in fields adjacent to retained native vegetation and has been recorded in mosaics of partly cleared habitats, the species can tolerate some disturbance and looks to at least be potentially capable of using the areas of retained associated PCTs within the Project Area, even if in low condition. The retained vegetation in the east of the Project area, in the area of the proposed Upper Reservoir, is considered suitable habitat and is

contiguous and provides potentially useable habitat for the GTF, particularly in the gullies where denser vegetation is present. The western and central sections of the Project Area, where mining related disturbance or agricultural activities have removed the majority of native vegetation leaving just scattered patches (Plate 10; Plate 11), is also potentially suitable habitat around those retained patches. The GTF is commonly recorded in association with paperbarks and the patches present provide dense canopy and ground cover (Plate 10) that could provide adequate cover and foraging habitat. Whether the vegetation is too fragmented is not clear. There is no literature available to indicate what level of clearing represent too much clearing for this species to be able to maintain a population.

4.2.3 Dispersal habitat

There are no continuous native vegetation strips running through the Project Area from the east to the west and/or then westwards to link the Project Area to the vegetated areas further west past the Avon River. The remaining retained patches of native vegetation may be sufficient to allow dispersal by individuals occasionally, although the areas cleared of native vegetation between these patches is significant enough to make this questionable. It is most likely that there would be no connectivity in this direction through the rural landscape if a population of the GTF was present. The eastern end of the Project Area is in direct contact with intact lands further to the east including The Glen Nature Reserve and this vegetation could be used for dispersal movements by GTFs over time when there are suitable climatic conditions. Etheridge's Creek, Dog Trap Creek and Wards River are all larger streams that are sufficiently close that it could be possible that the GTF would ultimately be able to maintain a broad connection across the landscape through occasionally dispersing individuals using the available smaller drainage lines in wetter periods.

5. Assessment of offset requirements under the BAM

5.1 Suitability of habitat on the Project Area

The information in Sections 2 and 4 demonstrates that there is suitable vegetation available within the Project Area that could be used for shelter, foraging and dispersal by the GTF. However, there are no evident suitable breeding sites anywhere within the Project Area that would allow for a population of the GTF to be present in this landscape. The presence of both breeding and complementary suitable non-breeding habitat is essential for the maintenance of a population within a given location and there is just not breeding habitat evident. This view is further supported by the lack of records for the species anywhere within the locality and the location is likely too far west from the coast for the species to be present. If it was present, the long-term habitat clearing and disturbance is likely to have reduced the population sufficiently that it is no longer extant.

5.2 Importance of the Project Area to the Green-thighed Frog

It is concluded that the Green-thighed Frog is absent in the Project Area and its immediate surrounds. There are no suitable breeding sites present and the long-term disturbance likely prevent this species from using the site, even if is the species was able to disperse into the area occasionally.

Based on the BAM survey guidelines for threatened frogs (DPIE 2020b) the following applies when assigning any species polygon for the species:

> *The species polygon boundary should align with aquatic habitats linked directly to the record and a buffer, incorporating the PCTs with which the species is associated, of 100 metres radius from the top of bank.*

As there are no records for the species in the Project Area and as it is considered that there is not suitable breeding habitat for the Green-thighed Frog to allow it to maintain a population within the locality, there is no reason to produce a polygon to protect PCTs for this species.

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7. Appendix A Dr Frank Lemckert CV

Frank Lemckert **PRINCIPAL SCIENTIFIC ECOLOGIST**

Frank has been a professional scientist since 1992, specialising in understanding and managing the ecology and management of threatened species. Frank has conducted ecological work throughout eastern Australia (NSW, Victoria, Queensland), establishing long-term research and monitoring programs into the management of fauna and developing strategies to mitigate the impacts of human disturbances. He has worked extensively with the NSW state and federal Governments on varying issues of fauna and flora management including the preparation of a draft NSW/National recovery plan for the Giant Burrowing Frog (*Heleioporus australiacus*) and recent expert review roles on fauna management plans and monitoring strategies for the NSW Natural Resources Commission. Frank is an accredited expert under the NSW Biodiversity Assessment Method (BAM) for a range of threatened frogs and wrote the BAM survey guidelines for NSW's threatened frogs. Frank has prepared reports on endemism and representation in reserves of flora and fauna for the Commonwealth, represented the NSW Forestry Commission in license negotiations for the Comprehensive Regional Assessment process (2000), been a member of a state regulators advisory group for the management of Cane Toads across Australia and the Taren Point Cane Toad Advisory Group, and provided expert ecological advice on illegal land clearing for the NSW and Commonwealth Governments. He has authored over 90 peer-reviewed publications. Frank is a research associate with the Australian Museum and University of Newcastle and convenor of the NSW Declining Frog Working Group. He is a recognised expert in frog ecology and management, but has completed management related projects and works on a range of terrestrial vertebrate fauna.

Frank's primary role as a consultant has been to use his expertise and experience in technical writing and threatened species legislation to develop and maintain quality assurance in project reporting including:

- Species Impact Statements.
- >100 flora and fauna reports and assessments of significance using the EP&A Act and EPBC Act.
- Biodiversity Assessment Reports for Warragamba Dam Raising, Nowra Bridge, Golden Highway and Eurobodalla Dam.
- Manager for the Oxley Highway to Kempsey and Frederickton to Eungai ecological monitoring program.
- Lead fauna survey design for the HumeLink transmission line project for Snowy Hydro 2.0.
- Complete targeted survey and monitoring works for threatened frog species including Giant Barred Frogs, Wallum Froglets, Green-thighed Frog and Green and Golden Bell Frogs.
- Construction and Environmental Management Plans, Monitoring Plans and Vegetation Management Plans for roads at Port Macquarie, Berry to Bomaderry and South Nowra.
- Nest Box, microbat and Green and Golden Bell Frog management plans for the Berry to Bomaderry and Oxley Highway to Kempsey Highway Upgrades.
- Review of monitoring strategies for the Woolgoolga to Ballina and Warrell Creek to Nambucca Heads programs for the Pacific Highway Upgrade.
- Review of two proposed Coal Seam Gas Impact Assessment methods for Matters of National Environmental Significance (contracted by the Commonwealth Government).
- Provision of species credit species expert reports for the Warragamba Dam raising project and Western Sydney Growth Centres Biocertification.

- Roadside mapping, survey and management strategies for the Wallum Froglet and Mahony's Toadlet.
- Develop frog and reptile survey guidelines and impact offset guidelines for the Biodiversity Assessment Method.

QUALIFICATIONS

- Bachelor of Science, University of Sydney, 1984 (Terrestrial Ecology and Marine Management)
- Master of Science, University of Sydney, 1991 (Population biology of the Common Froglet)
- PhD, University of Newcastle, 2009 (Management of forest frogs in timber production forests of NSW).

PROJECT EXPERIENCE

ECOLOGICAL IMPACT ASSESSMENT

- MONITORING OF BAT POPULATIONS AND ASSESSMENT OF POTENTIAL IMPACTS OF THE PROPOSED JEREMIAH WIND FARM AT ADJUNGBILLY, NSW (2019-PRESENT).
- MANAGEMENT OF IMPACTS ON GREEN AND GOLDEN BELL FROGS FOR THE KIWEF PROJECT AT KOORAGANG ISLAND, NSW FOR DARACON (2019-PRESENT).
- IMPACT ASSESSMENTS FOR HOUSING DEVELOPMENTS ON KOALAS IN THE CAMPBELLTOWN AREA (PRIVATE DEVELOPMENT AND CAMPBELLTOWN COUNCIL (2019)
- EXPERT REPORT ON THE GREEN AND GOLDEN BELL FROG FOR TWO WESTERN SYDNEY GROWTH AREAS BIOCERTIFICATION PROJECT (2018-PRESENT)
- WARRAGAMBA DAM RAISING PROJECT TARGET SURVEYS, IMPACT ASSESSMENTS, EXPERT REPORTING (SIX SPECIES) AND Q/A FOR WATER NSW (2018-19)
- GRANITE HILLS WIND FARM BIRD AND BAT STRIKE MODELLING AND ECOLOGICAL IMPACT ASSESSMENT, NIMMITABEL, AKUO ENERGY (2018) AND ELYSIAN WIND FARM, NIMMITABEL, AKUO ENERGY (2018)
- VEGETATION REMOVAL AND THREATENED FROG MANAGEMENT STRATEGIES, NEW INTERCITY FLEET MANAGEMENT FACILITY, JOHN HOLLAND GROUP (2018-PRESENT)
- NOWRA BRIDGE EIS ECOLOGICAL ASSESSMENTS, NSW RMS (2018)
- HEATHCOTE ROAD UPGRADE IMPACT ASSESSMENT AND REVIEW OF MITIGATION MEASURES, NSW RMS (2018-2019)
- EUROBODALLA DAM BIODIVERSITY ASSESSMENT REPORT, EUROBODALLA SHIRE COUNCIL (2017-18).

GOVERNMENT REVIEWS/REPORTS

- BIODIVERSITY ASSESSMENT METHOD FROG SURVEY GUIDELINES FOR SPECIES CREDIT SPECIES (2020)
- EXPERT WORKSHOP TO DEVELOP A NSW-WIDE NIL-TENURE FAUNA MONITORING PROGRAM, NSW NATURAL RESOURCES COMMISSION (2020)
- REVIEW OF SPECIES MANAGEMENT PLANS FOR THE YELLOW-BELLIED GLIDER, GIANT BURROWING FROG, EASTERN BRISTLEBIRD AND SOUTHERN BROWN BANDICOOT PREPARED UNDER THE NSW THREATENED SPECIES LICENSE FOR FORESTRY OPERATIONS, NSW NATURAL RESOURCES COMMISSION (2019)
- PROVISION OF INFORMATION AS THE BASIS FOR THE DEVELOPMENT OF SIX THREATENED FLORA SPECIES MANAGEMENT PLANS TO BE PREPARED UNDER THE NSW THREATENED SPECIES LICENSE FOR FORESTRY OPERATIONS, NSW NATURAL RESOURCES COMMISSION (2019)
- EXPERT REVIEW OF BIODIVERSITY IMPACT ASSESSMENT REPORT FOR THE HORNSBY QUARRY REHABILITATION PROJECT (2019)
- HORNSBY COUNCIL EXPERT WITNESS FOR DEVELOPMENT IMPACTS AT DURAL, HORNSBY SHIRE COUNCIL (2016)

- EXPERT ADVICE ON IMPACTS OF ILLEGAL LAND CLEARING AT EVANS HEAD, NSW STATE GOVERNMENT (2016)
- EXPERT ADVICE ON IMPACTS OF ILLEGAL LAND CLEARING AT SOMERSBY, COMMONWEALTH GOVERNMENT (2015)
- REVIEW OF MONITORING STRATEGIES FOR THE WOOLGOOLGA TO BALLINA AND WARRELL CREEK TO NAMBUCCA HEADS PROGRAMS FOR THE PACIFIC HIGHWAY UPGRADE, NSW RMS (2014)
- REVIEW OF IMPACT ASSESSMENT PATHWAYS FOR TWO LPNG PROJECTS, COMMONWEALTH GOVERNMENT (2013)
- REVIEW OF THREATENED SPECIES MODELLING IN FORESTRY AREAS, VIC FORESTS (2012)
- FLORA AND FAUNA REPRESENTATION IN THE AUSTRALIAN RESERVE SYSTEM, COMMONWEALTH GOVERNMENT (2010)
- FLORA AND FAUNA ENDEMISM PATTERNS ACROSS AUSTRALIA, COMMONWEALTH GOVERNMENT (2009)
- REVIEW IMPACTS TO THREATENED REPTILES AND AMPHIBIANS IN THE SOUTHERN BRIGALOW BELT, FOR WPS (2008)
- EXPERT REPRESENTING FORESTS NSW IN THE COMPREHENSIVE REGINAL ASSESSMENT PROGRAM FOR THE REGIONAL FOREST AGREEMENT PROGRAM (1999-2001)
- EXPERT REVIEW OF FAUNA AND FLORA IMPACTS FOR 13 NSW FORESTRY COMMISSION EIS REPORTS (1992-94).

EPBC REFERRALS

- AUSTEN QUARRY (*EUCALYPTUS PULVERULENTA*), HARTLEY, HY-TEC INDUSTRIES (2014-15)
- MARYS MOUNT KOALA (*PHASCOLARCTOS CINEREUS*) REFERRAL, GUNNEDAH QUARRY PRODUCTS (2015)
- GREEN AND GOLDEN BELL FROG (*LITORIA AUREA*) REFERRALS FOR THE PRINCES HIGHWAY UPGRADE AT SOUTH NOWRA, NSW RMS (2011-2012).

MONITORING PROGRAMS

- NIL-TENURE FERAL MANAGEMENT AND MONITORING STRATEGY FOR THE NARRABRI COAL SEAM GAS PROJECT, SANTOS (2019).
- THREATENED FAUNA MONITORING HUME HIGHWAY, KAPOOKA, NSW RMS (2018)
- GREEN AND GOLDEN BELL FROG BASELINE MONITORING PROGRAM AT MEROO LAKES, NSW OEH (2016-17)
- OXLEY HIGHWAY TO KEMPSEY THREATENED BIODIVERSITY MONITORING, NSW RMS (2013-2017)
- FCNSW STATE-WIDE ECOLOGICAL MONITORING PROGRAM, FORESTRY CORPORATION OF NSW (2009-10)

PLANS OF MANAGEMENT / STRATEGIES

- GREEN AND GOLDEN BELL FROG PRE-CLEARING WORKS KOORAGANG ISLAND (DARACON 2016 & CURRENT)
- REVIEW OF SPECIES MANAGEMENT PLANS FOR THE YELLOW-BELLIED GLIDER, GIANT BURROWING FROG, EASTERN BRISTLEBIRD AND SOUTHERN BROWN BANDICOOT PREPARED UNDER THE NSW THREATENED SPECIES LICENSE FOR FORESTRY OPERATIONS, NSW NATURAL RESOURCES COMMISSION (2019)
- PROVISION OF INFORMATION AS THE BASIS FOR THE DEVELOPMENT OF SIX THREATENED FLORA SPECIES MANAGEMENT PLANS TO BE PREPARED UNDER THE NSW THREATENED SPECIES LICENSE FOR FORESTRY OPERATIONS, NSW NATURAL RESOURCES COMMISSION (2019)
- NESTBOX, MICROBAT AND GREEN AND GOLDEN BELL FROG MANAGEMENT PLANS, BERRY TO BOMADERRY UPGRADE OF THE PRINCES HIGHWAY, NSW RMS (2017)
- GREEN AND GOLDEN BELL FROG SURVEYS AND MONITORING, PRINCES HIGHWAY UPGRADES AT SOUTH NOWRA AND BERRY TO BOMADERRY, NSW RMS (2012-2017)
- THREATENED FROG MODELLED HABITAT REQUIREMENTS, HORNSBY SHIRE COUNCIL (2016)
- MICROBAT MANAGEMENT PLAN FOR CLARENCETOWN BRIDGE, NSW RMS (2016)

- EASTERN BENTWING-BAT MANAGEMENT PLAN, GERRINGONG, NSW RMS (2014)
- GREEN AND GOLDEN BELL FROG MANAGEMENT STRATEGY, PRINCES HIGHWAY UPGRADE, NSW RMS (2012-2014)
- EXPERT REVIEW OF THREATENED FROG MANAGEMENT PLAN - WOOLGOOLGA TO BALLINA UPGRADE, NSW RMS (2014)
- THREATENED MICROBAT MANAGEMENT PLAN FOR WARRINGAH MALL, NORTHERN BEACHES COUNCIL (2014)
- COMMONWEALTH/NSW GIANT BURROWING FROG RECOVERY PLAN, DEWHA/DECC (2012)
- NSW DPI REPRESENTATIVE FOR THE NATIONAL ADVISORY GROUP ON CANE TOAD MANAGEMENT (2009-2011)
- TAREN POINT CANE TOAD MANAGEMENT ADVISORY GROUP (2007-2008).

TRAINING

- LEAD INSTRUCTOR > 50 WILDLIFE TRAINING SCHOOLS RUN IN NSW, ACT AND VICTORIA PROVIDING PRESENTATIONS ON THE SURVEY, IDENTIFICATION AND MANAGEMENT OF ALL FLORA AND FAUNA. THIS INCLUDED DETAILED INSTRUCTION ON THE MANAGEMENT OF THREATENED WADING AND AQUATIC BIRDS AND OTHER AQUATIC SPECIES PRESENTED TO QUEENSLAND, VICTORIAN, NSW AND COMMONWEALTH GOVERNMENT STAFF (1993-2017)
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